CE 499: SPECIAL TOPICS: INNOVATION IN ENGINEERING DESIGN FOR GLOBAL CHALLENGES I

Instructors	**Coordinator**
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Units: 3
Fall 2018
Thursdays, 8:00pm – 10:50pm, LOCATION TBD

1. COURSE DESCRIPTION

Today, there are numerous global crises that challenge the world and devastate populations, such as the refugee crisis with massive impact on higher education, economy, health and so on. Engineering innovation plays a critical role in solving many of the challenges brought about by these global crises. This course aims to teach engineering students how to lead the design of products, services and technologies with a human-centered approach to help solve the needs of the real people who are in the middle of these crises. The course is geared towards students who would like to create new solutions, are comfortable with focusing on wicked problems, and care about cultural, economic and geographic nuances. The course is built on the principles of "create, collaborate, innovate." The course provides students with an understanding of the design process, research methodologies and innovation strategies using a team-based project work through the process of observation, visualization, rapid prototyping and iteration.

This course has two parts: Part 1 (Fall semester) and Part 2 (Spring semester). Over the course of one year, 36 contributors (24 USC students in Los Angeles and 12 refugees in a host nation) will form a taskforce to seek at least four life-saving or life-improving innovations aimed at the most vulnerable and hardest-to-reach people impacted by the refugee crisis. These innovations will involve connection to the private sector and input from affected communities in order to provide, supply, or locally generate solutions such as: safe drinking water and sanitation, provision of energy, education, life-saving information, shelter or services to help refugees living in camps and in urban squats.

2. LEARNING OBJECTIVES

Instructors will teach the students the process of product innovation, prototyping, fabrication and building sustainable business models in the initial stages of the course, then continue to mentor and guide teams as they are working on their projects. In this course, students will learn:

- The process of product/service development
- Design thinking and systems thinking approaches to development
- Identifying and validating a product need and use case via user research
- Prototyping concepts for user research and validation
- Building a Minimum Viable Product (MVP)
- Designing for manufacturing
- Understanding the product life-cycle
- Developing a sustainable business model
- Learning how to effectively use global collaboration tools and techniques
- Fundraising/crowdsourcing to fund product development
- Sourcing and managing prototyping and manufacturing vendors
- Rapid prototyping techniques and methods
- Building bill of materials
- Product distribution

- Entrepreneurship in restricted environments/lack of resources

3. METHODS OF TEACHING

A combination of design feedback sessions, lectures, hands on software sessions, experiments with new technologies and discussions. Guest lecturers may also be brought in to provide specialized guidance on specific topics to one or all of the teams. Additional out of class time required for team-based project work, course assignments and reviewing relevant material. Teams are expected to meet and collaborate outside of class, both in person as well as virtually with their global team members. Each team will share their progress, prototypes, findings, and challenges with the entire class weekly, while instructors mentor the teams and help them solve the challenges they encounter at each stage of development. The rest of the class will also participate in helping teams define the need for their product and work through development challenges.

4. ATTENDANCE

Continuous attendance is critical for success in this class in order to ensure that teams continue making progress on the development of their products. Attendance is part of the evaluation criteria. If a student misses a class, it is his/her responsibility to ask at the next class what he/she missed or find out about topics covered.

5. CLASS PARTICIPATION

Participation in the class is part of the evaluation criteria. This is a highly interactive class. There is continuous interchange between the instructors, guest lecturers, students and refugees. Questions and participation in discussions are highly encouraged.

6. CLASS COMMUNICATION

As teams will involve contributors outside USC without access to USC resources, teams will make use of free-to-use, globally available collaboration software including: Skype, Slack, Google Docs, Trello, Google hangouts and WhatsApp.

7. COURSE COORDINATOR

Due to the special needs of this course, Mr. Daniel Druhora will act as the coordinator for this course. His role and responsibilities include handling administrative tasks, coordinating stakeholders, logistical planning for travel and communication. He could be reached at: druhora@usc.edu

8. OFFICE HOURS

Instructors' Office Hours: TBD. Instructors will also be available via email and course communication tools.

9. REQUIRED TRAVEL

This course will involve travel to overseas locations, which will be announced at the beginning of the semester. At least one of these trips will include a visit to a refugee camp (e.g., in Greece or Turkey).

10. TEAM STRUCTURE

The course will have 36 contributors (24 USC students in Los Angeles and 12 refugees in a host nation). 6 teams made up of 4 USC students and 2 refugees will be formed at the beginning of the semester.

11. ADDITIONAL RESOURCES

Due to the special nature of the course, several individuals/groups will also contribute to the class in addition to the instructors, course coordinator, students and refugees. These will include additional academic, industry/NGO advisors, as well as marketing and communication support. Student Clubs, such as Spark SC, Engineers Without Borders, will also provide support to the course.

