COURSE SYLLABUS

ISE545: Technology Development and Implementation

(a.k.a.: Open Technological Innovation in Competitive Global Market)

Fall Semester, 2014

Ang Liu, Ph.D.
Visiting Assistant Professor;
Aerospace and Mechanical Engineering Department
Manager, the Viterbi iPodia (ViP) Program Office
Office: Denney Research Center (DRB) 260
Phone: 213-740-8429; Email: angliu@usc.edu

Course Sections: 31545D (on-campus) 31745D (off-campus)

Course Unit: 3 Units

Prerequisite: A graduate student standing in engineering is required (or with a special approval by the instructor). *This is a degree required course for MSPDE (Master of Science in Product Development Engineering)*

Class Hours: Mondays, 6:40pm to 9:20pm

- 6:40pm to 7:50pm (70 minutes) – session I
- 7:50pm to 8:10pm (20 minutes) – session break (**optional**)
- 8:10pm to 9:20pm (70 minutes) – session II

Class Location: USC Olin Hall of Engineering (OHE) 100-D

Office Hours: 5:00pm to 6:00pm, on Mondays

- Face-to-face meetings held in DRB-260
- Phone meetings via 213-740-8429
- Skype VoIP (Skype Username: angliu_oc)

Teaching Assistant: Jing Zhang
Email: zhan947@usc.edu; Tel: TBD
Office Hours: TBD; Location: TBD

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1. The Background:

Technology has been the key driver of world economy over the past few decades. Much of the recent economic growths (and bubbles) are the direct results of successes (and failures) of new technological products, services, and systems developed by engineers in the laboratory and implemented by entrepreneurs on the market. In today's technology-based society and highly globalized economy, understanding the technological innovation process from laboratory developments to market implementations under open environments and global competitions has become a key challenge for the entire engineering profession.

While the mother of inventions is the curiosity of few individuals, the mother of innovations is the demand of many customers. A well-developed technology that performs high functions in the laboratory without a successful implementation to satisfy some human purposes on the market cannot result in good economic returns to sustain further developments. Hence, the subject of "technology development and implementation" must be studied with an integrated approach that focuses on the dynamic interplays between technology development and market competition. This integrated approach to technological innovation is inherently interdisciplinary between the conventional engineering and business curriculum. Traditionally, engineering students study the innovation process from a pure technical (or development) viewpoint, whereas business students learn the social (or implementation) side of the innovation process. Such a divided and separated “development-vs.-implementation” approach makes it difficult for students to gain a comprehensive understanding of the complete technological innovation process from laboratory development to market implementation that is so important to their professional careers.

The learning objective of ISE545, Technology Development and Implementation, is to overcome the above deficiency by providing a complete, holistic, interdisciplinary, and integrated view of the open technological innovation process in a competitive global market. The course blends both market and engineering perspectives to understand open technological innovation under global market competitions. It explains the key concepts of open innovations that utilize technical means to develop new products and services to compete on the global market. ISE545 students will learn how to (1) understand the industrial dynamics of technological innovation, (2) formulate technological innovation strategies for companies, and (3) develop breakthrough innovative technological products and services. Through lecture assignments, classroom discussions, case studies, and team debates, students will develop a deep understanding of the realities of industrial practice, and the complex roles played by members of a technological innovation team. In addition to academic theories, the course also provides practical methods and real-world cases that can be put into direct uses for various technological innovation endeavors from laboratory to market.

2. The Pedagogy:

In ISE545, students are expected to learn the key concepts related to open technological innovation in a competitive global market, and apply these concepts to real-world innovation cases of their interests. To achieve this learning objective, students must understand both the "contents" and the "contexts" of various technological innovation "concepts". Unlike content knowledge, which can be taught by the teacher via classroom lectures, useful contextual understanding can only be acquired by students themselves through active engagements and participations in various interactive activities with their peers supervised by the teacher.

