ME292C

Human-Centered Design Methods

Syllabus

GENERAL INFORMATION

Faculty:

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Graduate Student Instructor: Daniel Lim, limdan7@berkeley.edu

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

Class Meetings: T Th 11 am -12:30 pm in 310 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 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.

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 and social responsibility, 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 and quality of teamwork
30% on the quality of your individual assignment solutions
30% on the quality of your team's work on project-related assignments, including weekly reflections
30% on the quality of your team's final project presentation, case study 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.

UNLESS OTHERWISE SPECIFICED, 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 early in the Fall semester. 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 JOURNAL

We highly recommend that each individual in the class maintain a design journal throughout the semester. Although not graded, journaling is key to effective design practice and can be used to create a team design portfolio/ case study at the end of the semester. This portfolio/ case study write-up is meant to be a reflection piece where students can review how the methods they used impacted their design outcomes.

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 exercises are labeled as "team exercises". These are "work in progress" exercises to allow the teaching staff to give you feedback in class. We ask you to upload your "work in progress" to your bCourses website as soon as possible after the exercise in class to share with your team. 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 & STRATEGIES
1 Th 8/24	**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. **Read:** Dym, C.L., A.M. Agogino, O. Eris, D.D. Frey and L.J. Leifer, "Engineering Design Thinking, Teaching and Learning," *Journal of Engineering Education*, Jan. 2005, v. 94, no. 1, pp. 103-120. (bCourses) **Read:** Sara Beckman & Michael Barry. "Innovation as a Learning Process: Embedding Design Thinking", *California Management Review.* (bCourses) **Watch:** *Video:* 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/ **I-1. Individual Assignment Due:** Complete student profile survey, https://goo.gl/forms/U6qoq0fl8wOHiqMt1
2 T 8/29	**The Role of Industrial Design and Innovation Opportunities for Start-ups** 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. Upload your bug list to the course website under "assignments" and "twenty bugs". **Read:** John Kolko, "Design Thinking Comes of Age," Harvard Business Review, September, 2015, https://hbr.org/2015/09/design-thinking-comes-of-age **Scan:**What is Industrial Design? Industrial Design Society of America (IDSA), http://www.idsa.org/education/what-is-id

	Read: THRIVing in the "Age of the Customer", ISDA, http://www.idsa.org/news/insights/thrive **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).
3 Th 8/31	**Design Context and Strategy** Product planning involves developing a strategy for your product or service in the context of your organizational goals, skill-sets and resources. Discussion on the role of design in several schools of competitive strategy (Porter's positioning school, resource school, dynamic capabilities) and then a particular view on design strategy in general. This lecture will provide students a broader view on the ways in which design contributes to competitive strategy. **Guest Speaker:** Dr. Andy Dong, Chair of the MBA Design Strategy Program at CCA (California College of the Arts) and adjunct faculty at UC Berkeley. **Read:** Michael E. Porter, "The Five Competitive Forces that Shape Strategy", *Harvard Business Review*, 2008. (bCourses) **Read:** David J. Collis and Cynthia A. Montgomery, "Competing on Resources", *Harvard Business Review*, 2008. (bCourses) **Read:** J. Bruce Harreld, Charles A. O'Reilly III, Michael L. Tushman, "Dynamic Capabilities at IBM: Driving Strategy into Action,", California Management Review, vol. 49 (4), 2007. (bCourses) **I-3. Individual Assignment Due:** Complete the Skills Matrix survey. Each student will do this independently by going to the website at (Chrome is recommended): http://skillmatrix.xyz/ Fill out the sign-in form with: **UID:** Your UID (You can find your UID on the website www.berkeley.edu/directory) **First Name:** Your first name **Survey Key: 292CFa17_1** Write Chengwei Zhang if you don't have an account or have Questions: zcwist@gmail.com
4 T 9/5	**Sustainable Design Strategies** Designing environmentally sustainable products and services has become increasingly important in recent years as awareness of both environmental quality and damage has increased. This class session will focus on the relationship between design and sustainability, with a special nod to human-centered design. We will characterize major frameworks for thinking about sustainable innovations and then review investment and design opportunities in these contexts. Students will conduct an interactive exercise with sustainable innovation ideation. Guest speaker Dr. Bill Schneiderman, founder and CEO of The Results Group for 23 years, brings an entrepreneurial mindset and spirit to all the firm's Management Consulting work and relationships. His experience and expertise spans high volume to high complexity, material-intense to information-intense, and high growth to urgent turnaround environments. Much of Bill's consulting work has involved improving product and service innovation and development, for technology-based firms, startups and established companies. He currently serves as an Advisory Board Member or Chair for three emerging companies, where he has utilized his experience in coaching executives to good effect. Bill is also currently Adjunct Faculty at The University of California for graduate level courses with emphasis on innovation, design and development. Prior to consulting, he held several line management positions with IBM. Before joining industry, Bill held tenure-track positions in Psychology, at The University of Alberta and at Marshall University. Bill earned his BA from Harvard University, Ph.D. in Psychology from the University of Michigan, and MBA with Highest Distinction from the Amos Tuck School of Business at Dartmouth. **Scan:** Elton B. Sherwin, Jr, Addicted to Energy (Energy House Publishing, 2010), pp. 11-62