12. RECOMMENDED READING

- Design of Everyday Things, Don Norman

- The Lean Startup, Eric Ries
- Engineering for sustainable human development: A guide to successful small-scale development projects, Bernard Amadei
- Ten Principles of Good Design, Dieter Rams
- Convivial Toolbox: Generative Research for the Front End of Design, Liz Sanders
- The Field Guide to Human-Centered Design, by IDEO.org, http://www.designkit.org//resources/1
- Designing for People, Henry Dreyfuss

13. ASSIGNMENTS

At the beginning of the course, teams will identify several project ideas out of a longer list developed by collaboration among students, refugees, instructors, refugee camp managers, NGOs and government organizations working directly with refugees. Teams will immediately begin researching/validating the need as well as brainstorming potential solutions. After further validation with their global team members, each team will down select to one idea to pursue. Teams are required to continue to get a deeper understanding of the problem and various potential solutions on a continuous basis. Each team will immerse themselves in the challenges of the refugee crisis and specific problem spaces, identify potential products, services or solutions that could meet a need, and begin to learn the product development process. They will also work with stakeholders to validate problems and user needs and begin prototyping solutions for testing and validation. Teams continue iterating and improving on their products, including sending prototype to their global team members for real-world testing and evaluation. Teams begin developing a plan for scaling product into a sustainable solution for refugees. Prototypes and scalability plans are refined and revealed at an international summit involving all team members and potential stakeholders.

It is crucial that students turn in whatever they have on the due date. NO assignment will be accepted late. Assignments are due the beginning of the class as specified in the class schedule below. An incomplete grade will only be issued when a student is unable to complete the work because of documented illness. A letter from your physician will be required documentation.

→ **It is important to note** that each team will have a "Design Journal" in which they document their validation and decision process at every step, focusing on their processes. This Journal will be submitted with reports, presentations, prototypes, etc. as outlined in the assignments descriptions below.

Part 1 Midterm Assignment: Each team will identify the opportunity/need for the product by carefully studying their users and their needs. Based on this understanding, the teams will identify 3 product ideas and prepare SWOT analysis for each one of them by researching existing products/solutions and doing a competitive benchmarking of their product ideas to existing products/solutions. Each team will submit a report and present their report in class.

Part 1 Final Assignment: At the end of Part 1, each team will define their product, prepare a validation spec sheet, built their prototypes and test them with real users/customers. At the end of the class, each team will submit a short report summarizing their journey and present their MVP.

14. GRADING SCHEMA

Class participation & discussion: 10%
Midterm and oral presentations: 40%
Project and oral presentations: 50%
TOTAL: 100%

15. GRADING CRITERIA

It is important to note that the grading will not be primarily based on the ultimate success of the project, but on the development process, ability to learn from failure and adjust, and ability to work as a team both locally and with the global counterparts. Successful project teams will include both individuals who

understand the unique context of the refugee crisis in a given nation, and those who are capable of developing, testing, refining and transitioning to scale their innovation to produce transformative impact. Projects are expected to take an integrated innovation approach, defined as the coordinated application of scientific/technological, social and business innovation, to develop solutions to complex challenges. This approach does not discount the singular benefits of each of these innovations alone but highlights the powerful synergies that can be realized by aligning all three.

16. CLASS STRUCTURE & SCHEDULE:
* Class sequence, dates topics and guest speakers are subject to change.

PART 1: FALL SEMESTER			
#	Date	Topics	TO DO List
1	8/23	**COURSE INTRODUCTION** Refugee Crisis Overview Team introductions	
2	8/30	**IDENTIFY THE OPPORTUNITY/ FINDING THE NEED** Immersion – understanding & empathizing with the user Learning customer routines, challenges, pain points Identify the specific problem or need Guest Lecture: "Innovating for and with the Developing World" Prof. Bernard Amadei, NAE member and founder of Engineers Without Borders.	
3	9/6	Validating the need/Onsite User Research (TRAVEL - CAMP VISIT)	
4	9/13	Validating the need/Onsite User Research (TRAVEL - CAMP VISIT)	User Personas - ensure the team understands who they are designing for
5	9/20	**USER ARCHETYPES / USER JOURNEY** Understand the use case/define the user journey (how will the product be used) User Archetypes - Who is the user? Who isn't' the user? - What is their age? Gender? Where do they live? - What are the resources available to them? - Why do they need this product? - How will they discover it? - Where will they get one? - How will they use it? - How many potential customers are there?	User Journey - ensure the team understands the need and the context around it

