

University of California, Berkeley

Design, Evaluate and Scale Development Technologies

Dev Eng C200, Mech Eng C200, MBA 290T

Fall 2015, Version 18

General Information

Faculty:

Alice M. Agogino, Department of Mechanical Engineering, 415 Sutardja Dai Hall (CITRIS Building), (510) 642-6450, <https://twitter.com/agogino>, agogino@berkeley.edu

David Levine, Haas School of Business, F671 Haas, (510) 642-1697, levine@haas.berkeley.edu

GSI: Miho Kitagawa (Mechanical Engineering), mkitagaw@berkeley.edu

GSRs: Two GSRs will be joining the class in support of research on development engineering. Madeline Foster-Martinez (Environmental Engineering), madeline@berkeley.edu will focus on the course projects and evaluations. Lee-Huang Chen (Mechanical Engineering), leehuangc@berkeley.edu, will focus on DevEng software and sensors (e.g., ODK workshop and the Cook Stove experiment)

Class Meetings:

11:00 am -12:30 pm M W (110 Cheit Hall on M and I-Lab on W, Haas School of Business)

Optional (but highly recommended) workshops noon-1:00 pm F (I-Lab, Memorial Stadium or Cal Design Lab). Schedule and location on bCourses→Pages,

<https://bcourses.berkeley.edu/courses/1376877/pages/friday-workshop-schedule>

Office Hours and Optional Discussion/Workshops:

Agogino: Th 2:30-4:00, 415 Sutardja Dai Hall (CITRIS Building) or after class

Levine: M 1:30-3:00 in F671 Haas or by appointment

Class Representatives

One student from the technical side and one from the Economics / Business side will be invited to help with class feedback.

Course Description

This course provides students with a set of skills that will allow them to address complex problems and design challenges in development engineering. Students will learn to participate in and lead innovation and creativity in collaborative settings. This course includes design projects and case studies, many related to projects at UC Berkeley.

Student teams will work with preliminary data to define the problem. They will then collect and analyze interview and survey data to learn about user needs. Students will explore how to use novel monitoring technologies, experiments, and large datasets both to understand user needs and to provide rapid feedback for product improvement. Students will use a variety of tools to analyze their data, ideate potential solutions, and prototype. The teams will use their projects to develop plans for rapid improvement, scaling, continuous improvement and a rigorous impact evaluation.

Topics Covered

1. Project Design (including human-centered design with participant observations and interviews using qualitative research and survey data collection).
2. Development Technologies (including wireless sensors, mobile data collection, and prototyping);
3. Measurement and evaluation techniques (including design of experiments, statistical analysis for impact analysis). Methodologies for collection and evaluation of data to improve projects in the field, and eventually scaling projects and conducting a rigorous evaluation.
4. Developing and evaluating social impact (including sustainability and scaling of projects). Going beyond rigorous evaluations to look at broader impact on people and communities.

Class/Laboratory Schedule

3 hours lecture per week and one hour optional workshop/discussion.

Assessment of Student Progress Toward Course Objectives

- 25% on homework assignments & group exercises
- 25% class participation
- 10% final class presentations on capstone project
- 40% on capstone USAID DIV Letter of Interest

Class Participation

Students are co-producers of each class. *Students will need to come to class prepared by completing the required reading, preparing the discussion questions, completing any homework, and reading relevant current events.* Class participation makes up 20% of the grade, but it is also a requirement to pass. There are multiple measures of class participation:

- Be present and prepared at the start of each session;
- Post good questions, comments, articles, or suggested links on bCourses
- Presentations of team work

- Peer Reviews: For most assignments students should review each others' work. That way, professors receive better assignments and students get used to pretesting every work product and to helping each other.

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.

Assignments

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

Submit assignments on the bCourses "assignments" tab under the appropriate heading prior to the start of class on the day they are due. Bring one copy of your homework to class, as we will frequently ask you to share your results (Digital sharing is fine).

bCOURSES Website

We will make extensive use of the course Website both to communicate information to you and to converse with you about your readings, homework and your projects. You will find the course on <https://bcourses.berkeley.edu>.

Laptop, Tablet and SmartPhone

MBA courses do not allow general use of laptops, tablets, smartphones or other computer devices during class time. Our 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.

Schedule

The schedule below provides learning goals for each session, along with required readings and assignments. The assignments are listed chronologically in order of the date assigned. We have made every effort to provide you all course details in this syllabus, but we sometimes have to make changes due to unexpected circumstances, such as a change in the visit date of a guest lecturer. Please check bCourses announcements and assignment updates for changes to the schedule.