	(bCourses) **Scan:** William McDonough and Michael Braungart, The Upcycle (New York, North Point Press, 2013), Ch.1 (bCourses)
II. MODULE ON DESIGN RESEARCH	
5 Th 9/7	**Team Launch and Project Planning** Students will break up into MEng Capstone teams or alternatives to set initial goals for their project within the context of this class. We will provide time at the start of class for pitching new projects and "match-making" for students without a Capstone of at least 2 students. During this class session, we will talk about team dynamics and interactions as being critical to new product development success. You will be given team launch exercises to work on during the class. We will also summarize the highlights of the Skills Matrix survey at the class level. **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. **Team Exercise:** By now, most of you will be in your capstone teams, so please arrange a table to sit in together. Please work on a short mission statement (written in functional terms) and your collaborative plan. Also work with your team on a plan to start conducting observations and interviews in preparation for class on 9/12 and 9/14.
6 T 9/12	**Customer and User Needs Assessment** An introductory overview will be provided for a range of user design research methods. All of the methods for this module will be on theDesignExchange in the Research Collection: https://www.thedesignexchange.org/collections/46 **Read:** 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 1 on 1 Interview: https://www.thedesignexchange.org/design_methods/138 Day in the Life: https://www.thedesignexchange.org/design_methods/57 Design Ethnography: https://www.thedesignexchange.org/design_methods/340 **Watch Video**: Getting People to Talk: An Ethnography & Interviewing Primer, http://vimeo.com/1269848 **Team Exercise:** Develop a draft assessment plan. Be sure to bring your customer/user research to date to class on 9/14 for a Team Exercise. Your customer/user needs assessment plan should 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)? At least 5 of these methods should be those from your theDesignExchange readings. • 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)?

