

ME292C

Human-Centered Design Methods

Syllabus

GENERAL INFORMATION

Faculty:

- *Alice M. Agogino*, Department of Mechanical Engineering, 415 Sutardja Dai Hall (CITRIS Building), (510) 642-6450, agogino@berkeley.edu
- *Marcelo López-Parra*, Visiting Professor in Mechatronics, UNAM, lopezp@unam.mx

Graduate Student Instructors: Julia Kramer, j.kramer@berkeley.edu; Daniel Lim, limdan7@berkeley.edu

Designer-in-Residence: Euiyoung Kim, avant80.kim@gmail.com

Class Meetings: W F 3-4:30 pm in 310 Jacobs Hall

Optional Discussion/Workshops: 11:00 am-noon F, 220 Jacobs Hall

COURSE OBJECTIVES

This course provides hands-on and real world experience in the development of innovative and realistic customer-driven engineered products, services or systems. Design methods and tools are introduced, and the student's design ability is developed in a capstone design project or equivalent. The course is organized around the following modules: design research, analysis & synthesis, concept generation & creativity, prototyping, communication & visualization. Students will be expected to use tools and methods of professional practice and use these tools to consider the social, economic and environmental implications of their products, services or systems. There is an emphasis on hands-on innovative thinking and professional practice. We will engage product designers from industry as speakers and coaches.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Reading Materials: theDesignExchange.org. Supplemental required course reading materials will also be available on bCourses.

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.

DESIRED COURSE OUTCOMES

Students can expect to depart the semester understanding customer-driven design methods, tools and processes.

TOPICS COVERED

Design processes and methods, design roadmapping, triple bottom line, CAD/ solid modeling, customer/user needs assessment, personas and empathic design, framing and analyzing customer research, translating the "voice of the customer", concept generation, concept selection, concept development, concept testing, product architectures, design for variety, design for environment, design for assembly/

manufacture, prototyping, visualization & information technologies, engineering ethics, entrepreneurship and innovation.

GRADING

Your course grade will be determined as follows:

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

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 (2 points out of 10) 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.

JACOBS HALL

Jacobs Hall is well equipped for prototyping in the class. Students will be expected to get a Maker Pass (\$75) in lieu of a textbook and go through appropriate safety and equipment training; fee waivers are available for students with financial need. More on equipment access and getting a Maker Pass: <http://jacobsinstitute.berkeley.edu/our-space/makerpass/>.

Also see this page for Jacobs' equipment list: <http://jacobsinstitute.berkeley.edu/our-space/labs-and-equipment/> or this one that links to the Maker Pass activation process: <http://jacobsinstitute.berkeley.edu/our-space/makerpass/get-maker-pass/>.

Your \$75 Maker Pass will also give you access to the Invention Lab in Sutardja Dai Hall (CITRIS – Center for Information Technology in the Interest of Society). See: <http://invent.citris-uc.org/about/>

ME MACHINE SHOP TRAINING

If members of your team need to use the ME student machine shop, you need to go through safety training between September 7th and October 28th. But slots fill up quickly, so we recommend you sign up as soon as possible. Training details: <http://www.me.berkeley.edu/services/student-machine-shop/shop-training>. MEng students should talk to their faculty sponsors to get prioritized for shop training as well. For more information on the facilities, see: <http://www.me.berkeley.edu/services/student-machine-shop>.

DESIGN PORTFOLIO AND CASE STUDY

Each individual in the class will be **required** to maintain a design journal throughout the semester that can be used to create a design portfolio at the end of the semester. In addition, each student will be required to turn in a short case study of use of one of more design methods used in their team's design process. This case study write-up is meant to be a reflection piece where students can review how the methods they used impacted their design outcomes. This design portfolio and case study counts 10% towards your individual 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)*

BERKELEY'S HONOR CODE: We expect the students to act with honesty, integrity, and respect for others. Note the following link to UC Berkeley's principles of community: <http://diversity.berkeley.edu/principles-community>.