DAY	TOPIC
1 W 8/26 C110	<p style="text-align: center;">Phase I: Understanding the Problem, Context and Needs</p> <p>Unit 1: Introduction to Development Engineering</p> <p>Our first day of class will be on W 8/26 with an introduction to the course and the field of development engineering. What are the key issues and challenges? Who are the stakeholders? We will also discuss capstone project options.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Hans Rosling, “New insights on poverty”. TED talk, March 2007: http://www.ted.com/talks/hans_rosling_reveals_new_insights_on_poverty.htmlhttp://www.ted.com/ • Amy Smith, “Simple designs to save a life,” Feb. 2006: https://www.ted.com/talks/amy_smith_shares_simple_lifesaving_design • Wong, Kristine, 2014: “Cleantech in the developing world: from solar power to refrigeration,” http://www.theguardian.com/sustainable-business/2014/jun/13/cleantech-developing-world-solar-power-refrigeration
HW 0: Due 8/31	<p>Pitching a Project. Your interest may be quite general or focused on one or two specific domains or problems. If you are particularly interested in pitching a capstone project for a class team, describe it in a few sentences (and how far along the project is). One of the student-initiated class projects last year won 1st place in the Big Ideas competition for global health. Please post your ideas for a project at: https://docs.google.com/a/berkeley.edu/spreadsheets/d/15GylGaBQ3Qh1FtbqF401b8Lf3hf2kl60014IIwASOv0/</p> <p>We will make time to pitch ideas on the Friday workshop on Sep. 4 at noon.</p>
2 M	Preview the iterative design thinking processes in the context of development engineering, associated research methods and their roles in needs assessment. Cover theories of persistent

<p>8/31</p> <p>C110</p>	<p>poverty.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Banerjee, Abhijit V., and Esther Duflo. 2007. "The Economic Lives of the Poor." <i>Journal of Economic Perspectives</i>, 21(1): 141-168. (bCourses) • Whitesides, George, 2012. "The Frugal Way: The promise of cost-conscious science," <i>Science</i>, pp. 154. (bCourses) • T. Brown and J. Wyatt. "Design Thinking for Social Innovation (SSIR)," 2010: http://www.ssireview.org/articles/entry/design_thinking_for_social_innovation/ <p>Optional Readings:</p> <ul style="list-style-type: none"> • Abhijit Banerjee and Esther Duflo. <i>Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty</i>, Public Affairs, 2011. • Amartya Sen. <i>Development and Freedom</i>. Anchor. 2000 • <i>Voices of the Poor</i> by World Bank, http://bit.ly/worldbank-voices-of-poor
<p>HW 1</p> <p>Due: 9/9</p>	<p>Individual Homework: Spend at least 30 min. observing hand washing practices in a restroom, dining room or restaurant. Do you see different results when subjects know you are observing them? Take photos of the associated hand washing facilities, along with related signage. Document your observations and photos. Interview at least one person asking about their hand washing habits. Bring hard copies to class on Sept. 9. Also identify one study on hand washing practices in the U.S.</p>
<p>3 W</p> <p>9/2</p> <p>I-Lab</p>	<p>Unit 2: Needs Assessment with Primary, Secondary & Tertiary Sources</p> <p>Review of needs assessment methods in development engineering and introduction of one case study. Where are problems in different locations? To design a "Safe water solution" you have to know more than water. The solution to a development challenge must be based on knowledge of: Market segments (urban/rural, high/low education), ability to pay (levels and timing of income; access to credit and costs of credit), information sources for consumers, household decision making structures (role of women), existing social groups (e.g., formal, informal, NGO government), distribution channels, and so forth. We will first discuss research methods using tertiary data (e.g., published data) and secondary sources first (e.g., individuals or organizations working in the area, organizations that work in similar areas).</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Luby, Stephen P., et al. "Difficulties in maintaining improved handwashing behavior, Karachi, Pakistan." <i>American journal of tropical medicine and hygiene</i> 81.1 (2009): 140 http://www.ajtmh.org/content/81/1/140.full.pdf+html • Curtis, Val, et al. "Hygiene: new hopes, new horizons." <i>The Lancet infectious diseases</i> 11.4 (2011): 312-321. (bCourses) • Rose George, "Let's talk crap. Seriously." http://www.ted.com/talks/rose_george_let_s_talk_crap_seriously.html (Ted Talk, 2013). <p>Optional Readings:</p> <ul style="list-style-type: none"> • Mathers CD, Loncar D (2006) Projections of Global Mortality and Burden of Disease from 2002 to 2030. <i>PLoS Med</i> 3(11): e442. doi:10.1371/journal.pmed.0030442. http://www.plosmedicine.org/article/info%3Adoi%2F10.1371%2Fjournal.pmed.0030442