7 Th 9/14	**Research Methods on Translating Customer Interviews and Card Sorting** We will give you a chance to share your interviews with your team and analyze them. We will then work on refining your customer/user needs assessment plan. **Read:** "Five Keys To Successful Design Research", http://www.core77.com/hack2work/2009/09/five_keys_to_successful_design.asp **Read:** Translating Customer Interviews handout, from Ulrich & Eppinger, Product Design and Development, bCourses. **Read:** Assignments from theDesignExchange – Open card sort: https://www.thedesignexchange.org/design_methods/199 Closed card sort: https://www.thedesignexchange.org/design_methods/150 Contextual inquiry: https://www.thedesignexchange.org/design_methods/315 Usability Testing: https://www.thedesignexchange.org/design_methods/232 **Recommended Reading**: Interviewing Users: How to Uncover Compelling Insights, by Steve Portigal. This is a great reference book and is available in digital form. **I-4. Individual Assignment Due:** Choose a product or service that competes with or serves as 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. Although you may team up for this assignment, there must be one unique interview and analysis per team member to be used for grading and providing feedback. Record what your interviewee says and translate your customer statements into needs statements (see the Ulrich and Eppinger handout on bCourses). Submit the transcript of the interview, interpretation of customer needs and your page of lessons learned to the assignments tab under customer interview. Also add to your team's website under Customer Needs. **Team Exercise:** Open card sort on your user needs to date. Refine your customer/user needs assessment plan. Be sure you come in with the following for every interview: a one-page summary of what you have learned about the interview process. A transcript of the interview, interpretation of customer needs.
8 T 9/19	**Research Methods on Personas and Scenarios** We will work on the use of personas and community involvement in design research. **Read:** Translating Customer Interviews handout, from Ulrich & Eppinger, Product Design and Development (bCourses) **Read:** Assignments from theDesignExchange personas – Personas: https://www.thedesignexchange.org/design_methods/74 Community Appraisal: https://www.thedesignexchange.org/design_methods/152 Conversation Café: https://www.thedesignexchange.org/design_methods/159 Focus Group: https://www.thedesignexchange.org/design_methods/183 **Team Exercise:** Bring hard copy of images that visually represent the customers/users and context of your capstone project. We will work on a personal exercise in class.
III. MODULE ON ANALYSIS & SYNTHESIS METHODS	
9 Th 9/21	**Frameworks for Understanding Customer Needs** 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 interpreting, analyzing and framing your design research as described in Analyze of theDesignExchange.

	Read: Readings from theDesignExchange Analysis Collection – https://www.thedesignexchange.org/collections/47 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 Why-How Laddering: https://www.thedesignexchange.org/design_methods/337 Empathy Map: https://www.thedesignexchange.org/design_methods/61 Competitive Analysis: https://www.thedesignexchange.org/design_methods/154 Kano Analysis: https://www.thedesignexchange.org/design_methods/67 **Read:** "Get Inside the Lives of Your Customers" on bCourses. **Read:** Turn Customer Input into Innovation, http://hbswk.hbs.edu/archive/2815.html **Team Exercise:** Work on your customer empathy map and competive analysis. Identify what your team identifies as your users' top 5 needs.
10 T 9/26	**Translating the Voice of the Customer (Creating Imperatives for Business Opportunities)** 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 specifications and imperatives, and will show a case study. **Read:** Assignments from theDesignExchange – Atomize: https://www.thedesignexchange.org/design_methods/42 Context Mapping: https://www.thedesignexchange.org/design_methods/53 Customer Journey Mapping: https://www.thedesignexchange.org/design_methods/8 Spectrum Mapping: https://www.thedesignexchange.org/design_methods/86 Touchpoints Matrix: https://www.thedesignexchange.org/design_methods/99 Task Analysis: https://www.thedesignexchange.org/design_methods/91 **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 **Team Exercise:** Develop a customer journey map to illustrate "pain points" customer have now in meeting the needs you are working on. The customer for the journey map should represent at least one of your personas.
11 Th 9/28	**Peer Review: Mission, Customer User Needs and Analysis** Your project should now have completed a first pass at the following activities: • Conduct and analyze 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. 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 customers, other stakeholds and teaching staff. You should continue to update your Mission Statement as you gather new inputs (archiving the old ones on bCourses).

	This will be a peer review of 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, • A brief review of the means used to collect customer and user needs information, • A summary of the identified customer and user needs and the analsysis tools you used, • Interesting personas and 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-5. Individual Assignment Due:** Now that we have completed the Research and Analysis, modules, please update your Design Skills Matrix (link will be provided through bCourses). **T-1. Project Deliverables Due:** Mission statement, value proposition, customer/user needs analysis (using at least 5 Research and 5 Analysis methods from theDesignExchange reading). Teams should justify why and how they decided to select particular methods and describe the results and outcomes from using each method. Include all meaningful insights and comprehensively discuss learnings and next steps. Please include documentation (pictures, interview transcripts, sketches, diagrams, frameworks, and etc). Based on this search and anlysis, provided an updated mission/market hypothesis for further testing. As with all project deliverables, include a team short discussion of the lessons learned to date, and any observations you have about your team. We also ask that you upload feedback from the peer review to share with your team.
IV. MODULE ON CONCEPT GENERATION & DEVELOPMENT	
12 T 10/3	**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. This session will be led by a guest lecturer Vivek Rao, former designer at IDEO and current doctoral student at UC Berkeley. **Read:** Assignments from theDesignExchange Ideate Collection – _ Visual brainstorming: https://www.thedesignexchange.org/design_methods/136