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
I. MODULE ON DESIGN PROCESSES & MODELS	
1 W 8/24	<p>Introduction to Design and Innovation and Entrepreneurship Processes and Methods 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.</p> <p>Read: Dym, C.L., A.M. Agogino, O. Eris, D.D. Frey and L.J. Leifer, "Engineering Design Thinking, Teaching and Learning," <i>Journal of Engineering Education</i>, Jan. 2005, v. 94, no. 1, pp. 103-120. (bCourses)</p> <p>Read: Sara Beckman & Michael Barry. "Innovation as a Learning Process: Embedding Design Thinking", <i>California Management Review</i>. (bCourses)</p> <p>Read: John Kolko, "Design Thinking Comes of Age," <i>Harvard Business Review</i>, September, 2015, https://hbr.org/2015/09/design-thinking-comes-of-age</p> <p>Watch: <i>Video:</i> Nightline, "The Deep Dive" (aka, "the IDEO Shopping Cart" Video) Part 1: http://www.youtube.com/watch?v=ooN05Q030Qo Part 2: http://www.youtube.com/watch?v=y_kVSJ7eAw4 Part 3: http://www.youtube.com/watch?v=fUz09EkIm64http://opinionator.blogs.nytimes.com/2014/08/21/innovation-within-reach/</p>
2 F 8/26	<p>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</p> <p>Read: THRIVING in the "Age of the Customer", ISDA, http://www.idsa.org/news/insights/thrive</p> <p>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”.</p> <p>I-1. Individual Assignment Due: Complete student profile survey,</p>

	<p>https://www.surveymonkey.com/r/me292</p> <p>I-2. 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).</p> <p>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 8/31.</p>
3 W 8/31	<p>Delta Design Game</p> <p>You should have prepared for the role assignment you were given in class on Friday 8/26. 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.</p> <p>Re-read: Delta Design Task and Role (on bCourses).</p>
4 F 9/2	<p>Customer and User Needs Assessment</p> <p>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.</p> <p>Read: Assignments from theDesignExchange – User observation: https://www.thedesignexchange.org/design_methods/236 AEIOU: https://www.thedesignexchange.org/design_methods/139 POEMS: https://www.thedesignexchange.org/design_methods/77 POSTA: https://www.thedesignexchange.org/design_methods/209 Watch Video: Getting People to Talk: An Ethnography & Interviewing Primer, http://vimeo.com/1269848</p> <p>By now, many of you will be in your capstone teams, so please arrange a table to sit in together. Others will be formed before the team launch on 9/7.</p>
II. MODULE ON DESIGN RESEARCH	
5 W 9/7	<p>Design Context, Mission and Planning</p> <p>Product planning involves developing a strategy for your product or service in the context of your organizational goals, skill-sets and resources.</p> <p>Students will break up into MEng Capstone teams or alternatives to set initial goals for their project within the context of this class. You will also begin work on identifying relevant technologies for a technology roadmap.</p> <p>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. You will be given team launch exercises to work on during the class.</p> <p>Read: Collaborative Plan on bCourses (start on your individual plan to bring to class) Read: “The Trouble with Teamwork” on bCourses. Read: Value Proposition Canvas, http://www.peterjthomson.com/2013/11/value-proposition-canvas/value-proposition-canvas-questions/. Template on bCourses.</p>