M 9/7	Labor Day holiday – no class.
4 W 9/9 I-Lab	<p>We introduce a range of research methods for performing primary data collection for needs assessments, including observations, interviewing, focus groups, and embedding/empathic design. We will discuss trade-offs across the various methods, issues in reducing the distance between researchers and subjects (novices/experts, local/ distant geographies, wealthy/poor, etc.), and how to communicate user needs research within your team.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Sandhu, Jaspal S. “Measure early, measure often: rapid, real-time feedback in design for social innovation”. Jan. 2013: http://poptech.org/e3_jaspal_sandhu • “Designing For Humans: an Ethnography Primer,” IDSA, 2010: http://www.aiga.org/ethnography-primer/ • The Design Toolkit, IDEO.org, http://www.designkit.org/ • Getting People to Talk: An Ethnography & Interviewing Primer, http://vimeo.com/1269848 • David Levine, “Advice on doing research interviews,” (bCourses) <p>Optional Readings:</p> <ul style="list-style-type: none"> • Ware NC, Idoko J, Kaaya S, Biraro IA, Wyatt MA, et al. (2009) Explaining Adherence Success in Sub-Saharan Africa: An Ethnographic Study. PLoS Med 6(1): e1000011. doi:10.1371/journal.pmed.1000011 http://www.plosmedicine.org/article/info%3Adoi%2F10.1371%2Fjournal.pmed.1000011 <p>Class Exercise: In-class exercises on observations and interviewing based on your hand washing data.</p>
HW 2 Due: 9/14	<p>Individual Homework: Conduct one interview associated with your capstone project.</p> <p>When you have completed your observation and interview:</p> <ul style="list-style-type: none"> • Write up a one-page summary of your key findings including quotes from those you observe or interview. Don’t over-generalize at this point, as you want to keep the people you learned about “alive” for your classmates. Include a short description of the person you interviewed and the circumstances in which you interviewed him or her to set the context for your findings. • Create a one-page document that captures the best story you observed or heard to highlight one of your key insights. The story should not rehash the entire interview, but should bring alive a particular insight for your study team members. <ul style="list-style-type: none"> ○ Start with a catchy headline ○ Include a picture or drawing ○ Write a one-paragraph story that captures the essence ○ Close with the “moral” of the story – one line that captures the insight <p>Upload your work – one-page summary <u>and</u> one-page story to bCourses before class. Bring a copy of your story to class to share with your teammates</p>
5 M 9/14	<p>Unit 3: Capstone Launch and Analyzing Qualitative Data</p> <p>Building on qualitative research methods, this unit will focus on analyzing data from design</p>

C110	<p>research. Students should consider which methods will be of value to their projects (data on customer and user needs– interview notes, photographs, etc.) and how to access your customers and other stakeholders. We’ll also use this class time to work with students on applying some of the framing and reframing tools to a case or on real data. Techniques will include personas, scenarios, 2x2 matrices, and journey maps.</p> <p>Class Exercise: Launch capstone teams of 4-5 people, each with at least one technology and one social science student for your Capstone project. Develop a draft problem definition and begin your user research plan.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Weiss. Robert S. <i>Learning From Strangers</i>. Chapter 4: Interviewing, pp. 61-119. The Free Press, 1995. (bCourses) • Scan Research Methods on theDesignExchange, https://thedesigntexchange.herokuapp.com/ • An Introduction to personas and how to create them, http://www.steptwo.com.au/papers/kmc_personas/index.html <p>Optional Readings:</p> <ul style="list-style-type: none"> • Jenkins, Carol, and Peter Howard. "The use of ethnography and structured observations in the study of risk factors for the transmission of diarrhea in highland Papua New Guinea." <i>Medical anthropology</i> 15.1 (1993): 1-16. <i>Note on Observation</i> on bSpace. Note the value of failure stories! • Aarthi Rao & Sandra McCoy. "Fostering Behavior Change for Better Health." Stanford Social Innovation Review blog, Aug. 17, 2015. http://ssir.org/articles/entry/fostering_behavior_change_for_better_health
HW 3 Due: 9/21	<p>Team Homework: Turn in your “problem definition” file, http://diytoolkit.org/tools/problem-definition-2/ to bCourses project site. It is fine to change your group’s project focus as the semester proceeds. Also turn in your collaborative plan and draft assessment plan (target audience, methods for qualitative/ quantitative user needs, prototype testing) for your capstone project. (Note: Individualize Learning Style profile is due earlier by 5:00 pm 9/15 Tues. This will be done by individualized email with title: DEV ENG: HOMEWORK DUE TUESDAY, 9/15 by 5:00 PM).</p>
6 W 9/16 I-Lab	<p>Framing and Reframing the Problem with Insights from Research</p> <p>Work with your team to go over interviews, complete a collaborative plan for your team and develop a draft user research plan.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Scan: OpenDataKit: magnifying human resources through technology. http://opendatakit.org • Scan: Rebecca Smith, Kendra Leith (2014) D-lab Scale-Ups: User Research Framework. (bCourses) • Bansal, Sarika. August 21, 2014. “Innovation Within Reach,” New York Times, Opinion, http://opinionator.blogs.nytimes.com/2014/08/21/innovation-within-reach/ • Staus, Tamara, “Berkeley Lab Water Technology “Boomerangs” from Bangladesh to California,” http://blumcenter.berkeley.edu/news-posts/berkeley-lab-water-technology-boomerangs-from-bangladesh-to-california/

