ME110/ UGBA290T-2 Spring 2015

Introduction to Product Development

Syllabus

GENERAL INFORMATION

Faculty:

- *Alice M. Agogino*, Department of Mechanical Engineering, 415 Sutardja Dai Hall (CITRIS Building), (510) 642-6450, agogino@berkeley.edu
- *Michael Borrus,* Haas School of Business and XSeed Capital, mborrus@berkeley.edu

Graduate Student Instructors:

- Jeremy Faludi, Mechanical Engineering, faludi@berkeley.edu
- Miho Kitagawa, Mechanical Engineering, mkitagaw@berkeley.edu
- Katie Benintende, MBA, Haas School of Business, kbeninte@berkeley.edu

Reader: Pablo Rosado, Mechanical Engineering, pablojrosado@berkeley.edu

Class Meetings:

12:30 pm - 2:00 pm T Th (I-Lab, Memorial Stadium). Optional workshops 1-2:00 pm F (I-Lab, Memorial Stadium)

Office Hours and Optional Discussion/Workshops:

Agogino: Th 3:00-5:00 pm, 415 Sutardja Dai Hall (CITRIS Building) or after class
Borrus: T, 2-3:30 pm, Haas School of Business,F502 Haas or after class

GSI Hours: TBA

DESCRIPTION

This course provides an introduction to the design process and conceptual design of products. It provides an experience in preliminary project planning of complex and realistic mechanical engineering systems. Design concepts and techniques are introduced; the student's design ability is developed in a design project or feasibility study chosen to emphasize innovation and ingenuity, and provide wide coverage of engineering and business topics, with an emphasis, this semester, on entrepreneurship opportunities. Design optimization and social, environmental, economic, and political implications are included. There is an emphasis on hands-on creative components, teamwork, and effective communication. There is a special emphasis on the management of innovation processes for the development of sustainable products, from product definition to sustainable manufacturing and financial models. Both individual and group oral presentations will be required. This semester two sections of the class (UGBA290T-2 business and ME110 mechanical engineering and other disciplines) will join forces to enable a multidisciplinary team learning experience.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Reading Materials: The primary reading material for the class is the textbook *Product Design and Development* (Fifth Edition) written by Karl Ulrich and Steve Eppinger (available in hard copy, rental and digital form). This book is a very basic text that provides a step by step view of how new product development processes are to be conducted. There should be used, rental, ebook version of the textbook available at reduced cost. See:

https://bcourses.berkeley.edu/courses/1298185/pages/cheaper-versions-of-textbook.
Supplemental required course reading materials will also be available on bCoures.

bCourses Use: We will make extensive use of the course bCourses web site to both communicate information to you and to converse with you about your homework and your projects. You will find the course listed on http://bCourses.berkeley.edu/. Once you have formed your project groups, we will set up group pages on which we expect you to store your working documents for your project. The faculty will review the group pages regularly to provide feedback on your work. Our experience is that the teams that heavily use their bCourses pages and email connections do better in the class, and we strongly encourage you to use them.

COURSE OBJECTIVES

This course provides hands-on and real world experience in the development of innovative and realistic customer-driven engineered products. Design concepts and techniques are introduced, and the student's design ability is developed in a design project or feasibility study chosen to emphasize ingenuity and provide wide coverage of engineering and business topics. Innovative thinking is nurtured. Students will be expected to use tools and methods of professional practice (e.g., optimal design, solid modeling, life cycle assesment, market analysis) and use these tools to consider the social, economic, environmental and political implications of their products. Both individual and group oral presentations will be required.

DESIRED COURSE OUTCOMES

Students can expect to depart the semester understanding new product development processes as well as useful tools, techniques and organizational structures that support new product development practice in the context of the “triple bottom line” – economy, environment and society.

TOPICS COVERED

Product development processes and organization, product planning, triple bottom line, high performing teamwork, CAD/ solid modeling, customer/user needs assessment, personas and empathic design, translating the "voice of the customer", concept generation, concept selection, concept development, decision analysis, concept testing, taguchi method and experimental design, product architectures, design for variety, design for environment, life cycle assessment, design for assembly/ manufacture, prototyping, design costing, information technologies, design optimization, engineering ethics, universal design and entrepreneurship, innovation and intellectual property.

GRADING

Your course grade will be determined as follows:

10% on the quality of your preparation for and participation in class discussions
30% on the quality of your individual assignment solutions
10% for your final design journal
30% on the quality of your team’s work on project-related assignments and final report
20% on the quality of your team's final project presentation and prototype

Team Peer Assessments: At midsemester, we will ask for individual peer assessments of the contributions made by your team mates. This midsemester assessment will *not* be considered in preparing your final team grade; they are considered an “early warning” for struggling teams. There will also be an end-of-semester peer assessment, which could have an influence on your individual grade.

CLASS PREPARATION AND PARTICIPATION

Readings are meant to guide your thinking about the class assignments. Readings are given in the class schedule; we expect you to come to class prepared to discuss the readings and the suggested questions. In any given class session, a handful of students may be called upon specifically to speak about the readings and answer questions about them. If you have prepared in advance according to the syllabus, you will have no problem responding when called upon. Your individual class participation grade will be based upon your in-class remarks during discussions and will be judged by the teaching staff.

INDIVIDUAL ASSIGNMENTS

We have periodically assigned individual exercises to have you experiment with some of the concepts we are teaching. These are due at the start of each class, unless otherwise noted. Late assignments are discouraged but accepted, heavily penalized at 20% of the total score (20 points out of 100) for each day for late.

ALL INDIVIDUAL ASSIGNMENTS ARE TO BE SUBMITTED VIA THE BCOURSES "ASSIGNMENTS" TAB UNDER THE APPROPRIATE HEADING PRIOR TO THE START OF CLASS ON THE DAY THEY ARE DUE. YOU MAY WANT TO BRING ONE COPY OF YOUR HOMEWORK TO CLASS, AS WE WILL FREQUENTLY ASK YOU TO SHARE YOUR RESULTS (DIGITAL SHARING IS FINE).