	<p>T-1. Project Check-in: Mission statement (short mission written in functional terms), value proposition and collaborative plan. This can be uploaded at the end of the class or before the next class if you need more time.</p>
6 F 9/9	<p>Research Methods (Contd.)</p> <p>Read: “Five Keys To Successful Design Research”, http://www.core77.com/hack2work/2009/09/five_keys_to_successful_design.asp</p> <p>Read: Translating Customer Interviews handout, from Ulrich & Eppinger, Product Design and Development, bCourses.</p> <p>Read: Assignments from theDesignExchange – Contextual inquiry: https://www.thedesignexchange.org/design_methods/315 1 on 1 Interview: https://www.thedesignexchange.org/design_methods/138</p> <p>Recommended Reading: Interviewing Users: How to Uncover Compelling Insights, by Steve Portigal. This is a great reference book and is available in digital form.</p> <p>I-3. Individual Assignment Due: Choose a product or service 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 or service about what they like and dislike about the product. This interview can be done very informally in 5-10 minutes as a practice exercise. Record what your interviewee says and translate your customer statements into needs statements (see the Ulrich and Eppinger handout on bCourses). 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.</p>
7 W 9/14	<p>Research Methods and a Customer/User Needs Assessment Plan</p> <p>We will then work on developing a customer/user needs assessment plan that answers the following questions:</p> <ul style="list-style-type: none"> • 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)? <p>Read: Assignments from theDesignExchange personas – Personas: https://www.thedesignexchange.org/design_methods/74 Composite characters: https://www.thedesignexchange.org/design_methods/313</p> <p>Read: An Introduction to personas and how to create them, http://www.steptwo.com.au/papers/kmc_personas/</p> <p>T-2. Project Check-in: Submit your draft 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.</p>
<p>III. MODULE ON ANALYSIS & SYNTHESIS OF DESIGN RESEARCH</p>	
8 F 9/16	<p>Frameworks for Understanding Customer Needs</p> <p>In this class we will present different ways of analyzing customer 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. Readings and exercises in this module will focus on <u>interpreting, analyzing and framing your design research as described in Analyze of theDesignExchange.</u></p>

	<p>Read: Assignments from theDesignExchange – 2 x 2: https://www.thedesignexchange.org/design_methods/37 Reframing: https://www.thedesignexchange.org/design_methods/82 Powers of Ten: https://www.thedesignexchange.org/design_methods/78 Read: “Get Inside the Lives of Your Customers” on bCourses. Read: Turn Customer Input into Innovation, http://hbswk.hbs.edu/archive/2815.html</p> <p>I-4 Individual Assignment Due: Complete a survey on Design Research methods and skills (link will be provided through bCourses).</p>
<p>9 W 9/21</p>	<p>Translating the Voice of the Customer (Creating Imperatives for Business Opportunities)</p> <p>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. An example from frugal innovation will be covered as an example in class.</p> <p>Read: Assignments from theDesignExchange – Competitive Analysis: https://www.thedesignexchange.org/design_methods/154 Customer Journey Mapping: https://www.thedesignexchange.org/design_methods/8 Read: Bansal, Sarika. August 21, 2014. “Innovation Within Reach,” New York Times, Opinion, http://opinionator.blogs.nytimes.com/2014/08/21/innovation-within-reach/ Read: “Consumer Insight Maps: The Map As Story Platform In The Design Process”, http://piim.newschool.edu/journal/issues/2011/01/pdfs/ParsonsJournalForInformationMapping_Erwin-Kim.pdf</p> <p>I-5 Individual Assignment Due: <u>Identify what you think are your users’ top 5 needs. Between this session and the next, you will compare these needs with those that your teammates have developed before presenting these as part of your Peer Review.</u></p>
<p>10 F 9/23</p>	<p>Peer Review: Mission and User Needs</p> <p>Your project should now have completed a first pass at the following activities:</p> <ul style="list-style-type: none"> • 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. • Identify three or four needs that you feel are important, but latent and not addressed by current products. • Translate these needs into specifications and imperatives. <p>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 bCourses).</p> <p>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:</p> <ul style="list-style-type: none"> • Your mission statement, • 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.

I-6 Individual Assignment Due: Complete a survey on Analysis and Synthesis methods and skills (link will be provided through bCourses).

D-3. Project Deliverables Due: Updated value proposition, 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. We also ask that you upload feedback from the peer review. **We will give an intermediate grade for the project work based on the material you have uploaded by 9/28.**

IV. MODULE ON CONCEPT GENERATION & DEVELOPMENT

11 W
9/28

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.

Read: Assignments from theDesignExchange –

6-Up Sketches: https://www.thedesignexchange.org/design_methods/317

Visual brainstorming: https://www.thedesignexchange.org/design_methods/136

Brainstorming : https://www.thedesignexchange.org/design_methods/111

Read: "Creative Thinking Techniques" (<http://www.virtualsalt.com/crebook2.htm>)

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. Also each team member is to individually fill out a preliminary Concept Generation survey:

<https://www.surveymonkey.com/r/7ZPZRTP>

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.