	Brainstorming : https://www.thedesignexchange.org/design_methods/111 How Might We: https://www.thedesignexchange.org/design_methods/342 **Read:** "Creative Thinking Techniques" (http://www.virtualsalt.com/crebook2.htm) **I-6. 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 that will be posted on bCourses. **Team Exercise:** Submit your concepts to your team folder and the clustering exercise you did in class. In preperation for the T-2 project deliverable, work on a spreadsheet of your collective concepts and upload to your project folder on Concept Generation. A spreadsheet template will be provided on bCourses.
13 Th 10/5	**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). This session will be led by Dr. Euiyoung Kim and graduate student Danielle Poreh. **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 Heuristic Ideation: https://www.thedesignexchange.org/design_methods/125 **Read:** "Morphological Charts" (similar to Attribute Listing), http://www.ifm.eng.cam.ac.uk/research/dmg/tools-and-techniques/morphological-charts/ **Scan:** "Creax Function Database", http://function.creax.com/ **T-2. Project Deliverable Due:** Submit spreadsheet of your team's Concepts and Clusters. A spreadsheet template will be provided on bCourses.
14 T 10/10	**Product Architecture, Product Platforms and Technology Roadmaps** 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. **Read:** Assignments from theDesignExchange – Affinity Diagramming: https://www.thedesignexchange.org/design_methods/48 Do-Redo-Undo: https://www.thedesignexchange.org/design_methods/121: **Read:** http://www.ifm.eng.cam.ac.uk/roadmapping/research/ **Read:** "Roadmapping for Strategy and Innovation": http://www.ifm.eng.cam.ac.uk/uploads/Research/CTM/Roadmapping/roadmapping_overview.pdf, also on bCourses. **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 **Team Exercise:** We will continue to work on expanding concepts and clustering them. Be sure to

	upload updated concept spreadsheet with new concepts and clustering.
15 Th 10/12	**Design for the Environment and Whole Systems Design** 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. This class starts with an introduction to the Whole Systems Mapping method. You will use an abbreviated version of it to reframe your product and consider new design strategies. Class will be spent with you learning the method and performing it on your product, in your teams. You will also be introduced to biomimicry methods. **Read:** Assignments from theDesignExchange – Life Cycle Analysis: https://www.thedesignexchange.org/design_methods/312 Biomimicry: https://www.thedesignexchange.org/design_methods/311 Forced Analogy: https://www.thedesignexchange.org/design_methods/123 **Read:** from bCourses: Kambrook Kettle case study: "Mainstream appliance meets eco-design" (*Journal of Sustainable Product Design*) **View Video:** Janine Benyus TED talk: Biomimicry in action. https://www.ted.com/talks/janine_benyus_biomimicry_in_action?language=en# **Scan:** "Biomimicry Institute", http://www.biomimicryinstitute.org/ **Optional:** - 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 - Autodesk Sustainability Workshop: http://sustainabilityworkshop.autodesk.com - Autodesk Sustainability Workshop pages on biomimicry: http://sustainabilityworkshop.autodesk.com/products/biomimicry
16 T 10/17	**Concept Selection and Testing** In this class we will describe methods for concept screening, concept scoring and testing as a means of selecting among competing ideas for products. We will present a case study on how you could conjoint analysis for early stage design decisions. **Read:** Assignments from theDesignExchange – Weighted matrix: https://www.thedesignexchange.org/design_methods/103 Borda Count Voting: https://www.thedesignexchange.org/design_methods/43 Conjoint Analysis: https://www.thedesignexchange.org/design_methods/155 **I-7. 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. **Team Exercise:** In your team meeting, compare notes on the benchmark competitive markets and top 5 needs. Work together on joint screening & selection matrices.
V. MODULE ON PROTOTYPING AND BUILDING	
17 Th	**Low-Fidelity Prototyping Workshop** We will introduce tools and techniques for prototyping and testing your product concepts. Bring to class discarded items that would normally go to landfill to add to our supply of prototyping materials.