WEBSITE USE:

We will make extensive use of the course Website to both communicate information to you and to converse with you about your homework and your projects. You will find the course listed on http://bCourses.berkeley.edu/. Once you have formed your project groups, we will set up email lists and folders where we expect you to store your working documents for your project. The faculty will review the group pages regularly to provide feedback on your work. Our research shows that teams that heavily use their shared documents and email connections do better in the class, so we strongly encourage you to use these group function.

JOURNAL

Each individual in the class is **required** to maintain a design journal throughout the semester, to be turned in at the end of instruction for the semester,on the day of your team's final presentation during RRR week. It counts 10% towards your individual grade. The journal will be returned at the end of the Spring Semester. This journal should include your individual thinking (both imagery and words) pertaining to your project. Think of it as a diary of sorts. You may sketch pictures, paste in pictures or business cards, write words, create mindmaps, or choose any other approach that works for you to capture your ideas, thoughts, and reflections about your product and your project. The journal should be used both to **capture ideas** about the product itself as you move through the process, but also to **document thoughts, reflections and insights** on the process of product development, group dynamics, project process, etc. Inventors use journals as it helps to document when they came up with an original idea (useful in the patenting process); engineers do this to work out complex technical details; and designers do this to generate lots of ideas (as ideas feed off of one another); project managers use journals as a management tool to generate "lessons learned" and "best practices" to help run future product development projects more effectively. You can tailor your journal to your own working style and your unique role within your project team. There are copies of exemplary design journals on the bCourses website if you would like to see what one might look like. Only the faculty will see these journals; no one else will see them unless you choose to share. Your design journal will count towards your individual assignments grade.

LAPTOP, TABLET AND SMARTPHONE POLICY

Class time will focus almost entirely on in-class exercises to bring to life project-based learning. You will need to give your full attention to your teammates, to the work you are being asked to do together, and to what you are taking away from that work. Please do not use your laptops or smart phones in class, unless it is for a class exercise or to take notes (no email, texting, web browsing, Facebook, etc.) Any violation of this policy will lead to a reduction in your participation grade. We love the way Adaptive Path, one of the design firms we work with, describes its policy along these lines:

HONOR THE GATHERING. *In this ever more interrupt-driven digital world, it's a challenge to bring together all the right people at the same time to think, make and solve problems that are too complex for just a few people to figure out. Gatherings of this magnitude need opening ceremonies to acknowledge the value of the time we are about to spend together. Typically these ceremonies don't include marching bands or fireworks (although that would be cool), but there are small and simple actions that help us all recognize that this is a sacred time. These small things include sending out invitations ahead of time, providing food and drink, creating an environment where people can focus without laptops or smart phones, welcoming and orienting people to our day together, and having the client sponsor begin the workshop with essentially an opening blessing for the people gathered and the work we will accomplish.*
(www.adaptivepath.com)

PROJECT BACKGROUND AND GENERAL INFORMATION

The goal of the class project is to learn principles and methodologies of product development in a real world context. Most product development professionals work under tremendous time pressure and do not have an opportunity to reflect on the development process. In this course, the stress level will be low enough to allow time to experiment and learn. You will be asked to form project teams of 4 to 5 students. Some teams will have the opportunity to work with students from multiple disciplines. You will have opportunities during the first two weeks of class to scope out the possible projects and get to know potential teammates.

PROJECT BACKGROUND

Your challenge in the project portion of this course is to design a new product (a physical product, piece of software or service, business model), test it on a consumer group, and produce an early prototype version of it. The goal of this exercise is to learn principles and methodologies of product development in a realistic context.

Guidelines (not rules) for successful projects are as follows. These arise from constraints due to the classroom setting, and observations of successful teams in past semesters.

- There should be a demonstrable market need for your product. One good way to verify a market need is to perform a competitive review and to identify existing products that try to meet the need. Your product need not be a variant of an existing product, but the market need addressed by your product should be clearly evident. The product does not have to have a tremendous economic potential, but should at least be an attractive opportunity for a small firm.
- Avoid products in over-worked areas. In the past, teams who have worked on over-worked areas (better bicycle locks, lost items finder, better backpacks) find that it is really hard to find an angle that has not already been covered in the market or by previous classes.

- Don't use cost-reduction as the motivating driver. Rarely are innovative products created by the goal of reducing costs alone. The driver should be to meet a compelling unmet need.
- The product should require no basic technological breakthroughs, but you can use new innovations originating on or off campus as the basis for your idea. If you choose a physical hardware product (rather than a software user interface design or service), the product should contain fewer than 10 parts. We do not have time to deal with large technological uncertainties; we are more concerned that you have a product that people really want, applying existing technologies, even if those technologies are new.
- You should be confident of being able to build a reasonable prototype of the product. If you choose to make a hardware product, you must have access to prototyping capabilities such as machining processes and the skill sets to run them. In some cases a combination of a non-functioning "appearance" type model and a rough mechanical or electrical "working" prototype may be acceptable.
  - Your ME team member should have access to shop facilities. We recommend that all ME students sign up for the student shop training during the early part of the semester, if you have not already done so. Gordon Long is the Principal Lab Mechanician in charge of the student machine shop. You will need to visit him (or Mick Franssen, Dennis Lee, Jesse Lopez or Scott McCormick) in 1166 Etcheverry Hall to make an appointment. The qualification training is for education and safety purposes. It consists of three 1- hour sessions and a final 2 hour session on an actual hands-on application. He recommends that interested students sign up early during the first 3 weeks of the semester as training is on a first come-first served basis and the schedule gets full later in the semester. This semester they will start the scheduling process on January 20th. The actual training will be scheduled during the period between January 28th to March 20th. More information ME shop website at: http://www.me.berkeley.edu/new/Shop/.
  - Another option is the CITRIS Invention Lab, which provides knowledge, tools and support to rapidly design and prototype novel interactive products, embedded sensing systems and integrated mobile devices. The Invention Lab offers a variety of prototyping equipment ranging from basic craft tools to electronics workbenches, CAD stations and professional digital fabrication machines. Key equipment includes a laser cutter, professional and entry level 3D printers, Vinyl cutter, and circuit board mill. Common prototyping materials and supplies are available for purchase in the lab. Lab staff provides additional guidance and support for design and equipment use. Fees for use of the lab per semester is $125 for individual student use (more if working with a research group). More at: inventionlab.org
  - For software user interface products, you should have access to proficiency in Web design tools or other software prototyping tools.
- You should have access to more than five potential users of the product (more than 20 would be nice.) You will need to talk with them or observe them when you launch your product and visit them with your product mock-ups or prototypes.
- Save any highly proprietary ideas for another context, as we will be open in discussing the projects in class and do not wish to be constrained by proprietary information. By contrast, novel business ideas are generally not proprietary, benefit from exposure and feedback, and depend generally on execution for differentiation.
- The most successful projects tend to have at least one team member with strong personal interest in the target market. We strongly encourage those of you thinking about starting your own companies to bring your ideas to the class.