<p>12 F 9/30</p>	<p>Concept Generation: Structured Methods This class will focus on structured methods for concept generation, such as Morphological Matrices, Functional Decomposition, etc. After reviewing your teams’ original 10 individual concepts, double the number through brainstorming and structured methods (e.g., for a team of 5, you should strive for a total of 100 concepts).</p> <p>Read: Assignments from theDesignExchange – 3-12-3 Brainstorm: https://www.thedesignexchange.org/design_methods/106 6-3-5 brainwriting: https://www.thedesignexchange.org/design_methods/107 Attribute listing: https://www.thedesignexchange.org/design_methods/109 Do-Redo-Undo: https://www.thedesignexchange.org/design_methods/121 Biomimicry: https://www.thedesignexchange.org/design_methods/311</p> <p>Read: “Morphological Charts”, http://www.ifm.eng.cam.ac.uk/research/dmg/tools-and-techniques/morphological-charts/</p> <p>Scan: “Creax Function Database”, http://function.creax.com/ Scan: “Biomimicry Institute”, http://www.biomimicryinstitute.org/</p> <p>Optional View Video: Janine Benyus TED talk: Biomimicry in action. https://www.ted.com/talks/janine_benyus_biomimicry_in_action?language=en#</p> <p>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. <u>Upload an updated spreadsheet of your collective concepts to your project folder.</u> Also submit any metaphors and related concepts generated during in-class exercise. Upload to bCourses before the next class.</p>
<p>13 W 10/5</p>	<p>Product Architecture and Product Platforms 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? What role will emerging technologies play in strategic thinking about product platforms? 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.</p> <p>We will also provide an introduction to technology roadmaps by guest speaker Euiyoung Kim, Disruptive Designer, Jacobs Institute.</p> <p>Read: http://www.ifm.eng.cam.ac.uk/roadmapping/research/</p> <p>Read: “Roadmapping for Strategy and Innovation”: http://www.ifm.eng.cam.ac.uk/uploads/Research/CTM/Roadmapping/roadmapping_overview.pdf, also on bCourses.</p> <p>Optional Reading: scan Pine’s classic article on mass customization on Google Books: http://books.google.com/books?id=2_3PMY4LQHkC&source=gbs_navlinks_s</p>
<p>14 F 10/7</p>	<p>Design Roadmaps Guest speaker Dr. Euiyoung Kim, Disruptive Designer at the Jacobs Institute of Design Innovation, will lead a workshop to apply design roadmaps to your project. Design Roadmapping parallels existing product roadmapping and technology roadmapping processes. It leverages three needs we have observed in organizations as they use existing roadmapping processes: (1) to focus on development of customer and user experiences, not just on features; (2) to increase engagement of</p>