	<p>Class Exercise: Continue teamwork, needs assessments and framing exercises.</p> <p>Optional Readings:</p> <ul style="list-style-type: none"> • Vechakul, Jessica, and Alice M. Agogino. 2013. "A Comparison of Two Transdisciplinary Human-Centered Design Approaches for Poverty Alleviation". <i>Proceedings of The Future of Transdisciplinary Design</i> (TFTD13). (bCourses) • Schaeffer, N.C. and Presser, S. (2003). The science of asking questions. <i>Annual Review of Sociology</i>, 29, 65-88. http://www.ssc.wisc.edu/~alang/357/Schaeffer%20and%20Presser_Science%20of%20Asking%20Questions.pdf <p>Class Exercise: Work on team assignments and create a persona for your project.</p>
<p>7 M 9/21 C110</p>	<p>Unit 4: Quantitative and Mixed-Methods Needs Assessment</p> <p>Review and compare quantitative and mixed (qualitative and quantitative) methods in research design: surveys, phone, and internet tools. Reflections and instruction on human subjects and ethical considerations.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Survey Research, Research Methods Knowledge Base, 2006. http://www.socialresearchmethods.net/kb/survey.php • Albert, Jeff, Jill Luoto, and David Levine. "End-user preferences for and performance of competing POU water treatment technologies among the rural poor of Kenya." <i>Environmental science & technology</i> 44.12 (2010): 4426-4432. http://faculty.haas.berkeley.edu/levine/papers/Albert_et_al_EST_2010.pdf • Checklist for good survey questions (on bCourses) <p>Optional Readings:</p> <ul style="list-style-type: none"> • Dillman, Don A., <i>Mail and Internet Surveys</i>, second edition (updated), 2007. • Schaeffer, N.C. and Presser, S. (2003). The science of asking questions. <i>Annual Review of Sociology</i>, 29, 65-88. http://www.ssc.wisc.edu/~alang/357/Schaeffer%20and%20Presser_Science%20of%20Asking%20Questions.pdf <p>Class Exercise: Write an outline for an open-ended, semi-structured interview and then have a classmate review it. Use this interview to inform your next homework assignment.</p>
<p>HW 4 Due: 9/28</p>	<p>Team Assignment: Write and pilot a section of survey you could use to learn about your capstone project.</p> <p>Also submit a revised assessment plan (target audience, methods for qualitative/ quantitative user needs, prototype testing) for your capstone project. List names and job titles of at least 3 people you intend to interview in the next 3 weeks.</p>
<p>8 W 9/23</p>	<p>Unit 5: Integrating Needs Assessment Findings to Develop Solutions</p> <p>The goal is to gain insights from the qualitative and quantitative data from the needs assessment. This is sometimes called "Telling today's story" to understand the context and users' most</p>