- Most products are really not very well designed. (See, for example, the badly designed products listed at http://www.baddesigns.com/examples.html.) Thus, if you pick almost any product that satisfies the general guidelines in this list, you will likely be able to develop a product that is superior to everything currently on the market.

Projects adhering to these guidelines will have the greatest probability of success.

PROJECT ASSIGNMENTS

Project assignments are intended to pace the development process for your product. There is little slack in this schedule and so assignments must be completed on or before the scheduled due date in order to maintain the project schedule. All project assignments are clearly spelled out in the class syllabus. Please post the items to be reviewed on bCourses.

All project deliverables (except the project proposal and the sketchbook/journal) are to be completed as a team. Please deliver all assignments according to the following format:

- Submit all project assignments and deliverables electronically. Unlike individual assignments that are to be submitted through the assignments tab on bCourses on the due date for the assignment, Project Assignments and Deliverables should be posted to ***your group's page*** on the class Web site where they will be visible to all members of your group as well as all faculty members (and coaches if you choose to include them on your site).
- Maintain a history of your project deliverables on your group Web site so that the faculty can review your progress over time, not just your most recent output. You should save formal project deliverables as well as interim documents on the site.
- Be concise. We like project deliverables that are 2-5 pages in length when possible. The exception to this guideline is concept sketches where one concept per page is preferred.
- Please develop a naming scheme for documents posted to your group website; this scheme should make it obvious to us what the documents are. Name files intended for faculty review should begin with the letters DEL (short for deliverable). Follow DEL with an indication of what the document is. For example, when you submit your mission statement for faculty review, name the link DEL-missionstmt.

DESIGN COACHES

We are privileged to offer you the opportunity to collaborate with some of the leading experts in product development from prominent firms in the Bay Area. The design coach is tasked with giving you a practitioner's viewpoint and advice on all aspects of your product and product development progress. Given the coaches' many years of experience in product development and coaching design teams for this course, you will find their input invaluable.

WORKING WITH YOUR TEAM

Many of you have worked on *group* projects before. The goal of this class is to develop high performance *team* skills. We hope that through this course you will learn to differentiate between *groups* and *teams*. Teamwork and effective communication are vital to successful projects in academic and professional settings.

There are two reasons, among many, why learning to work effectively on a team is germane to your success. (1) There is definitive evidence that effective teams outperform groups on ambiguous, complex and interdependent tasks (of which new product development is an example). (2) Studies have found that most organizations regularly use cross-functional teams. It is critical to understand the nature of cross-functional teams, and to learn about them through participation in them. This course is designed to have you take on various roles at different

points in the semester, and to assess patterns of cooperation and team dynamics. It is also important to reflect on how they impact your team's performance.

Over the years of offering this course, we have found that some basic team practices greatly benefit both the tangible and intangible outcomes of the team projects. Here are a few recommended best practices for you and your team:

1. Commit to regular meeting times. Face-to-face meetings are optimal, but virtual conferences (video-conference, tele-conference and email chats) are good alternatives when they are not possible**.** Structure meetings with a clearly assigned agenda, an end-time, and with specificied desired outcomes from that meeting (next steps, decisions, other actions), for which specific individuals are responsible. Reserve five minutes at the end of each team meeting to do a wrap up of decisions, assignments and next steps. This will make the meetings and the work in between meetings more productive (i.e. higher quality outputs with less time used over the course of the semester). We have reserved rooms from 1-3:00 pm F for Discussions and team meetings to help you in this scheduling.
2. Please use the team bCourses e-mail alias to communicate with your team. It will also archive and thread your e-mails so that you can review past conversations. Store shared documents on the group page on the website.
3. Work together, not separately. Get to know each other's strengths so that your team can leverage them (e.g., who are the CAD, Matlab, controls, drawing gurus, who's good at organizing and running meetings, who's good at eliciting feedback from customers, etc.) There are wide gaps in results between teams that truly collaborate versus groups that split up the work and staple it together when assignments are due. By design, there are many decisions and outputs you must work through as a team.
4. Open and candid communication will serve your team the best. Discuss the means by which you wish to resolve problems as a team (like all teams, you will have problems). Also discuss what strategies you will use if problems persist. Decide, for example, when you want to involve the faculty or your design coaches in helping you resolve problems.
5. Use your mission statement to create a shared vision that will allow your team to stay engaged and focused. Make explicit your learning goals up front – both subject matter and experiential. Share them with your teammates so they can support you in those goals throughout the semester. Speak up early if your goals are not being met. Corrective actions early on are typically more valuable to you and your team than end-of-semester adjustments.
6. *Have fun!*

ME110 Spring 2015

Introduction to Product Development

Class Schedule and Assignments

Alice M. Agogino (Mechanical Engineering) and Michael Borrus (Haas School of Business)

TEXTBOOK AND OTHER REQUIRED MATERIAL

The primary reading material for the class is the textbook: Karl Ulrich & Steve Eppinger. *Product Design and Developmen, fifth edition.*. All students are expected to read the full text of all assigned readings (rental, digital and used hard copies available). Most of the additional readings will be available for free on the web or through bCourses. One Harvard Business School case will require a fee on study.net.

SCHEDULE

The schedule below provides learning goals for each session, along with required readings and individual (I) and team (T) assignments. Unless otherwise noted, the individual assignments should be submitted to the appropriate class bCourses assignments link and the team assignments to the relevant folder in your project bCourses. Unless otherwise noted, **ALL INDIVIDUAL ASSIGNMENTS ARE DUE BY THE BEGINNING OF CLASS ON THE DAY DUE**. The team project assignments labeled as "deliverables" **MUST** be turned in at the designated due date. Most of the team project assignments are labeled as "check-ins". These are "work in progress" team assignments to allow the teaching staff to give you feedback in class. We ask you to upload your "work in progress" on the due date, but they could be turned in or updated by the next class time. We have made every effort to provide you all course details in this syllabus, but we sometimes have to make changes due to unexpected circumstances, such as a change in the visit date of a guest lecturer. Please check bCourses announcements and assignment updates for changes to the schedule.