	<p>designers early in the planning process; and (3) to provide a means for rapidly responding to changes in the environment.</p> <p>Design Roadmapping is an attempt to reconcile differences that arise when customer/user needs are not considered simultaneously with technology choices. The proposed Design Roadmapping process assists project prioritization and selection. The process aggregates design experience elements along a timeline that associates key user needs with the products, services and/or systems the organization wishes to deliver. The five-step Design Roadmapping procedure is provided along with detailed information. The decisions from the Design Roadmapping process have been incorporated into the company's commercial plans. We will present case studies of design roadmapping in industry then allow teams to apply to their own capstone project. A longer workshop will be scheduled for teams who want to further develop their design roadmap.</p> <p>Read: E. Kim, S. Beckman, J. Chung, A.M. Agogino, "Design Roadmapping: A framework and case study of planning development of high-tech products in Silicon Valley," <i>Journal of Mechanical Design</i> on bCourses. http://mechanicaldesign.asmedigitalcollection.asme.org/article.aspx?articleid=2537150</p> <p>T-6. Project Check-in: At the end of the session, turn in your design roadmap to bCourses.</p>
<p>15 W 10/12</p>	<p>Design for the Environment and Whole Systems Design</p> <p>We will be joined by guest speaker Jeremy Faludi, a specialist in sustainable design, http://www.faludidesign.com</p> <p>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? The focus will be on how sustainability can be a driver for innovation.</p> <p>This class starts with an introduction to Whole Systems Mapping method. You will use an abbreviated version of it to reframe your product and consider new design strategies. You will also be introduced to biomimicry methods. You will use an abbreviated version of it to generate sustainable redesign ideas for your product. Class will be spent with you learning the method and performing it on your product, in your teams.</p> <p>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.</p> <p>Read: Assignments from theDesignExchange – Life Cycle Analysis: https://www.thedesignexchange.org/design_methods/312</p> <p>Read: from bCourses: Kambrook Kettle case study: "Mainstream appliance meets eco-design" (<i>Journal of Sustainable Product Design</i>)</p> <p>Optional:</p> <ul style="list-style-type: none"> - Designing Cradle to Cradle Certified Products for the Circular Economy: http://education.c2ccertified.org/lms/ - Life-Cycle Assessment Primer by Jeremy Faludi and Adam Mentor: http://faludidesign.com/MCAD_images/LCA_Primer_Autodesk-SWorkshop_Final.pdf <ul style="list-style-type: none"> - Autodesk Sustainability Workshop: http://sustainabilityworkshop.autodesk.com - Autodesk Sustainability Workshop pages on biomimicry: http://sustainabilityworkshop.autodesk.com/products/biomimicry <p>T-7. Project Check-in: Take photos of your table during the workshop, at the end of every activity. Turn in the photos you took.</p>
<p>16 F 10/14</p>	<p>Concept Selection and Testing</p> <p>Erin MacDonald from the d.school at Stanford University will describe methods for concept screening, concept scoring and testing as a means of selecting among competing ideas for products you might develop using conjoint analysis.</p>

	<p>Read: Assignments from theDesignExchange – Usability testing: https://www.thedesignexchange.org/design_methods/232 Usability report: https://www.thedesignexchange.org/design_methods/263 Weighted matrix: https://www.thedesignexchange.org/design_methods/103 Read: “Extremely Rapid Usability Testing”, (http://grouplab.cpsc.ucalgary.ca/grouplab/uploads/Publications/Publications/2009-ERUT.JUS.pdf)</p> <p>I-8. Individual Assignment: Identify 2 competitive products that best meet your users’ 5 needs for a benchmarking exercise in class. Upload to bCourses as an individual assignment and bring to class to share with your team.</p> <p>T-8. Project Deliverable: You should now have at least 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 have your team’s 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. Your team also work on your individual concept selection assignment and upload an integrated matrices to the project bCourses/Concept Selection folder. We will give an intermediate grade for the project work based on the material you have uploaded by 10/19.</p>
V. MODULE ON PROTOTYPING AND BUILDING	
17 W 10/19	<p>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.</p> <p>Read: Assignments from theDesignExchange – Live Prototyping: https://www.thedesignexchange.org/design_methods/318 Wireframe: https://www.thedesignexchange.org/design_methods/36 Prototyping: https://www.thedesignexchange.org/design_methods/257 Read: “Prototyping Is The Shorthand Of Design”, http://uwdata.github.io/hcid520/readings/Kelley-Shorthand.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</p> <p>I-9 Individual Assignment Due: Complete a survey on Concept Generation methods and skills (link will be provided through bCourses).</p> <p>T-9. Project Check-In: Submit photographs of any prototypes you create in-class.</p>
18 F 10/21	<p>Medium to High Fidelity Prototyping Review of low and high prototyping methods. We will have guests present examples of medium to high fidelity prototyping. We expect all students to be familiar with solid modeling. If you do not, we will offer special workshops.</p> <p>Guest Speaker from Industry – Dr. Chris D. McCoy, Co-founder You3Dit.com, Lecturer UC Berkeley, Mechanical Engineering, Haas School of Business, I.E. Business School.</p> <p>From Zero to Prototype in one hour – leveraging low cost digital fabrication techniques to quickly realize product concepts for market testing. In this session you will apply the Rapid Innovation Cycle (see reading assignment) to solve a problem that has perceived business potential. You will leverage your solid modeling and rapid prototyping resources in Jacobs to execute on the low-fidelity prototype during class. Online or out-of-class instruction can be provided for the following tools if students are not familiar with them:</p> <p>Tools / Resources Required: 1. Thingiverse.com</p>