		Guest Lecture: "Logistics and Philanthropy in War Zones and the Lost Art of Bootstrapping" by Phil and Tamar Koosed, founders of BAMKO and Save The Syrian Children.	
6	9/27	**DEFINE THE USER JOURNEY** Understanding the user goals and steps - What is hard for the user? Why? Intuitive design Instructions Product Issues/Maintenance - How could a user misuse the product? End of Life/Repair	Brainstorming overview of all ideas/solutions
7	10/4	**IDEATION** Product Brainstorming Evaluate all ideas Down selection Guest Lecture: "The New Communication" with Annenberg Prof. Gary Wexler, author of the Boomer Rebellion and founder of The Red Table.	2X2 Matrix of brainstorm ideas and how they were evaluated
8	10/11	**BENCHMARKING/RESEARCH** Competitive benchmarking Research existing products/solutions SWOT analysis of product	*Midterm due:* Benchmarking report (existing/competing products & current solutions addressing the need/opportunity) SWOT analysis of final 3 product ideas
9	10/18	**IDEA VALIDATION** - How can we prove the need is real? - Why is this solution better than existing solutions?	
10	10/25	**DEFINE THE PRODUCT** List all essential features (Required but not high value) List differentiating features (1-3 key features) List all extra features (throw these away)	Prototype validation spec sheet (what the purpose of the prototype is, what will be evaluated, how it will be evaluated, how the prototype should be used, what the findings were, what recommended next steps/next iteration are)
11	11/1	**DESIGN-PROTOTYPE-TEST-REFINE LOOP** Guest Lecture: "Human Centered Design" with Shri Narayanan Director, Ming Hsieh Institute (MHI); Research Director, Information Sciences Institute, (ISI).	1st Prototype build
12	11/8	**PROTOTYPING/DESIGN ITERATION** Building a prototype: define what you are building	MVP planning document: (what are the required/non-differentiating features, what are the key differentiating

			features, what are all other features (to be discarded for now))
13	11/15	Building a prototype: define what you are building - What is the specific purpose? - What are you testing/investigating/validating? - How long will it last? Guest Lecture: Dyane Epstein, Chief of Mission, Somalia, International Organization for Migration IOM "The Internally Displaced, Challenges in Human Integration."	
14	11/22	THANKSGIVING BREAK	
15	11/29	Project presentations/assessments	
	*	**BUILD MVP** (first prototype to test with real users/customers)	*_Final_ is due on the schedule date of the final exam*

17. ACADEMIC RESPONSIBILITIES

Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. Your letter must be specific as to the nature of any accommodations granted. DSP is located in STU 301 and is open 8:30 am to 5:30 pm, Monday through Friday. The telephone number for DSP is (213) 740-0776.

Academic Integrity

The University, as an instrument of learning, is predicated on the existence of an environment of integrity. As members of the academic community, faculty, students, and administrative officials share the responsibility for maintaining this environment. Faculties have the primary responsibility for establishing and maintaining an atmosphere and attitude of academic integrity such that the enterprise may flourish in an open and honest way. Students share this responsibility for maintaining standards of academic performance and classroom behavior conducive to the learning process. Administrative officials are responsible for the establishment and maintenance of procedures to support and enforce those academic standards. Thus, the entire University community bears the responsibility for maintaining an environment of integrity and for taking appropriate action to sanction individuals involved in any violation. When there is a clear indication that such individuals are unwilling or unable to support these standards, they should not be allowed to remain in the University." (Faculty Handbook, 1994:20)

Academic dishonesty includes: (Faculty Handbook, 1994: 21-22)
1. **Examination behavior** – any use of external assistance during an examination shall be considered academically dishonest unless expressly permitted by the teacher.
2. **Fabrication** – any intentional falsification or invention of data or citation in an academic exercise will be considered a violation of academic integrity.
3. **Plagiarism** – the appropriation and subsequent passing off of another's ideas or words as one's own. If the words or ideas of another are used, acknowledgment of the original source must be

made through recognized referencing practices.

4. **Other Types of Academic Dishonesty** – submitting a paper written by or obtained from another, using a paper or essay in more than one class without the teacher's express permission, obtaining a copy of an examination in advance without the knowledge and consent of the teacher, changing academic records outside of normal procedures and/or petitions, using another person to complete homework assignments or take-home exams without the knowledge or consent of the teacher.

The use of unauthorized material, communication with fellow students for course assignments, or during a mid-term examination, attempting to benefit from work of another student, past or present and similar behavior that defeats the intent of an assignment or mid-term examination, is unacceptable to the University. It is often difficult to distinguish between a culpable act and inadvertent behavior resulting from the nervous tensions accompanying examinations. Where a clear violation has occurred, however, the instructor may disqualify the student's work as unacceptable and assign a failing mark on the paper.

Return of Course Assignments

Returned paperwork, unclaimed by a student, will be discarded after a year and hence, will not be available should a grade appeal be pursued following receipt of his/her grade.