DAY	TOPIC
1 T 1/20	**Introduction to New Product Development (NPD), Innovation and Entrepreneurship** We will cover course logistics and requirements and then develop the motivation and framework for the course. Come to class prepared to discuss why new product development is important, what the key activities are, how innovation and entrepreneurship relate, and how new product development frames opportunities for entrepreneurship. We will also introduce several start-up companies with new product development opportunities interested in participating in class and suggest other work on campus from which class projects might be sourced. **Read:** Ch. 1: Introduction to Product Design and Design Thinking **Read:** Bansal, Sarika. August 21, 2014. "Innovation Within Reach," New York Times, Opinion, http://opinionator.blogs.nytimes.com/2014/08/21/innovation-within-reach/ **I-1. Individual Assignment Due:** Complete student profile survey at: https://www.surveymonkey.com/s/DLXF735
2 Th 1/22	**Design Thinking Exercises** We will use waste material for a design project in a studio session today. Each student is asked to bring in two items that you find in your trash or dumpster. Or bring in something you just don't want, but can't figure out what to do with it. Come to class prepared to create new designs from these discards. Also make a note in your journal of what you did bring in, along with a list of other things you found but left in the trash. Consider the following thought questions: What role does technological research play in the product development process?. How is the process described in this chapter similar to/different than the process you have used in other design projects in class or work? What is the role of a design journal in the design thinking process? Can design thinking be extended to a business concept as a whole? How might design thinking affect the activities of entrepreneurship? **Read:** Ch. 2: Development Processes and Organizations

	Read: Dumpster diving: an Introduction, http://www.kuro5hin.org/story/2003/1/29/215523/088 **I-2. Individual Assignment Due:** Complete the Jung Typology Test and the Kolb learning styles survey available through a link that will be sent to you by email. You will need to know your Myers Briggs profile (link below) in order to complete the survey. • The ***Jung Typology Test*** and information about it are available at www.humanmetrics.com. Read the background on the test and then take and score it.
3 T 1/27	**The Role of Industrial Design and Innovation Opportunities for Start-ups** **Scan (Steps 1-32):** What is Industrial Design? Industrial Design Society of America (IDSA), http://www.idsa.org/education/what-is-id **Read:** "Designing for Humans: an Ethnography Primer," IDSA, 2010: http://www.aiga.org/ethnography-primer/ **I-3. Individual Assignment Due:** List of 20 "bugs". Please either bring the physical object or a photograph associated with at least one of your "bugs" to class to share with others during class. Identify, by putting the appropriate letter beside it, which of your bugs, if solved, potentially leads to a new feature (F), vs. a new product (P), vs. potentially a new company (C) (see below for more info on this typology). We are all capable of identifying market needs and thus generating ideas for new products, in part by noticing the deficiencies in the products we use in everyday life. To prove to yourself that you can identify market needs, generate a list of at least 20 "bugs." Designers at the product design firm IDEO use "bug lists" to record their observations of products and situations where products failed to meet the actual conditions of use. This list should include any observation or annoyance that comes to your mind. Note that we are looking for a list of "bugs" (e.g., my vegetable peeler hurts my hand when I peel potatoes) rather than a list of product solutions (e.g., a vegetable peeler with a soft handle). In other words, do NOT invent solutions to the problems you see – just state the problem. However, not all bugs, when solved, have the potential to ground a start-up business. Make a quick judgement about which of your bugs, if solved, might lead to improved features (F) of existing products vs. standalone new products (P) vs. form the basis of an entrepreneurial company (C). Upload your bug list to the course website under "assignments" and "twenty bugs". **Read:** Delta Design Task (on bCourses). **At the end of class we will train** for Delta Design Game. Roles will be assigned in class. The game will be played in class on 2/3.
4 Th 1/29	**Design Context, Product Planning and Defining a Venture-Backable Market Opportunity** Product planning involves developing a strategy for your products in the context of your organizational goals, skill-sets and resources. The Triple Bottom Line refers to considering three components to an organization's bottom line: profit, societal benefits, and environmental impact. Which of these matter in a start-up context? What makes for a good venture-backable startup idea? How are initial market opportunity hypotheses developed? Be prepared to discuss the components of a Mission Statement and how it might reflect the components of a Triple Bottom Line. **Read:** Ch. 4 Product Planning **Scan:** Google Preview of *The Triple Bottom Line*, Andrew Savitz and Karl Weber, http://bit.ly/npd-tbl **I-4. Optional Individual Assignment Due:** Project proposal (PDF format) as a one page document is due by class time. If you receive instructor approval to pitch, 3 slides of your proposal are **due by noon on 2/2** in order for us to compile and post for use on 2/3. Details of the required format and content are