C110	<p>important challenges and needs.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Sherwin, David. September 23, 2013. "A Five-Step Process for Conducting User Research." http://www.smashingmagazine.com/2013/09/23/5-step-process-conducting-user-research/ • Wood, Amy E. and Christopher A. Mattson. 2014. "A Method for Determining Customer Needs in the Developing World." Proceedings of the ASME 2014 International Design Engineering Technical Conference, DETC2014-35357. <p>Class Exercise: Bring in your projects customer research to date for use in a class exercise.</p>
<p>9 M 9/28 C110</p>	<p>IT for Development:</p> <p>Guest speaker Tapan Parikh is on the faculty of our I-School and studies the design and use of information and communication technologies for sustainable development. More at: http://people.ischool.berkeley.edu/~parikh/</p> <p>Information technologies are essential tools for the representation and communication of human knowledge. However, many groups are still inadequately represented on the Internet. My research group developed Avaaj Otalo, a phone-based voice message board allowing small farmers in rural India to ask, answer and browse agricultural questions and answers. Avaaj Otalo has been deployed for over four years, and receives hundreds of calls every week. I report on recent results from this deployment, including evidence of impact on farmer decision-making, reducing the use of less effective and potentially harmful pesticides, through a randomized controlled trial (RCT). While Avaaj Otalo illustrates the importance of designing appropriate user interfaces for representing knowledge from underrepresented groups, knowledge must still be translated to structured, quantitative forms for aggregation and policy decision-making. Local Ground is a data collection, mapping and information visualization tool that helps youth develop data skills by making connections between different representations of empirical phenomena. Students begin by collecting open-ended qualitative data, in the form of free-hand drawings, pictures and audio interviews. Based on these observations, students can design of structured data collection instruments for more systematic inquiry and analysis. These various forms of data are combined into narratives that can articulate youth perspectives to a variety of stakeholders. Local Ground has been used to involve youth the planning of a public park, ground-truth civic data about food access, and document air quality issues across the BART transportation system. Within these projects, I explore several themes in my work, including the design of more accessible interaction techniques allowing new populations to author content, the importance of bottom-up data for planning and evaluating development projects, and how we can employ participatory computing technologies to support learning and human agency.</p> <p>Required Readings:</p> <p>Neil Patel, Krishna Savani, Paresh Dave, Kapil Shah, Scott R. Klemmer and Tapan S. Parikh. 2013. Power to the Peers: Authority of Source Effects for a Voice-based Agricultural Information Service in Rural India, <i>Information Technologies and International Development</i> (ITID), Vol. 9, No. 2.</p>
<p>10 W 9/30 I-Lab</p>	<p>Use of Big Data and New Sensors:</p> <p>Lab experiments and experiments in the field. This lecture will involve hands-on use of sensors for data collection and a case study.</p>

	<p>Thought question: How might you obtain sensor data that would help your capstone project?</p> <p>Required Readings:</p> <ul style="list-style-type: none"> Wilson, Daniel, Mohammed Idris Adam, Omnia Abbas, Jeremy Coyle, Angeli Kirk, Javier Rosa, and Ashok Gadgil, 2014. "Comparing Cookstove Usage Measured with Sensors Versus Cell Phone-Based Surveys in Darfur, Sudan". CoDev (Center for Cooperation and Development), http://cooperation.epfl.ch/page-107182-fr.html Albert, Jeff, Jill Luoto, and David Levine. "End-user preferences for and performance of competing POU water treatment technologies among the rural poor of Kenya." <i>Environmental science & technology</i> 44.12 (2010): 4426-4432. http://faculty.haas.berkeley.edu/levine/papers/Albert_et_al_EST_2010.pdf
HW 5 Due 10/5	<p>Individual Assignment: Submit 10 or more ideas or concepts related to your capstone. This is a brainstorming phase, so there are no bad ideas. We'll refine later. Upload digital version to Assignments and bring in hard copy for class exercise</p>
11 M 10/5 C110	<p style="text-align: center;">Phase II: Designing and Prototyping a Solution</p> <p>Unit 6: Designing Concepts</p> <p>This session will focus on <i>diverging</i>; that is, generating a LOT of ideas for your project. We'll use a variety of methods to help you view your situation from different perspectives, and thus be able to generate different ideas.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> <i>Creative Thinking Techniques</i> (http://www.virtualsalt.com/crebook2.htm) Scan Ideate Methods on theDesignExchange, https://www.thedesignexchange.org/ <p>Class Exercise: Use tools presented in class to create or improve a solution. Share your individual concepts in class. Consider potential partners: Researchers, designers and engineers in poor nations or technical experts who may not know much about poverty. Mix and match ideas from elsewhere.</p>
12 W 10/7 I-Lab	<p>Unit 6: Expanding Design Concepts</p> <p>After reviewing your teams' original 50 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). After class in your next team meeting, expand your concepts using both brainstorming and structured methods and update your spreadsheet with the new concepts generated. Upload to bCourses before the next class.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> "10XE Principles", Rocky Mountain Institute, http://www.rmi.org/rmi/10xE+Principles "Morphological Charts", http://www.ifm.eng.cam.ac.uk/dmg/tools/concept/morph.html "Creax Function Database", http://function.creax.com/ Scan "Biomimicry Institute", http://www.biomimicryinstitute.org/ <p>This class will focus on structured methods for concept generation, such as Morphological</p>