In traditional learning, students are first lectured by the teacher in classrooms at school (i.e., the schoolwork) to learn the content knowledge of a course subject. Afterwards, they are asked to complete various assignments alone (or with peers) at home (or in the library) by themselves (i.e., the homework) to develop contextual understandings of these content knowledge they received in lectures. This traditional pedagogy of "*listening lectures as schoolwork and then doing exercises as homework" is called the "passive learning*", which is proved to be very ineffective in terms of enhancing students' ability to understand and apply the concepts. Researchers have found out that, in general, students capture no more than 20% to 40 % of a lecture's main ideas; and they can only remember less than 10% of the contents after 3 weeks without reviewing the lecture materials (if notes were ever taken). Homework exercises, which are very important for developing contextual understanding of the content knowledge, are often done by students in an ad-hoc manner in isolation without much interaction with peers or any guidance by the teacher. This old learning paradigm is now being seriously threatened by the recent movements of MOOC (Massively Open Online Courseware) that is made available by leading institutions to everyone in the world free of charge. Facing this destructive MOOC innovation of higher education, universities that still hold on classroom lectures as the main value proposition of campus education will soon see the end of their existence. Fundamental changes on how students learn effectively in the classroom on campus and how universities overturn their downward value proposition are urgently needed.

In the fall semester of 2014, ISE545 will adapt a major pedagogical shift in which the old "*lectures as schoolwork first exercises as homework next*" model will be "inverted" to become the new "*lectures as homework first exercises as schoolwork next*" model. Specifically, before the weekly in-class session begins, the teacher will post his lecture materials online, and students are required to study these materials upfront, provide their feedback in terms of how painful they perceive over the subject content, and/or perform some assigned tasks at home by themselves (i.e., the new homework). These homework activities should give students an initial impression of the subject contents and, at the same time, provide the teacher with early inputs on the focuses of in-class lecturing. By doing so, the inverted learning enables teachers to focus on what students "want to" learn based on the pre-class feedback of study materials that define what students "need to" learn. This gives teachers the ability to focus in-class time on activities that meet students' real learning needs, motivating them to be more engaged in the whole learning process.

This new inverted approach subscribes to the "active learning" model, in which students are motivated to actively prepare themselves at home first and then purposefully engage in various learning activities in classroom to master both the contents and contexts of the key subject concepts. By doing so, students are offered the privilege, at least in certain degree, to customize the lectures which used to be completely dictated by the instructor. Every ISE545 student in fall 2014 must fully understand and follow this major pedagogical change to benefit from this new pedagogy. They are required to carefully complete the homework assignments before coming to the in-class sessions, actively participate in the learning activities in the classroom weekly, and closely collaborate with their teammates at all time.

3. <u>The Subject</u>:

The subject of "open technological innovation in competitive global market", which students will learn in ISE545 in fall 2014, consists of the following ten key questions:

1. What is innovation, how it differs from invention, and what are the characteristics and different types of technological innovation?
2. How do market globalization and information technology impact on open technological innovation?
3. How do innovation and competition interact with each other on an open competitive global market (the S-curves)?
4. What is "crossing the chasm" during the innovation process (standard battle and dominant design of a new technology)?
5. How does market competition lead to technology/product commoditization on the market (outsourcing and off-shoring)?
6. What is the Segment-Zero Principle, and how does it impact on open technology innovation and global market competition?
7. Why does a particular product feature excite customers on the market (the Kano Customer Satisfaction model)?
8. What is the systematic framework for developing breakthrough innovative technologies and products (Innovative Design Thinking framework)?

These key concepts will be explained systematically throughout the semester according to the planned weekly schedule (see the Course Schedule below). Students will learn these concepts in organized weekly "learning module". A learning module starts with a set of slides on subject contents with key questions and relevant exercises, which will be posted online at least 24 hours before the class time for students to study at home (as homework). It is required that all students complete these homework and provide feedbacks of their studies before the class begins. The instructor will begin the in-class session with reflexive overviews and explanations of some key concepts based on students' inputs each week. Then, under the supervision of the instructor, students will engage in various learning activities in order to develop necessary contextual understandings of these key concepts. Each learning module will be concluded with a list of take-away and reflections.