	<p>2. TinkerCAD.com 3. Cura for Type A Machines</p> <p>Read: McCoy, Chris D., Chagpar, Zubin, Tasic, Igor, “The Rapid Innovation Cycle—An innovation and market testing process for new products and services development.” Nov. 2012: http://bit.ly/RICpublication</p> <p>Read: Rapid Prototyping Methods on theDesignExchange - Rapid Prototyping: https://www.thedesignexchange.org/design_methods/24 Laminated Object Manufacturing: https://www.thedesignexchange.org/design_methods/18 Direct Shell Production Casting: https://www.thedesignexchange.org/design_methods/10 Fused Deposition Models: https://www.thedesignexchange.org/design_methods/15</p>
19 W 10/26	<p>Prototyping at Jacobs Hall Guest lecturer from industry Chris McCoy will continue on rapid prototyping and use of the facilities at Jacobs Hall.</p>
20 F 10/28	<p>Animations I We will be joined by guest speaker Professor Dennis Lieu you will provide a module allows you to build on solid models to create animations with 3D Studio. Download 3D Studio Max. An .edu e-mail address is needed. http://www.autodesk.com/education/free-software/featured. Topic for this day will include navigation of the 3D Studio user interface, creating basic geometry, importing and transforming surface models from imported solid models.</p> <p>T-10a Project Check-In: Submit your animations assignment.</p>
21 W 11/2	<p>Animations II 3D Studio topics covered: Creating and adjusting different types of lights and cameras; Different rendering engines; and File types and file compression.</p> <p>T-10b Project Check-In: Submit your animations assignment.</p>
22 F 11/4	<p>Animations III 3D Studio topics covered: Adjusting color, reflection, and transparency of materials. Applying material surface maps.</p> <p>T-10c Project Check-In: Submit your animations assignment.</p>
23 W 11/9	<p>Animations IV 3D Studio topics covered: Animation with keyframes and motion controllers; Creating realistic motion by controlling position, velocity and acceleration of objects entering keyframes; Motion of lights and cameras.</p> <p>T-10d Project Check-In: Submit your animations or images of your prototypes to your bCourses project folder.</p>
F 11/11	<p>Non-instruction Day (Veterans Day)</p>
24 W 11/16	<p>CAD to Systems Design, Analysis and Control Guest lecture by Prof. Dave Auslander who will introduce topics associated with moving from 3D CAD models to various forms of systems design, analysis and control. Almost all mechanical systems that utilize modulated power require active control to achieve their desired performance goals. In order to make the design and implementation process as efficient as possible, it is very desirable that a</p>