	Matrices, Functional Decomposition, Biomimetic Design, etc.
13 M 10/12 C110	<p>Unit 7: Prototyping & Testing Early Concepts</p> <p>Techniques for low and medium fidelity prototyping; using prototypes to generate new concepts; “building to think”, prototypes for communicating concepts and testing concepts; hypothesis testing, evaluating data, and selecting concepts.</p> <p>The goal: Fail fast, get rich feedback, and improve.</p> <ul style="list-style-type: none"> • Think forward a few steps: <ul style="list-style-type: none"> ○ Prioritize concepts that are more likely to fit with a business model ○ Simulate the impact under different assumptions ○ Evaluation of ideas depends on the setting. For example, in one problem the apparent right answer might be “Kill all the animal disease vectors” – except the target consumer group is Buddhist. <p>Required Readings:</p> <ul style="list-style-type: none"> • “Prototyping Is The Shorthand Of Design”, http://bit.ly/ep-84086B33-F723-4B8A-A609-D766810B0329 <p>Class Exercise: Prototype solutions.</p>
HW 6 Due 10/14	<p>Team Assignment: Expand your concepts to at least 100 using concepts used in class on 10/7 Upload digital version to Assignments and bring in hard copy for class exercise</p>
14 W 10/14 I-Lab	<p style="text-align: center;">Phase III: Taking it to the Field</p> <p>Unit 8: Pilot and Field Testing – Qualitative</p> <p>Phases II and III are iterative, in a spiral of continuous improvement that should be taken into account in your assessment plan. How do you get your prototype to work in the lab. Pilot test with nearby experts and role playing. Once it works in and near the lab, design plan to test in target settings.</p>
15 M 10/19 C110	<p>Unit 9: Technologies for Monitoring & Testing</p> <p>Case study of technologies for monitoring and testing. Guest speaker Ashok Gadgil, Area Deputy for Science and Technology for the Energy Technologies Area of Lawrence Berkeley National Laboratory, and a Professor of Civil and Environmental Engineering at UC Berkeley.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Re-read: Staus, Tamara, “Berkeley Lab Water Technology “Boomerangs” from Bangladesh to California,” http://blumcenter.berkeley.edu/news-posts/berkeley-lab-water-technology-boomerangs-from-bangladesh-to-california/ • Galitsky, C, Gadgil, AJ, Jacobs, M & Lee, YM. "Fuel Efficient Stoves for Darfur Camps of Internally Displaced Persons. -- Report of Field Trip to North and South Darfur, Nov. 16-Dec. 17, 2005". LBNL-Report 59540 (Lawrence Berkeley National Laboratory, Berkeley, 2006). http://eetd.lbl.gov/sites/all/files/lbnl_59540_feb-24-2006.pdf • Ashok Gadgil, Andrée Sosler, Debra Stein, “Stove Solutions: Improving Health, Safety, and

	the Environment in Darfur with Fuel-Efficient Cookstoves," <i>Solutions for a sustainable and desirable future</i> (bCourses).
16 W 10/21 I-Lab	<p>Guest speaker Laura Stachel will speak on how she decided solar suitcases were important in Nigerian labor and delivery clinics (even though solar lights were not related to the obstetric medical skills she intended to disseminate).</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • WECARESolar, http://wecaresolar.org and http://dil.berkeley.edu/technology-portfolio/current-projects/we-care-solar/ • Video, link TBA
HW 7 Due 10/26	Team Assignment: Turn in notes from at least 10 interviews that will inform your capstone. List a few other names and job titles you will speak with (unless you can make the case against more interviews.)
10/23 HW 7 iLab Due: 11/3	<p>Friday Workshop (2 hours, required)</p> <p>Team exercise: Analyze data from stove usage monitors (SUMs). How well do the data from the SUMs line up with the observations?</p> <p>We will examine some or all of:</p> <ul style="list-style-type: none"> • Envirofit wood-burning stove • Berkeley-Darfur wood-burning stove • Ugastove charcoal-burning stove • Solar Household Energy's HotPot solar oven
17 M 10/26 C110	<p>Analyzing large datasets for insight. In this class we will explore the integration of large qualitative and quantitative data sets to gain insight for development projects. We will be joined by cook stove doctoral student Danny Wilson (Mechanical Engineering) and Angeli Kirk (Agricultural Resources and Economics) and will go over the Friday cook stove experiment.</p> <p>Required Readings</p> <p>TBA</p>
HW 8 Due: 11/3	Individual Assignment: Turn in your analysis of the data from the stove observation and stove sensors. How well do the data from the SUMs line up with the observations? Submit as homework. Note the cooks and design researchers are to turn in their homework earlier on 10/26 to make your data available for the data analysts.
18 W 10/28 I-Lab	<p>How to use large datasets for your project.</p> <p>Team exercise: Consider data sources such as:</p> <ul style="list-style-type: none"> • Administrative data such as electronic health records, school test scores, or government purchases • Operational data such as all mobile phone calls in a nation, every sale by Amazon, or every search by Google