4. Office Hours:

Standard office hours are from 5:00pm to 6:00pm, on every Monday. On-campus students can come to DRB-260 for face-to-face meetings. Group meetings, using Skype for example, with the Instructor during office hours are also possible in the same manner. As well, students are encouraged to meet with TA during the TA office hours.

5. Reading Materials:

There is no required textbook for this course, and some recommended reference books include:

- "*Strategic Management of Technological Innovation*", by Melissa A Schilling, the McGraw-Hill Irwin Company
- "*Strategic Management of Technology and Innovation*", (3rd edition), by Robert A. Burgelman, Modesto A. Maidique, and Steven C. Wheelwright, the McGraw-Hill Irwin Company.
- "*Product Design and Development*" (3rd edition), by Karl Ulrich and Steven Eppinger, the McGraw-Hill Irwin Company.
- "*Product Ideas to Product Success*", Matthew Yubas, Broadword Publishing, Inc.
- "*The Mechanical Design Process*" (3rd edition), David G. Ullman, the McGraw-Hill Companies, Inc.
- "*Axiomatic Design – Advances and Applications*", Nam Pyo Suh, the Oxford University Press.
- "*Product Design – Techniques in Reverse Engineering and New Product Development*", by Kevin Otto and Kristin Wood, Prentice Hall
- "*Creating Breakthrough Products – Innovation from Product Planning to Program Approval*", by Jonathan Cagan and Craig M. Voget, Prentice Hall
- "*Jack Welch and the GE Way*", by Robert Slater, McGraw-Hill Company.
- "*Execution – the Discipline of Getting Things Done*", by Larry Bossidy and Ram Charam, the Crown Business Books.

The instructor may recommend additional reading materials and website reference resources during the semester whenever appropriate.

6. Course Website:

Students' learning of this course is supported by a specially designed course website on the DEN Blackboard instruction system (http://www.uscden.net). All registered students have access to this website (ISE545_20143). The website structure is implemented to support the specific organization of the course instruction as described in this syllabus. Students should browse the entire site to familiarize themselves with the various areas and functions.

- Announcement -- important announcements of this course (check it frequently)
- Course Information -- syllabus; information about instructor; how to use this website
- Before-class Assignment -- pre-recorded videos, PowerPoint slides (your homework)
- In-class Webcasting -- video files of weekly in-class sessions
- Case Study -- all information about your two case studies
- Team Debate -- all information about your team debate projects
- Additional Reading -- interesting articles that are related to the course subjects
- Resource Link -- external links to websites that have relevant information to the course
- Communication -- all communication tools, including emails and roster
- Discussion Board -- share your thoughts before and after the class with your classmates
- Tools -- Digital Dropbox and other useful functions to manage your course work

7. Team Formation:

Collaborative learning within a small cohort is most effective for those courses in which "what you learn depends on with whom you learn". Because the case study and debate project are team-based in ISE545, the whole class will be assembled into six-eight teams, each with no more than 5 students of their own choices. Ideally, all teams should compose of members with different academic backgrounds and professional experiences. Coordinated by the TA, students are expected to organize their team membership for approval by Monday, September 16, 2014. Changes of team membership made after this date will only be granted on very special situations. To broaden the perspectives, off-campus and on-campus students are encouraged to team up to collaborate on case study and debate tasks. Teams are encouraged to use the DEN system for team meetings. Each team will be assigned a separate virtual meeting room, which only its members (and TA and Instructor) have access. Members can have interactive audio/video supports when conducting virtual meetings at times of their own choice.