10/19	**Read:** Assignments from theDesignExchange in the Build Collection – https://www.thedesignexchange.org/collections/49 Prototyping: https://www.thedesignexchange.org/design_methods/257 Early Stage Prototyping: https://www.thedesignexchange.org/design_methods/351 Live Prototyping: https://www.thedesignexchange.org/design_methods/318 6-Up Sketches: https://www.thedesignexchange.org/design_methods/317 Service Prototype: https://www.thedesignexchange.org/design_methods/28 Experience Prototype: https://www.thedesignexchange.org/design_methods/13 Paper Prototypes: https://www.thedesignexchange.org/design_methods/21 Wireframe: https://www.thedesignexchange.org/design_methods/36 **Read:** "Prototyping Is The Shorthand Of Design", http://uwdata.github.io/hcid520/readings/Kelley-Shorthand.pdf **I-8 Individual Assignment Due:** Now that you have completed the Ideate module, update your design skills matrix (link will be provided through bCourses). **T-3. Project Deliverable:** You should now have at least doubled the number of concepts you brought in on 10/3 (e.g., 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. You should have updated and further organized the concepts you have to date into a concept 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 should also include your integrated team's concept selection matrices to the project bCourses/Concept Generation folder. Teams should summarize the use of at least 5 methods from theDesignExchange readings and justify why and how they decided to select these particular methods and describe the results and outcomes from using each method. Include all meaningful insights and comprehensively discuss learnings and next steps. Please include documentation (pictures, interview transcripts, sketches, diagrams, frameworks, and etc). Also comment on whether the HM plots helped you with expanding or better organizing concepts. **Team Exercise:** Submit photographs of any prototypes you create in-class to your bCourse folder.
18 T 10/24	**Moving from Low to Medium and High Fidelity Prototyping** Review of medium and high prototyping methods, 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 your team project. You will leverage your solid modeling and rapid prototyping resources in Jacobs to execute on the low-fidelity prototype you developed during class on 10/19. **Guest Lecturer:** Dr. Chris D. McCoy, Co-founder You3Dit.com, Lecturer UC Berkeley, Mechanical Engineering, Haas School of Business, I.E. Business School. Online or out-of-class instruction can be provided for the following tools if students are not familiar with them: Tools / Resources Required: 1. Thingiverse.com 2. TinkerCAD.com 3. Cura for Type A Machines **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