	<ul style="list-style-type: none"> • Large-scale sensor data such as GPS on phones or cars and satellite observations of land use • Low-cost sensors you can put with some or all of your products, especially if the sensors can communicate with you. <p>Assume you had access to one or more of these large datasets (or another data source that might be available in a few years). How would you use those data to improve the functionality of your solution and/or speed the design, ongoing improvement, or monitoring and evaluation of your solution?</p> <p>Required Readings (Read quickly, as these are examples.)</p> <ul style="list-style-type: none"> • Tatem, Andrew J., <i>et al.</i> "The use of mobile phone data for the estimation of the travel patterns and imported Plasmodium falciparum rates among Zanzibar residents." <i>Malaria Journal</i> 8 (2009): 287. http://www.biomedcentral.com/content/pdf/1475-2875-8-287.pdf • Reread: Neil Patel, Krishna Savani, Paresh Dave, Kapil Shah, Scott R. Klemmer and Tapan S. Parikh. 2013. Power to the Peers: Authority of Source Effects for a Voice-based Agricultural Information Service in Rural India, <i>Information Technologies and International Development</i> (ITID), Vol. 9, No. 2.
<p>19 M 11/2</p>	<p>Unit 10: Pilot and Field Testing – Quantitative</p> <p>Quantitative methods for pilot testing. Dimensions to test include: product features, messaging to motivate purchase and usage, pricing, sales offers (free trial, lay-away, credit, etc.), channels. Determine the effect of a customer’s types on demand and willingness to pay, usage and satisfaction. At each stage, feed the results back to the development team.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • “The Effect of Marketing Messages, Liquidity Constraints, and Household Bargaining on Willingness to Pay for a Nontraditional Cookstove,” David Levine, Theresa Beltramo and Garrick Blalock. UC Berkeley: Center for Effective Global Action. 2014. http://www.escholarship.org/uc/item/4vj3w941 • Rob Bailis, “The Kitchen performance test (KPT),” 2007. http://www.pciaonline.org/files/KPT_Version_3.0_0.pdf <ul style="list-style-type: none"> ○ Just skim for the main idea. Read closely enough to point out several limitations. • “A/B testing,” <i>Wikipedia</i>, http://en.wikipedia.org/wiki/A/B_testing <p>Optional Readings:</p> <ul style="list-style-type: none"> • Ludwig, Kling and Mullainathan. “Mechanism Experiments and Policy Evaluation”, <i>Journal of Economic Perspectives</i>, Summer 2011, pp 17-38. • Bandiera, Barankay and Rasul, “Field Experiments in Firms,” <i>Journal of Economic Perspectives</i>, Summer 2011, pp 63-82.
<p>20 W 11/4</p>	<p>Unit 11: Business models</p> <p>Required Readings:</p>

I-Lab	<ul style="list-style-type: none"> • The Social Blueprint, http://www.socialblueprint.org/ <ul style="list-style-type: none"> ◦ Read: Social Blueprint Impact Canvas: http://www.socialblueprint.org/wp-content/uploads/2015/02/ISA_The-Social-Blueprint_-Impact-Canvas_v3.21.pdf • Levine “Notes on sales offers for stoves and filters” • David I. Levine, Theresa Beltramo, Garrick Blalock, and Carolyn Cotterman, “What Impedes Efficient Adoption of Products? Evidence from Randomized Variation in Sales Offers for Improved Cookstoves in Uganda,” 2013. <p>Optional Readings (but <i>highly</i> recommended if business models are new to you):</p> <ul style="list-style-type: none"> • <i>Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers</i>, by Alexander Osterwalder and Yves Pigneur, 2nd Edition, 2010, pages 1-50. http://www.businessmodelgeneration.com/downloads/businessmodelgeneration_preview.pdf • A nice slideshow by Osterwalder introducing his version of the Business Model Canvas http://www.slideshare.net/Alex.Osterwalder/business-model-innovation-matter
HW 9 Due: 11/9	<p>Team Assignment: Design an experiment to speed product improvement for your capstone project.</p> <p>Your experiment could measure product usage, product effectiveness, consumer willingness to pay, etc. It can study variation in marketing messages, product offers, product features, distribution channels, etc. It can examine how the product’s is used differently by different types of users (urban vs. rural, high vs. low literacy, etc.).</p>
21 M 11/9 C110	<p>Team Exercise: Business Model Canvas / Social Blueprint</p> <p>You have 6 minutes to present one segment of your canvas that you would like to get feedback on for a peer review. Be sure to give a clear statement of assumptions and how you will learn to answer critical questions. At this early stage, it is fine if your sketch is largely related to supply-side issues (what the Social Blueprint calls “Root Strategy”, how you will deliver your social venture or program) or to demand-side issues (“Business Base”).</p> <p>You are welcome to use Osterwalder’s Business Model Canvas, as long as you can address the additional questions: What is my anchor purpose? Is the challenge big? How big is the potential paying market?</p>
22 W 11/11	<p>Instructional Holiday</p>
HW 10 Due: 11/16	<p>Team Assignment: Design part of a business model for your capstone project. (You may choose another product with instructor approval.) You can work on one portion of a business model such as:</p> <ul style="list-style-type: none"> • Supply chain • Determining demand and consumer willingness to pay • Distribution • Finance <p>Etc.</p>
23 M 11/16	<p>Unit 12: Rigorous Impact Evaluation</p> <p>Guest Speaker: Paul Gertler, Director, UC Berkeley Clausen Center for International Business and</p>