	described below for 2/3 – but **due to us by noon on Monday 2/2**. Students who have an opportunity they would like to pitch are encouraged to meet with the instructures even earlier, at the start of the semester. (Note, students who do this optional assignment will be given credit for one more assignment.) Your one-page proposals should include: • A brief, descriptive project title (2-4 words) • Your name, phone number, e-mail, and school/department affiliation • A description of the market opportunity you have identified and whether you think it presents a venture-backed start-up opportunity. Your description may include any of the following: Documentation of the market opportunity, shortcomings of existing competitive products, and/or definition of the target market and its size. Please do **not** present *product ideas* at this point. Our strict focus in this phase of the course is on the *market opportunity* – the unfilled need or unsolved problem – and not on solution concepts. Your judgement about whether the opportunity could lead to a startup should be based on concepts developed earlier in class. Do not attempt to justify your judgement at this point – you will get a chance to reconsider down the road when we cover the issue of how to judge the venture-backability of a given market opportunity. **These proposals will be posted to a location where all participants in the class can see them.**
5 T 2/3	**Proposal Presentation and Voting** Faculty, company sponsors and tudents will be given an opportunity to pitch their project ideas in the studio. Details of the presentation below. **I-4+. Optional Individual Assignment Due:** Project proposal (3 slides **due by noon on 2/2** and presented today), Come to class prepared to give a VERY SHORT (i.e., 1 minute), yet convincing, presentation of your project proposal. Please prepare three slides that you can present in 15 seconds each that clearly communicate the market need on which you would like your classmates to work with you. We will collect all of the slides into a single presentation that we will run with PowerPoint's timed presentation feature. Your slides should communicate the following: • The first slide MUST include your name and school/department affiliation. • A verbal and visual demonstration of the product opportunity you have described in your proposal. Given that the audience will be able to read your written proposal at their leisure, you might spend your time explaining the richness of the market opportunity or demonstrating existing competitive products. • The slides are due absolutely **NO LATER THAN noon on Monday 2/2** so that we can get the full presentation assembled for the studio today. **I-5: Project Preferences due by midnight, Wednesday, February 4. Via a surveymonkey form,** you should list the FIVE projects on which you would most like to work in order of preference. If you would like to work with a particular group of classmates, please submit their names as well. They must submit your name as well for us to assign you all to the same team. Submit your preferences per the instructions on bCourses. We will process your preferences and assign teams. There is a good chance we will ask you to vote a second time after we have eliminated some of the projects in the first round, so stay tuned.

6 Th 2/5	**Delta Design Game** You should have prepared for the role assignment you were given in class on Tuesday 1-27. Make sure that you thoroughly understand the role you are to play. Prepare any materials you believe you will need to play the role. **DO NOT discuss** the other three roles with others in the class. Work hard to get to class on time as there is barely enough time to finish in the time allotted. At the end of the exercise, you will be asked to submit a sheet of paper for each team that provides all of the completed calculations for that team and a photo of your final design. The calculations and the photo must be submitted at the end of class. **Re-read:** Delta Design Task and Role (on bCourses).
7 T 2/10	**Project Launch** During this class session, we will talk about team dynamics and interactions as being critical to new product development success. We will first start with a review of Delta Design then relate to the role of product managers, engineers, industrial designers, marketers and others in multidisciplinary teams. We'll then conduct a team launch exercise in which you and your teammates debrief your MBTI and learning style profiles and the other questions on the survey. You will be given team launch exercises to work on during the class. Be sure to bring your MBTI profile to class. **Read:** Collaborative Plan on bCourses (start on your individual plan to bring to class) **Read:** "The Trouble with Teamwork" on bCourses **T-1. Project Check-in:** Mission statement, project plan and collaborative plan. This can be uploaded at the end of the class or before the next class if you need more time.
8 Th 2/12	**Customer and User Needs Assessment** An introductory overview will be provided for a range of user design research methods. More details on specific methods will be provided in future classes. We will then work on developing a customer/user needs assessment plan that answers the following questions: • Who is your customer and is there an early adopter segment of your customer base? • How will you access your customers and how should your approach differ in a start-up vs. large company context? • What methods will you use to collect information (e.g., interviews, observations, surveys)? • What types of information will you gather? • How reliable is customer feedback in the early stages of development and how should it affect your decision-making? • How will you document your information gathering (e.g., notes, audio recording, photos)? You will have time to compare notes with your team members on the use of interviews for this purpose.. **Read:** Ch. 5: Identifying Customer Needs **Read:** An Introduction to personas and how to create them, http://www.steptwo.com.au/papers/kmc_personas/index.html **Watch Video**: Getting People to Talk: An Ethnography & Interviewing Primer, http://vimeo.com/1269848 **I-6. Individual Assignment Due:** Choose a product that competes with or serves a similar purpose to the one your project team is developing. Interview a potential or current user of the product about what they like and dislike about the product. This interview can be done very informally in 5-10 minutes.

	Record what your interviewee says and interpret the data in terms of customer needs as described in Chapter 5. **Pay particular attention to the guidelines provided for translating customer statements into needs statements.** Prepare a one-page summary of what you have learned about the interview process. Submit the transcript of the interview, interpretation of customer needs and your page of lessons learned to the assignments tab under customer interview.
9 T 2/17	**Frameworks for Understanding Customer Needs** In this class we will present different ways of analyzing cutomer and user needs data. In "design thinking" terms, we call this framing and reframing. We'll use this class time to work with you on applying some of the framing and reframing tools to your project data. Please bring all of your customer and user needs data – interview notes, photographs, etc. – to class with you to use in these in-class exercises. We will also have a guest entrepreneur from a current venture-backed startup who will discuss how he developed the customer needs assessment for his start-up and how it frames his current activities and milestones. Ajay Kshatriya from Biota Technologies will join the class. **Read:** "Get Inside the Lives of Your Customers" on bCourses. **Read:** Turn Customer Input into Innovation, http://hbswk.hbs.edu/archive/2815.html **T-2. Project Check-in:** Submit your Customer/User Needs Assessment Plan. This can be uploaded at the end of the class or before the next class if you need more time. Complete the DesignExchange tutorial.
10 Th 2/19	**Translating the Voice of the Customer (Creating Imperatives for Business Opportunies)** In this class we will move a little ahead of where your project should be to introduce you to the next step of the process – translating customer and user needs information into specifications and imperatives. We'll introduce the basic concepts of generating specs and imperatives, and then have you do some exercises with your project data to play with the concepts. We will again have a guest entrepreneur from a current venture-backed startup who will discuss how he translated the voice of his customers into the design of his first physical storefront and associated mobile app. Sam Ulloa from Listo Financial will join the class. **Read:** Ch. 6: Product Specifications
11 T 2/24	**Peer Review: Mission and User Needs** Your project should now have completed a first pass at the following activities: Gather raw data on customer needs (through whatever means you deem most appropriate to your potential market). Generate a list of customer needs for your product and organize it hierarchically into primary, secondary and tertiary needs as described in your book. Identify three or four needs that you feel are important, but latent and not addressed by current products. Most of you will find that your Mission Statement continues to evolve throughout the product development process as you learn more about your target market and gather feedback from faculty, customers and others. You should continue to update your Mission Statement as you gather new inputs (archiving the old ones on the Website). This will be the first of three peer reviews you will have on your product development project. During class we will pair you up with another team or two to present and give feedback to one another. Come prepared to share: your mission statement, as is shown in your textbook, a brief review of the means used to collect customer and user needs information, a summary of the identified customer and user needs, one of your most interesting use scenarios, and a summary of lessons learned in the process to date. This is an opportunity to receive feedback from and give feedback to your classmates. It is also an opportunity to learn about new product development processes by observing what others have done