8. Course Grading:

Students will be graded according to the following scheme:

- **20% -- individual participation in active learning activities**
  - (10%) on time completion of before-class assignments
  - (10%) contributions to Discussion Board before and after the class
- **20% -- team case study presentations and reports**
  - (10%) the first case study team presentation and report
  - (10%) the second case study team presentation and report
- **30% -- team debate projects and the final reports**
  - (10%) the first team debate performance
  - (10%) the second team debate performance
  - (10%) the team debate project final report
- **10% -- Individual midterm examination**

- **20% -- Individual final examination**

Note that, a total of 50% of students' final grades (i.e., 20% for case study and 30% for debate project) is based on performance of their teamwork. All work done by the team is first given a "team grade". This team grade is then weighted for each member based on a confidential self-evaluation by all teammates at the end of the semester. Each student will be asked to fill out a questionnaire, which evaluates every team member (including him/herself) for the percentage contribution to the teamwork in different categories. The evaluations are averaged in order to find each student's contribution and the weighting factor is made proportional to the average. For example, if you have 3 students on your team and each makes the same (33%) contribution, then all will get the same grade as the team grade. However, if one of your team members makes a 40% contribution, one a 25% contribution, and the third 35% contribution, then the individual grades will be corrected by the difference from 33%. Thus, for example, if the team grade on your case study presentation is 85%, then the first student would get 92% (85 + (40-33)), the second would get 77% (85 + (25-33), and the third 87% (85 + (35-33)).

Each of the above learning components is described in more details below.

9. <u>Learning Components</u>:

- **Inverted/Active Learning by Individuals (20%)**
    - (10%) Completion of homework assignments <u>before</u> the class begins each week
        - At least 24 hours before the class begins each week, a set of slides, explaining key concepts with assigned questions and tasks, will be posted on the "Beforeclass Assignment" session on the ISE545 course website. Before coming to the class, students are required to study these materials, answer the questions, complete assigned tasks, and then send in their study results in order to earn this 10% of the grade.
    - (10%) Contributions to the Discussion Board <u>before and after</u> the class
        - A "thread" will be created each week in the Discussion Board session on the ISE545 course website. Students are expected to contribute to this discussion thread before and after the class by sharing their thoughts related to the weekly learning modules. Purposeful postings and meaningful additional information that stimulate other's participations are highly encouraged and rewarded for this 10% of the grade.

- **Case Study by Teams (20%)**

Case study is a very important means of learning for inter-disciplinary subjects, such as technology development and implementation, whose knowledge links directly to industrial cases and practices. Successful industrial cases can reveal important knowledge about the appropriate process and

methodology of technological innovation and product development; while well-documented business failures from the past can also help to improve the strategies and practices in the future. Two (2) case studies will be assigned to the class for a total of 20% of the grade. Student teams are asked to study the case, prepare a written report and make an oral presentation to summarize their analysis/diagnosis and, if appropriate, to propose a recommended plan of action. If possible, teams are encouraged to employ those theories and models discussed in the class to support their case study reports and presentations.

The team case study report should be **up to 10 pages** in length, 12 pt, type, typewritten, double-spaced, with maximum 1" margins. These reports should be organized with:

- a short introduction
- your diagnosis/analysis of the case
- the recommended action plan (if appropriate), and
- the conclusion

All case study reports are due *at the beginning of the class* – one week BEFORE the case is scheduled to be presented and discussed in the class. These reports should be submitted as a WORD file via the ISE545 course website. No credit will be given for late submissions. Each team will be given a 10-minute slot (see the Course Schedule below) for presenting their case study findings and recommendations. Each case study report and presentation counts 10% of the grade for the team.

- **Team Debate by Teams (30%)**

There are no black-and-white or yes-and-no answers to the questions addressed in this course. The best way to learn the subject of open technological innovation in competitive global market is to engage in team debates of real-world cases. A set of debate subjects related to innovations in various industries will be announced on September 08, 2014. Each team will choose a specific subject and debate position by September 15, 2014. All teams will prepare and engage in two (2) live-debate sessions, and then develop a comprehensive report by the semester end. The TA will coordinate will all debate teams and lead the live debate sessions. The instructor and TA will assist teams to formulate their project scopes and define their debate positions during all stages.

Live Debates: Debate teams will prepare for two live debates scheduled on October 13 and December 1, 2014. The performance of each live debate counts as 10% of the grade. The goal is to convince the *judges* (i.e., the instructor, the TA, and the rest of the class) of their positions and views by providing supporting evidences with logical analyses and convincing arguments. Meanwhile, teams can challenge the opponent team's positions by pointing out flaws in their arguments and reasoning. Specific debate procedures will be announced one week in advance. Each debate team should arrange for ALL its members to take on some representing/responding roles during the debate presentations.