C110	<p>Policy. He is considered an early pioneer in the randomized evaluation of social programs in developing countries. http://facultybio.haas.berkeley.edu/faculty-list/gertler-paul</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Esther Duflo: Social experiments to fight poverty (TED Talk) • David Levine “Template for evaluation design.” bCourses. • Scan Paul J. Gertler, Sebastian Martinez, Patrick Premand, Laura B. Rawlings and Christel M.J.Vermeersch, <i>Impact Evaluation in Practice</i>, pages 1-79. <ul style="list-style-type: none"> ○ https://openknowledge.worldbank.org/bitstream/handle/10986/2550/599980/PUB0ID181BLIC1009780821385418.pdf?sequence=1 <p>Optional Readings:</p> <ul style="list-style-type: none"> • Edward Miguel, Michael Kremer. “Identifying Impacts on Education and Health in the Presence of Treatment Externalities,” <i>Econometrica</i> 2004 vol. 72(1), pp 159 - 217.
24 W 11/18 I-Lab	<p>Unit 13: Rigorous Evaluation Studio</p> <p>After a brief lecture to follow up with the topic of rigorous evaluation, you will have time to work with your team on evaluation in the I-Lab.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Read Gertler, et al., <i>Impact Evaluation in Practice</i>, “When Can Randomized Assignment Be Used?” (pp. 55-56) and “Two Variations on Randomized Assignment” (pp. 64-79). <ul style="list-style-type: none"> ○ https://openknowledge.worldbank.org/bitstream/handle/10986/2550/599980/PUB0ID181BLIC1009780821385418.pdf?sequence=1 <p>Class Exercise: Sketch an impact evaluation for your capstone project.</p>
HW 11 Due: 12/1	<p>Team Exercise: Design an impact evaluation for your capstone project. (You may choose another product with instructor approval.) If your capstone project is not sufficiently advanced to merit a rigorous impact evaluation, assume preliminary stages go well enough to justify a large-scale study.</p>
25 M 11/23 C110	<p>Cellscope Case Study</p> <p>Guest speaker: Dan Fletcher, Professor and Chair of Bioengineering</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • D’Amrosio, Michael V., Matthew Bakalar, et al., “Point –of-care quantification of blood-borne filarial parasites with a mobile phone microscope,” <i>7 (286) Science Translational Medicine</i>, May 6, 2015. (bCourses) • Cellscope case study. (bCourses)
26 W 11/25	Holiday
27 M 11/30	<p>Unit 13: Scaling & Understanding Impact at Scale</p> <p>A discussion of scaling and impact at scale. We will discuss the DIV final report and give the class</p>

C110	<p>time to work with their team in the I-Lab.</p> <p>Required Readings:</p> <ul style="list-style-type: none"> • Prahalad, C.K. and Hart, S.L. "The Fortune at the Bottom of the Pyramid." <i>Strategy+Business</i> 26: 54-67. • Polak, Paul, YouTube video: TEDxMileHigh-the Future Corporation https://www.youtube.com/watch?v=ezVxt7TkyeM <p>Optional Readings:</p> <ul style="list-style-type: none"> • Karnani, Aneel. "The Mirage of Marketing to the Bottom of the Pyramid." <i>California Management Review</i> 49.4 (2007): 90-111. <p>Class Exercise: Sketch an impact evaluation for your capstone project.</p>
HW 12 Due: 12/1	<p>Team Capstone: Turn in a completed draft USAID DIV letter of interest and presentation. Share both with another group for peer review.</p>
28 W 12/2 I-Lab	<p>Unit 14: Class Summary</p> <p>Summary of class. Provide pointers to recommended classes in the Development Engineering Designated Emphasis.</p>
HW 13 Due: 12/5	<p>Team Capstone: Share your peer review with the group whose project you reviewed and turn in your review on bCourses.</p>
29 W 12/9 I-Lab	<p>Capstone Group Exercise: Final presentations (in lieu of a final exam) based on your USAID DIV letter of interest. Special two-hour session during RRR week. 10:30 am -12:30 pm (10:00-10:30 am will be set-up time). You are welcome to use your foam core boards along with a slide presentation. Turn in your final USAID DIV letter of interest and presentation on bCourses before class.</p>