	and learned from their projects. You might want to check out the Stanford Product Design alumni wiki on critique: http://stanfordpd.pbworks.com/Critique. Below is a summary of the guidelines CCA uses on engaging in critiques. WHAT WE CRITIQUE 1. Content: Does it make sense? Is it clear? Does it communicate what the designer claims? Is it interesting? 2. Process: Did the designer exploit the process(es) enough? Could more work have been done? 3. Grounding/defense: Can all of the designer's decisions be adequately defended? HOW WE CRITIQUE B E C O N S T R U C T I V E . We're all guilty of delivering too many barbed comments. Try to be constructive in your criticism (Something like "This part is successful because—; this part isn't because—; Maybe you could think about—"). Don't say every piece of work is great. The result is that nobody learns anything. It's not about "good" and "bad", more "successful" and "unsuccessful." (Reserve "good" and "bad" for your dog.) THE GREAT BIG NO-NO The phrase "I like it" without an explanation is forbidden. Learning to talk clearly and perceptively about other people's work takes effort and practice. The more you do it, the more eloquent you will become. FINALLY, It is far easier to determine if a concept, typeface, size, color, position, relationship, etc. is appropriate, awkward, elegant, oblique, or nasty if you have something to compare it to. You will learn more quickly (and become a better designer) if you make a habit of bringing multiple solutions to class for critiques. **T-3. Project Deliverables Due:** Updated mission statement, updated customer/user needs analysis and, based on the latter, updated market hypothesis for further testing, As with all project deliverables, include a team short discussion of the process you used, lessons learned, and any observations you have about your team.
12 Th 2/26	**Concept Generation: Creativity & Brainstorming** This class session will focus on brainstorming and "ideation" techniques used by new product development teams to generate product ideas from their understanding of customer wants and needs and of the available technologies. We will use in class exercises to help you move from your individual concept ideas to team ones. **Scan:** Ch. 7: Concept Generation **Read:** "Creative Thinking Techniques" (http://www.virtualsalt.com/crebook2.htm) **Scan:** Ideation Methods theDesignExchange: http://thedesignexchange.berkeley.edu:3000/design_methods **I-7 Individual Assignment Due:** Each team member is to INDIVIDUALLY generate 10 concepts and post to your website and bring to class. A "half-sheet" form will be provided on bCourses for you to use. **T-4. Project Check-in:** Submit your concepts to your team folder and the clustering exercise you did in class. Upload a spreadsheet of your collective concepts to your project folder. Add any new ones from the class activities today or before the next class if you need more time.
13 T 3/3	**Concept Generation: Structured Methods** This class will focus on structured methods for concept generation, such as Morphological Matrices, Functional Decomposition, Biomimetic Design, etc. **Read:** "Morphologocial Charts", http://www.ifm.eng.cam.ac.uk/dmg/tools/concept/morph.html **Scan:** "Creax Function Database", http://function.creax.com/

	Scan: "Biomimicry Institute", http://www.biomimicryinstitute.org/ **T-5. Project Check-in:** Double the number of concepts through brainstorming and structured methods. After class in your next team meeting, expand your concepts using both brainstorming and structured methods and a spreadsheet with all of the concepts generated. We recommend that they be clustered into theme areas. A team of 5 should expect to have around 100 concepts. Upload an updated spreadsheet of your collective concepts to your project folder. Also submit any metaphors and related concepts generated during in-class exercise. Upload to bCourses before the next class.
14 Th 3/5	**Prototyping: Low-Fidelity** We will introduce tools and techniques for prototyping and testing your product concepts. Bring to class more discarded items that would normally go to landfill to add to our supply of prototyping materials. **Scan:** Ch. 14: Prototyping **Read:** "Prototyping Is The Shorthand Of Design", http://www.ideo.com/images/uploads/news/pdfs/Kelley-Prototyping_Shorthand_DesignSummer-01.pdf **Read:** Sandhu, Jaspal S. "Measure early, measure often: rapid, real-time feedback in design for social innovation". Jan. 2013: http://poptech.org/e3_jaspal_sandhu **T-6. Project Check-In:** Submit photographs of any prototypes you create in-class.
15 T 3/10	**Concept Selection, Prioritzing Risks and Defining Milestones** Chapter 8 describes concept screening and concept scoring matrices as a means of selecting among competing ideas for products you might develop. We will also introduce you to start-up concepts of business risk assessment and value-creation milestones, which help to structure the on-going efforts of entrepreneurs in a startup. Appropriately adapted, these concepts are equally useful in the new product definition context. **Read:** Ch. 8: Concept Selection **I-8. Individual Assignment:** Identify a prioritized list of your top 5 needs. Identify 2 competitive products that best meet these 5 needs for a benchmarking exercise in class. Upload to bCourses as an individual assignment and bring to class to share with your team. **T-7. Project Check-in:** You should now have 80 concepts for a 4 person team and 100 concepts for a 5 person team. These should be in your project bCourses/Concept Generation folder. By class time you should have organized the concepts you have to date into a spreadsheet, removing redundant or infeasible ones. You should also have a prioritized list of your top 5 needs. If your users haven't prioritized triple bottom line needs to the top list, include those that your team feels is important. In class today, your team will have an opportunity to build on the individual concept selection assignment. Upload your combined matrices to the project bCourses/Concept Selection folder.
16 Th 3/12	**Concept Testing and Market Validation** Chapter 9 describes how you can go further in testing the top concepts with low fidelity prototypes. We will also have a guest entrepreneur from a current venture-backed Web startup who will discuss how she developed and is validating design concepts for her start-up's website. Amanda Bradford from The League will join the class. **Read:** Ch. 9: Concept Testing **T-8. Project Check-in:** In class we will do an exercise to help you to identify your top 3-5 concepts for concept testing next week on 3-17. We will also ask you to identify and rank order the key business