	Read: Rapid Prototyping Methods on theDesignExchange – Tangible Prototypes: https://www.thedesignexchange.org/design_methods/32 Addititive Manufacturing: https://www.thedesignexchange.org/design_methods/348 Fused Deposition Models: https://www.thedesignexchange.org/design_methods/15 Water Jet Cutting: https://www.thedesignexchange.org/design_methods/349 Laminated Object Manufacturing: https://www.thedesignexchange.org/design_methods/18 Direct Shell Production Casting: https://www.thedesignexchange.org/design_methods/10 Laser Cutting: https://www.thedesignexchange.org/design_methods/350
19 Th 10/26	**Prototyping at Jacobs Hall** Daniel Lim will lead a feedback session on prototyping for feedback and how to move your low-fidelity prototypes to the next level. He will recommend equipment and materials possible for this next stage, including resources available in CITRIS Invention Lab or Jacobs Hall. **Read:** "Extremely Rapid Usability Testing", (http://grouplab.cpsc.ucalgary.ca/grouplab/uploads/Publications/Publications/2009-ERUT.JUS.pdf) **Team Exercise:** Bring to class your prototyping plan to work on and get feedback from the teaching staff.
20 T 10/31	**Design and Prototyping for Impact** Guest speaker Prof. Amos Winter from MIT will speak on Engineering Reverse Innovations and how resource constraints can drive creative innovations. Winter created the Global Engineering and Research (GEAR) Lab at MIT, which focuses on the marriage of mechanical design theory and user-centered product design to create simple, elegant, yet frugal, technological solutions for use in highly constrained environments. Our technologies are aimed at making a positive impact on the world and elucidating novel scientific and engineering knowledge. **Read:** Participatory Co-Design on theDesignExchange: https://www.thedesignexchange.org/design_methods/129 **Read**: Christopher A. Mattson and Amos G. Winter, "Why the Developing World Needs Mechanical Design", ASME *Journal of Mechanical Design*, **138** (7), 2016. **Read:** Amos Winter and Vijay Govnidarajan, "Engineering Reverse Innovations," Harvard Business Review, 2015. https://hbr.org/2015/07/engineering-reverse-innovations **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:** Sandhu, Jaspal S. "Measure early, measure often: rapid, real-time feedback in design for social innovation". Jan. 2013: http://poptech.org/e3_jaspal_sandhu
21 Th 11/2	**Autodesk and Fusion 360** We will be joined by guest speaker Jeff Lee, Program Manager of Education, Autodesk. Jeff received his degrees from the Georgia Institute of Technology and UC Berkeley. Jeff has worked on topics such as new product design, sustainable design, and vehicle design with an emphasis on design thinking and user-centered design. Students should expect to learn basic 3D modeling principles (sketching, creating bodies, and modifying bodies) as well as best practices in Fusion 360. We will also cover how to set up models for rendering so that students can get a realistic image for poster boards, websites, or any other documentation. Experienced CAD (computer-aided design) users will learn a new tool; but those with limited CAD experience will benefit from this workshop. Participants will leave the workshop: • understanding basic part modeling in Fusion 360

	• understanding the browser and timeline features in Fusion 360 • understanding general project/data management in Fusion 360 • equipped with a general overview of Fusion 360 workspaces (Modeling, Rendering, Sculpt, CAM, Simulation, etc) **Download Fusion** at www.autodesk.com/workshop. Please sign up for an Autodesk account and make sure it works the night before the class **Look through Fusion Help** (http://help.autodesk.com/view/fusion360/ENU/) to get an overview of Fusion's capabilities **Watch a couple tutorial/quick tip videos** on the Fusion Youtube channel (https://www.youtube.com/user/AutodeskFusion360) If adventurous, **check out our online course content** (https://academy.autodesk.com/explore-and-learn) **Day of:** Bring Fusion downloaded/installed on laptop. Bring power cord and mouse **Team Exercise**: Work with your team on a short assignment.
22 T 11/7	**Autodesk and Fusion 360, Contd.** Students will be learning how to assemble parts and the different types of joints, editing joints, and motion studies. We will also discuss simulation and how to use it to validate designs. **Team Exercise**: Continue to work with your team on a short assignment.
23 Th 11/9	**Design Roadmaps** Guest speaker Dr. Euiyoung Kim, 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 designers early in the planning process; and (3) to provide a means for rapidly responding to changes in the environment. 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. **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," *Journal of Mechanical Design* on bCourses. http://mechanicaldesign.asmedigitalcollection.asme.org/article.aspx?articleid=2537150 **Read:** Design Roadmapping from theDesignExchange (Build collection), https://www.thedesignexchange.org/design_methods/328 **Team Exercise:** Meet with your design team to work on design roadmapping exercises. Upload to your project bCourses site to share with your team and instructors when you are done.
F 11/10	**Solid Modeling→Animations** We will be joined by guest speaker Professor Dennis Lieu for an optional class (time to be scheduled). He will lecture on how to build on solid models to create animations with 3D Studio or similar