	<p>simulation of the mechanical system be available to design and test the control system well before an actual system prototype is built. The primary reasons for this are: 1) feedback from the simulated system can be used to improve the design much faster and more economically than waiting for the control to be tested on a physical prototype and, 2) The design and testing of the control system can be done in parallel with other activities thereby improving the time-to-market.</p> <p>Mechanical systems that include inertial components, that is, systems that have mechanical motion, however, are notoriously difficult to simulate. That is because these systems are usually nonlinear, often have three-dimensional components to their motion, and, most importantly, not only contain constraints, but in many cases, are actually defined by their constraints. These properties make the generation of ad-hoc simulations very hard to do. In this project, we are working to make this into a process that is easy enough to use that it can be applied to large numbers of design projects that do not now use simulations. The primary tool we are using for the simulation environment, or as an intermediate to other simulation environments, is Modelica. Modelica is an open standard for the acausal representation of physical systems. It has a number of implementations, some commercial and some open source. As it explicitly provides for handling of constraints, common mechanical systems can be modeled directly.</p> <p>Scan: https://modelica.org/events/modelica2011/Proceedings/pages/tutorials/007/Tutorial7_OpenModelica_Fritzson.pdf</p> <p>I-10 Individual Assignment Due: Complete a survey on Prototyping and Building methods and skills (link will be provided through bCourses).</p> <p>T-11 Project Check-In: Submit your animations or images of your prototypes to date to your bCourses project folder.</p>
VII. VISUALIZATION & COMMUNICATION	
26 F 11/18	<p>Communicating Actionable Design Research This starts our module on methods and tools for communicating actionable design research., design results that can have impact. (Liz Goodman, guest speaker?) Read: Roschuni, C., E. Goodman, A.M. Agogino, “Communicating Actionable User Research for Human-Centered Design, Special Issue on Studying and Supporting design Communication, <i>Journal of Artificial Intelligence for Engineering Design, Analysis and Manufacturing</i>, Vol. 27 (Special Issue 02, 2013), pp. 143-154. doi:10.1017/S0890060413000048. (on bCourses) Read: Communicate Methods on theDesignExchange - Envisionment Videos: https://www.thedesignexchange.org/design_methods/251 Storyboarding: https://www.thedesignexchange.org/design_methods/30</p> <p>T-12 Project Check-In: You will be asked to develop a one line description and 3 min. “elevator pitch” in class. Upload your final to your bCourses folder.</p>
W 11/23-25	<p>Non-Instructional Day (Thanksgiving)</p>
27 W 11/30	<p>Visualization and UX Design Short introduction to UX Design. Learn how to develop your own Design Portfolio. We will also hold an optional portfolio tutorial session.</p>

<p>28 F 12/2</p>	<p>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 clients and potential investors. In this session we'll review good presentation and storytelling techniques, and let you start practicing applying them to your capstone projects. Be prepared to pitch your product today as a class exercise. Read: Chapter 1, "What Sticks?" in <i>Made to Stick</i>, http://www.heathbrothers.com/download/mts-made-to-stick-chapter1.pdf (you may need to register for free)</p> <p>I-11 Individual Assignment Due: Complete a survey on Visualization and Communication methods and skills (link will be provided through bCourses).</p>
<p>29,30 W/F 12/7&9</p>	<p>Reading Review Recitation Week Teaching staff will be available for feedback on teams' design progress and presentations. Presentations will be held during the Design Showcase at the Jacobs Institute for Design Innovation on W Dec. 7. We will invite venture firm and design judges for feedback. The teaching staff will be available on 12/9 to give you feedback on your final deliverables.</p> <p>The Design Showcase uses a tradeshow format. You will need to prepare a few "teaser slides" at the start, then a tradeshow booth presentation. Remember that most of the judges will not be familiar with your project at all, never having seen any of your previous work, so you have to tell them a story about why there's a need, how you focused on the customer to discover the detailed needs, and how you benchmarked and explored a wide range of potential solutions to come up with the best product. An effective presentation includes a slide presentation along with a display of a working prototype. Be sure to include all areas covered in the judging form (to be posted on bCourses). Typical questions a judge might want answered.</p> <ul style="list-style-type: none"> • What motivated the idea? • Who are the competitors and what products are out there now? • What need or needs are lacking in the current products out there? • Define what success is – financial, societal, environmental, etc. • What ideas did you discard, and will your final product idea meet the customer needs? • How did you decide on the final concept? • Why did you decide on the prototyping methods used and what kind of feedback did you receive?
<p>M 12/12</p>	<p>Final Reports (Online or in-Person 415 Sutardja Dai Hall)</p> <p>I-12. Individual Deliverables: Design Portfolio and Design Case Study are due. Could be changed to team assignment.</p> <p>I-13 Individual Assignment Due: Complete a summative survey on human-centered design methods and skills (link will be provided through bCourses).</p> <p>T-13. Final Project Deliverables: Turn in your final presentation (or the documentation of your tradeshow display), summary report (no more than 10 pages), photo of your prototype and/or the actual prototype, if appropriate. As required for all Project Deliverables, include a team lessons learned as well.</p>