The rest of the class (i.e., all students except for those who are part of the two opposing teams of a topic) will act as the "judges" of these debates sessions, whose scores will contribute partly to the

grading of each team. For all debate teams, an electronic copy of their presentation materials in PowerPoint file format, and other optional supporting materials, are due one week after the live debates.

Debate Final Report: Final team debate reports are due right before the final exam time. These final reports, which count as 10% of the grade, should summarize all findings and recommendations of the debate team throughout the semester. The reports should be prepared professionally with supporting facts. The reports are to be **up to 30 pages** in length (excluding the appendix), double-spaced, 12 pt., typewritten. Paper length is strictly enforced. Your debate project final reports are graded based on: (1) creativity/innovativeness, (2) professionalism of presentation and writing, (3) depth of literature, methodology, analysis, (4) quality of recommendations, and (5) likelihood of and steps for implementation.

- **Midterm (10%) and Final Examinations by individuals (20%)**

The ISE545 midterm exam is scheduled from 6:40pm to 8:40pm on Monday, October 27, 2014, and the final exam is scheduled from 6:40pm to 8:40pm on Monday, December 15, 2014. Both exams are **closed book** and limited to the materials that have been discussed in the class, case studies, and/or debate projects. Questions are open-ended, but are made brief and point specific as much as possible. They often require only short answers that show your comprehension of the concepts, definitions, approaches, and tools covered.

Make-up exams will only be offered, when there is absolute proven need for the students. Should you have to miss your exams, an individual oral exam will be scheduled with the instructor. No written make-up exams will be available. Final grades are due within 72 hours after the prescheduled "official" final exam date. Therefore, students must contact the instructor personally, ahead of time, to make arrangements to complete their make-up exams ahead of this prescheduled "official" final exam date.

10. Course Schedule:

A tentative course schedule, which includes weekly learning subject and activities, is as follow. The Instructor reserves the right to change this schedule during the semester to better fit students' learning needs and progresses.

Week	Date	Learning Activity and Subject	Case Study and Debate
1	08/25	Course Introduction and Subject Overview	Case study 1 handout
2	09/01	Labor Day (University Holiday)	Teams assembly completed
3	09/08	Characteristics of open technological innovation in competitive global market: the big picture	Debate subjects announced;
4	09/15	The dynamic interaction between technological innovation and market competition: the S-curves	Team debate subject chosen

5	09/22	Case Study 1 Presentation and Discussion	
6	09/29	Standard battles to shape the dominant design of a new technology: cross-the-chasm & timing of entry	Case study 1 team report due
7	10/06	Company’s competitive strategies in different market segments: the Segment-Zero Principle	
8	10/13	Team 1 Debate Exercise	Case study 2 handout
9	10/20	Modularization and commoditization of technology on a competitive market: out-sourcing and off-shoring	Team Debate 1 slides due
10	10/27	Midterm Examination (6:40pm to 8:40pm)	
11	11/03	Blue-ocean strategy to innovate new breakthrough products: the Kano Customer Satisfaction model	
12	11/10	Case Study 2 Presentation and Discussion	
13	11/17	A systematic framework for breakthrough innovation: Innovative Design Thinking)	Case study 2 team report due
14	11/24	Functional Design: how to choosing good innovation targets rationally	
15	12/01	Team 2 Debate Exercise	
16	12/08	University Study Day (no class)	Team Debate 1 slides due
17	12/15	Final Examination (6:40pm to 8:40pm)	Team Debate final report due

Academic Integrity:

"The Viterbi School of Engineering adheres to the University's policies and procedures governing academic integrity as described in SCampus. Students are expected to be aware of and to observe the academic integrity standards described in SCampus, and to expect those standards to be enforced in this course."

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 (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. The phone number for DSP is (213)740-0776.