	programs. Read Animated User Experiences on theDesignExchange in Build Folder: https://www.thedesignexchange.org/design_methods/4
24 T 11/14	**Role Playing Prototyping** In this lecture students will experiment with the Role Play method using role-playing setups to explore future use cases and scenarios arising in their specific product context. The students will learn the fundamentals and parameters to vary in a good role-play and reflect upon the learning and new opportunities identified. The students will focus on how they interact with each other, their surroundings, and artifacts, testing existing ideas and uncovering new ones. **Guest Speaker:** Matilde Bisballe Jensen; matilde.jensen@ntnu.no Entrepreneurial academic with a PhD in prototyping and creative processes in early stage product development. She has worked in the fields of human machine interaction in future autonomous cars as well as implementing maker mentality and makerspaces in industrial contexts. Further she has conducted several in-depth user research projects in China, Uganda, Denmark and Nepal. In these study she explored how different cultures affects the outcome and performance of human-centered design methods. **Read:** Role Play Method in theDesignExchange: https://www.thedesignexchange.org/design_methods/132
25 Th 11/16	**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 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. 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. **Scan:** https://modelica.org/events/modelica2011/Proceedings/pages/tutorials/007/Tutorial7_OpenModelica_Fritzson.pdf **I-9 Individual Assignment Due:** Now that you have completed the Build module, update your design skills matrix (link will be provided through bCourses).

	T-4 Team Deliverable Due: Submit your prototypes to date to your bCourses project folder (e.g., photos of physical prototypes, 3D models, animations, videos, role playing script). Summarize your use of at least 5 Build methods from theDesignExchange. Teams should justify why and how they decided to select particular methods and describe the results and outcomes from using each method. Include all meaningful insights and comprehensively discuss learnings and next steps. Please include documentation (pictures, interview transcripts, sketches, diagrams, frameworks, and etc).

VII. VISUALIZATION & COMMUNICATION	
26 T 11/21	**Communicating Actionable Design Research** This starts our module on methods and tools for communicating actionable design research., design results that can have impact. **Read:** Roschuni, C., E. Goodman, A.M. Agogino, "Communicating Actionable User Research for Human-Centered Design, Special Issue on Studying and Supporting design Communication, *Journal of Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, Vol. 27 (Special Issue 02, 2013), pp. 143-154. doi:10.1017/S0890060413000048. (on bCourses) **Read:** Communicate Methods on theDesignExchange – https://www.thedesignexchange.org/collections/50 Usability Report: https://www.thedesignexchange.org/design_methods/263 Envisionment Videos: https://www.thedesignexchange.org/design_methods/251 Composite Characters: https://www.thedesignexchange.org/design_methods/313 Service Blueprint: https://www.thedesignexchange.org/design_methods/27 Bifocal Display: https://www.thedesignexchange.org/design_methods/247 Storyboarding: https://www.thedesignexchange.org/design_methods/30 Revisit Empathy Map: https://www.thedesignexchange.org/design_methods/61 **Team Excercise:** You will be asked to develop a 30 min. "elevator pitch" in class. Upload your final to your bCourses folder to share with your team.
W 11/22-24	**Non-Instructional Day (Thanksgiving)**
27 T 11/28	**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. **Read:** Communicate Methods on theDesignExchange - Design Portfolios: https://www.thedesignexchange.org/design_methods/356
28 Th 11/30	**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 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 *Made to Stick,* http://www.heathbrothers.com/download/mts-made-to-stick-chapter1.pdf (you may need to register for free) **Team Activities:** Be prepared to pit you concept and get feedback in class. Come with a 30 sec. "elevator" pitch.
29,30 T/Th 12/5&7	**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 Thu Dec. 7. We will invite venture firm and design judges for feedback. The teaching staff will be available on 12/5 to give you feedback on your final deliverables.

	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. • What is the motivation for 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?
M 12/12	**Final Reports (Online or in-Person 200E Blum Hall)** **I-10. Individual Assignment Due:** Update your design skills matrix (link will be provided through bCourses). **T-5. 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. Template (with judging criteria) will be provided. Also submit your Design Case Study (template will also be provided). As required for all Project Deliverables, include a team lessons learned as well.