	risks associated with your top 3-5 concepts. Which risk should you try to take off the table as your first milestone?
17 F 3/13	**Product Architecture and Product Platforms** This will be the only required Friday workshop, which will allow us to cancel class on Thursday 3/19 just before Spring break. We will focus our discussion in this session on the definition of product architecture and the implications of product architecture decisions for product development, marketing, customers, etc. How might your product benefit from a product architecture/platform strategy? Identify product platforms you are familiar with and bring them or an image to class. Be prepared to discuss the relationship between product architecture and mass customization. You might want to scan Pine's classic article on mass customization on Google Books: http://books.google.com/books?id=2_3PMy4LQHkC&source=gbs_navlinks_s. **Read:** Ch. 10 Product Architecture
18 T 3/17	**Studio: Midterm Tradeshow on Concept Testing and Market Validation** **I-9. Individual Assignment Due:** Complete the on-line peer review and team assessment survey as per instructions on bCourses. This can be completed by Thursday, 3/19. **T-9. Project Deliverables Due:** Updated mission statement, customer/user needs data, market hypothesis, concepts and early prototypes. Summarize lessons learned. Be prepared to show these in a mini-tradeshow format. Session objectives: • Update your classmates as to progress on your product development effort. • Make the first "public" presentation of your "proof-of-concept ideas". • Gather feedback from classmates on your concept design and mockups. For this session: 1. Prepare a THREE-SLIDE summary of your: • Mission statement • Target market and market hypothesis • Salient customer needs Plan to orally present your concepts briefly at the beginning of the class in 1 minute, 20 seconds per slide. Submit the slides to your project folder **no later than noon on Monday 3/16**. This will bring the entire class up to speed on your project before they review your work and allow you to get peer feedback. 2. Prepare your "proof-of-concept" sketches, product renderings and early prototypes so that everyone can understand your ideas. After the brief review at the beginning of the class, we will spend about 50 minutes in a "tradeshow" environment during which you will wander around the classroom to look at the work. You are welcome to bring portable computers to set up your images. You should plan to handle any arrangements for using computers on your own. To support your concepts, you should have the following materials available. (Each team will likely have done different versions of these. Use what you have already developed.)

	• Customer/user needs hierarchy • Mapping of customer needs to specifications or design principles • Business risk prioritization and next milestone • Concept sketches • Product renderings or mockups (3D renderings, early physical or web mockups) • Concept screening and scoring matrices • Reason for choosing the concept(s) you have developed for today You should plan to have group members rotate responsibility for showing the concepts so that other group members can circulate. Think about the best way to efficiently and effectively collect feedback from your classmates. You may wish to have a mini-survey available for them to complete following the examples we covered in Concept Testing. Remember that each student will only have about 5 minutes to spend reviewing your work; so make your presentation as succinct as possible. From this point forward, your focus will be on developing and testing your product concept with your customer base, obtaining feedback, incorporating it into your product, and preparing intermediate and final product prototypes.
Th	**Class canceled due to required Friday workshop on 3-13.**
	Spring Break 3/23-27
19 T 3/31	**Team Feedback** This class session will be dedicated to giving you the feedback from your team survey and letting you process that feedback with your team. **T-10. Project Check-in:** Update your collaborative plan and upload to bCourses prior to the next class.
20 Th 4/2	**Low vs High Fidelity Prototyping** Review of low and high prototyping methods. **Re-Read:** Ch. 14: Prototyping **Scan:** Build Methods on theDesignExchange: http://thedesignexchange.berkeley.edu:3000/design_methods
21 Tu 4/7	**Design for Environment 1: DfE Design Methods** We will be joined by guest speaker (and your beloved GSI) Jeremy Faludi, a specialist in sustainable design, http://www.faludidesign.com What does designing products for environmental soundness entail? How might you make tradeoffs among cost, quality, features and environmental soundness when designing a product? What is sustainable design? This class is the first of two workshops on sustainable design methods. It introduces you to the United Nations Environment Program's (UNEP's) step-by-step method to design for sustainability. You will use an abbreviated version of it to generate sustainable redesign ideas for your product. You will have

	read the worksheet for the ten-step process before class; your questions will be answered and a brief lecture will summarize the method. Most of class will be spent with you performing the most important steps in the worksheet on your product, in your teams. Optional: To fully perform the method, you can fill out the rest of the worksheet after class. **I-10: Do Survey Individually:** Details to be announced in class. **Read:** from bCourses: Kambrook Kettle case study: "Mainstream appliance meets eco-design" (*Journal of Sustainable Product Design*) **Read:** UNEP Worksheet "D4S Redesign": http://www.d4s-sbs.org/d4sworksheetsr.pdf **Read:** Ch. 12: Design for Environment **Scan:** "The Cradle to Cradle Alternative", http://www.mcdonough.com/writings/cradle_to_cradle-alt.htm
22 Th 4/9	**Design for Environment 2: Whole Systems Design Method** This is the second workshop on sustainable design methods. It introduces you to the Whole Systems + Life-Cycle Thinking method to design for sustainability. You will use an abbreviated version of it to generate sustainable redesign ideas for your product. You will have watched the video about the process before class; your questions will be answered and a brief lecture will summarize the method. Most of class will be spent with you performing the method on your product, in your teams. Optional: To fully perform the method, you can use a free trial of life-cycle assessment software http://www.sustainableminds.com to perform the steps not done in class. **Re-View Video:** Whole Systems Design Strategies, http://sustainabilityworkshop.autodesk.com/products/improving-product-lifetime **Read:** Whole Systems and Lifecycle Thinking Quick Reference Guide: http://sustainabilityworkshop.autodesk.com/products/whole-systems-and-lifecycle-thinking **Read:** Lifecycle Assessment Primer by Jer Faludi and Adam Mentor: http://sustainabilityworkshop.autodesk.com/sites/default/files/core-section-files/lcaprimer_autodesk-sworkshop_final.pdf **T-11. Project Check-in:** Turn in life cycle chart of one of your top product/service choices. Turn in your draft before the next class.
23 Tu 4/14	**Assessing Entrepreneurial Opportunity: Market Quantitation, and Growth Trajectories** This week we take a step back to begin the assessment of whether your project might be turned into an actual start-up business and whether that business could be venture-backed. We'll cover basic principles of quantitative market assessment (TAM, SAM and SOM), market structure, competitive dynamics and growth trajectories. How do you go about sizing a market and its growth prospects? Why are new technology markets particularly difficult to assess? What kinds of markets can support venture growth trajectories? **Read**: • Blog post by by Shyam Jha, Cayenne Consulting, October 21, 2013 on TAM/SAM/SOM at: http://www.caycon.com/blog/2013/10/understanding-market-size-or-demystifying-tam-sam-and-som/

	• Christopher Steiner, "Pop goes the algorithm, " The Futurist v.47, June, 2013, at: http://www.wfs.org/futurist/2013-issues-futurist/may-june-2013-vol-47-no-3/pop-goes-algorithm • HBS case note, "Customer Discovery and Validation for Entrepreneurs", Frank V. Cespedes; Thomas R. Eisenmann; Steven G. Blankhttps://cb.hbsp.harvard.edu/cbmp/product/812097-PDF-ENG (pay and gain access through study.net) **T-12. Develop a hypothesis about whether your project presents a business opportunity best characterized as a feature (F), product(P) or start-up Company (C).** In no more than one page of bullet points, present your hypothesis, describe what quantifiable market data would permit you to test your hypothesis, and answer (yes or no) whether, by reference to growth trajectory concepts, you believe your project idea is venture-backable. Do no actual quantification or market research beyond that done in earlier classes. Instead, this exercise is intended to get you to think about what kinds of data would be useful in assessing the kind of business opportunity your project represents – not to search for that data.
24 Th 4/16	**Design for Production; Design for Scaleability** Whether you are designing a manufactured good, virtual product, software or service, product development teams must consider the produceability of their design and whether or not it can be scaled to their addressible market. Design for produceability originated in design for manufacturing concepts of the last century, and is one of the many "design fors" that a product development team must consider. In this class session we'll talk about the various "design for x" activities, including manufacturing. Consider thought questions 1 and 2 at the end of Chapter 13, Design for Manufacturing. Be prepared to perform a class exercise in design-for-assembly. We will be joined by guest speaker Roby DeManche, the Manager of Global Supply Chain and Business Operations at Nest labs. Responsible for sourcing and production of all mechanical components (including enclosures, displays, batteries, connectors, etc.) for current and future Nest products. Prior work experience: Supply Chain Operations at Apple and Product Development at Ford Motor Company. Education: MBA from Berkeley Haas and BSME from Colorado State University. **Read:** Ch. 13 Design for Manufacturing
25 T 4/21	**Testing and Refinement: Robust Design** We'll cover product testing with exploration of a specific tool for product design – design of experiments. We'll do an in-class exercise to help you understand how the tool works. **Read:** Ch. 15 Robust Design *In-class exercise: Taguchi method*
26 Th 4/23	**Entrepreneurship, Business Models and the Start-Up Ecosystem** There are many different business models that underlie successful entrepreneurial ventures, only some of which rely on traditional concepts like intellectual property protection. What kind of business model is appropriate for for your project, if you were to transform it into a real entreprneurial venture? Can and should your project be protected as intellectual property ? We will have a preliminary business model canvas for your project. We will be assisted by experts from industry in business models and strategy, Sue Cook and Bill Crandall. **Read:** UC Berkeley Disclosure Form, http://ipira.berkeley.edu/invention-disclosure-information **Read:** Business Model Canvas, http://www.businessmodelgeneration.com/canvas

	T-13: Project Check-in Business Model Canvas: Upload the business model canvas you developed during class.
27 T 4/28	**Product Development Economics and Costing** In this class we will go over basics of engineering economics and product costing. We will be joined by Dr. Mark Martin, President of Design4X. **Read:** Ch. 17 Product Development Economics **T-14. Project Check-in:** Business model canvas, rough financial models, triple bottom line strategy. Turn in before the next class.
28 Th 4/30	**Studio: Presentations, Storytelling and Pitching** As you approach the end of the semester, you should start thinking about how you will communicate your project outcomes to the judges who will be present at the final tradeshow. If your team also believes that your project is the potential basis of an entrepreneurial start-up, you will also want to think about how to pitch to investors.. In this session we'll review good presentation and storytelling techniques, and let you start practicing applying them to your projects. Be prepared to pitch your product today as a class exercise. **Read:** Chapter 1, "What Sticks?" in *Made to Stick,* http://www.heathbrothers.com/download/mts-made-to-stick-chapter1.pdf (you may need to register for free) **Read:** Make Your Presentation Stick, http://www.heathbrothers.com/download/mts-making-presentations-that-stick.pdf (you may need to register for free)
29,30 T,Th 5/5,7	**Reading Review Recitation Week and Project Presentation** During this week you will have an opportunity to present your final project to the class and to external judges. **T-15. Team Deliverables:** Prepare a 10-minute presentation that describes your final product and the process you went through to arrive there. The presentation should be of the quality to convince a top technical or investment group to purchase the rights to your product or to fund its final development and launch. An effective presentation includes a slide presentation along with a display of the prototype. Your presentation should not only attempt to sell your prototype to the audience, but should also make clear the process you went through to develop the prototype. Your presentation should include: o Your mission statement o A summary of your customer/user needs analysis, market hypothesis and business model o A couple of concepts you considered as alternatives to the one you developed, along with a justification for your final selection o Key design or technical features that addess the needs and differentiate your product o Tripple bottom line analysis: financials, societal and environmental o A demonstration of your product prototype o A list of the most important lessons you learned about the NPD process and teams **I-10. Individual Deliverables*:*** Turn in the journal you have been keeping throughout the semester. It will be returned after grading.
W	**Optional Design Fest Trade Show and Venture Pitch** We wil provide you an opportunity to present your final product to a broader audience of guests from

5/6	campus and industry or to a set of investors, joined by students in other human-centered design classes in the afternoon.
Th 5/14 3-6 pm	**Final Reports (Location TBA)** • **I-11. Individual Deliverables*:*** Complete the team evaluation survey. • **T-16. Final Project Deliverables:** Turn in your final presentation, summary report, photo of your prototype and the actual prototype, if appropriate. As required for all Project Deliverables, include a team lessons learned as well.