**Syllabus ISE :**

**Management of Technological Innovation**

**Fall 2016 Tuesday, Thursday 2:00 – 3:20 PM**

**Instructor: Kenneth Pickar**

**TA: TBD**

**Office TBD**

**Email TBD**

**Office hours TBD**

**Course Description: How are rapidly evolving technologies harnessed to produce useful products?**

Can one predict which area of research will take off and which will languish- or worse? Designed for students considering working in technically based companies (any size including start-up), or consulting. It can be useful as well for those intending a research-based career as it can address the question of whether a candidate research topic is worth the required personal commitment.

**Objective: The course will enable the student**

1. To develop skills for critical technology judgment. This includes networking to connect with key technology figures.

2. To apply learnings even in situations where you are not technologically adept at the candidate technology.

3. To further develop team skills as the team processes in the class emulate how technology is actually developed in organizations today

4. To deliver, well-organized, clearly and convincingly transmitted presentations and papers.

5. To hear distinguished guest speakers from various industries and academia share their analysis methodologies and experiences.

**Term projects,**

**1. Students, working in small teams (3-4) will study a technology of their choice.** Based on primary and secondary research, they will describe how it will evolve in the next ~ five years.

**Do *either* A or B**

**A. Write a Technology Assessment and projection*.***

* Choose a Technology
* Show the history of development of this technology with key breakthroughs indicated
* Show the characteristics of how this technology was advanced (industrial breakthroughs, product demands, university research, military spin-off, etc.)
* Show where the capability of the technology is heading (1-5 year projection). Justify your assumptions and conclusions.
* Does the “physics work”
* Who will develop (and how will this technology be fully exploited) through the time period in question, i.e. what are the drivers? Hint: look at what's in the laboratory or conceptual stage now. *Most importantly, look also carefully at market forces. Is there really a discernible demand from potential customers?* There are great technologies, producing seemingly cool products, which no one wants to buy. Furthermore, early adopter acceptance does not guarantee popular success.
* Apply critical reasoning; distinguish hype from reality. This is key! Don’t fall into the common pitfall of accepting unsupported (and often hyperbolic) assertions. These exaggerations can take the form of over-optimism in assessing the readiness of the technology for exploitation or in misjudging the market acceptance of products deriving from this technology. Scientists and engineers can enthusiastic promote technologies like pitchmen promote products on late-night TV. Don’t fall for it! Be critical. As for the Technology itself, you can get as deep into it as you want but I am looking for an analysis not a technical paper.
* Use two or more of the following techniques
1. S-curve analysis
2. Delphi (consulting “wise people”)
3. Trend extrapolation
4. Scenario development
5. Reasoning from analogy (the experience of similar technology innovations in similar markets)
6. Comparing with technology development models and norms.
7. Your own techniques
* Although much of this can be found on the Internet, a Google paper is not what we are looking for. You must interview people including industry insiders, analysts, reporters, consultants, professors, researchers, etc. From this data, show the strengths and weaknesses in your choice of methodologies. Market Research reports from Consultancies can be helpful.
* Show all references including on line references.
* Your own ingenuity.

**Or, Alternatively,**

**2. Perform a Technology Strategy Analysis of a Company.**

A “Consulting” project (student-chosen company) to understand and critique a strategy for market appropriateness, risk, alignment with core competencies, and clarity of communication. This will include extensive interviewing, analysis, and critiquing. Students will be marked on the quality of their analysis and the recommendations they make.

* Choose a firm. The firm can be large or small, or a business within a larger firm. This will generally require the permission of the firm if you want to do internal interviews. Caltech alumni could be helpful on this. It is your responsibility to find the firm.
* Develop a conceptual framework to perform an audit. You will get a lot of information on approaches from the cases studied in class but you might want to figure out your own methodologies. You want to examine what aspects of the firm’s capabilities and culture augment or discourage innovative development. A good approach is to begin with 2-3 hypotheses and prove or disprove them through your research.
* Do your homework! Use the framework you have developed to gather data. You may use public information, personal interviews, and internal documents. Look particularly for inconsistencies, unrealistic expectations, neglect of key success factors, poor execution, etc. A common shortfall is lack of critical consideration of market acceptability.
* Analyze the data
* Make recommendations on how the firm's capabilities can be improved.
* Write a Final Report. Prepare a presentation. You may get invited to present to the Firm you review as well.

Note: If you have some thoughts of becoming a management consultant, this project could give you a valuable apprenticeship.

* Cf. Burgleman, Christensen, Wheelwright pp. 7-12

Other appropriate reference plus your own ingenuity.

**Pre-requisites**

**General Engineering background**

**Materials**

**Lectures, Cases and Readings will be distributed. We will use Blackboard and HBS Publishing to distribute class materials.**

**HBS materials will be available at (To be activated)**

**Grading**

**Cases 20%**

Although there will be expository lecture material and reading assignments, learning will occur through your reading, analyzing and discussing cases. These cases are real (or real-like!) examples from companies, which present problems for the students to solve. There are no "correct" or "incorrect" answers. There are, however, answers, which are well thought-through or are superficially or illogically argued. One Team will present the case but *all other members of the class who are not presenting are also required to read the case or assignment, answer the questions and be prepared to comment on the ideas presented.*

Whether you present or not, your grade ("HW") will be based on your written analysis submitted to me.

**Class Participation 15%**

Students participate in discussions, with appropriate contributions and critiques. ***Note:*** ***Contradictions, Controversy, Contention makes it challenging and fun!***

**Team Participation 15%**

Teams will assess all members of their Team four times during the quarter and submit results including plans for improvement as needed. If there are irreconcilable issues, please notify the TA and changes of Teams can be made.

**Midterm Paper and Presentation 10% Due October 13**

Team Mark based on getting great interviews, quality of analysis and soundness of conclusions

**Final Team Paper and Presentation 40% Due December 2**

Team Mark based on getting great interviews, quality of analysis and soundness of conclusions

All Assignments are due prior to class at noon

**Discussion Session**

TA-led? Meeting times

**Attendance**

Everyone attends each class, *showing up on time*. If you have to unavoidably miss a class, we would like an e-mail or telephone message in advance before noon informing us of the fact.

**Quality Expectation**

When you are scheduled for a presentation, make sure it is rehearsed and flows smoothly and kept to the time limit assigned (typically 10 minutes)

**The Course Uses a Mixture of Instructor-based and Visiting Lectures**

The concept is to apply personal experiences from a variety of people in different industries to grapple with new technologies. The main themes are bound together by the Instructor. The journey to a solution is an important part of the learning process. The Classroom is expected to be lively as we all grapple with difficult challenges that seldom have a “neat” solution.

**Blackboard communication**

All HW submissions and Course communications and announcements will take place through Blackboard (blackboard.usc.edu). All emails will go through Blackboard; therefore, it's imperative that you have a fully operational Blackboard account with a current and correct email address posted. You are responsible for regularly checking Blackboard for announcements and new materials as well as to deliver your assignments. Emails rejected because your account is full will not be re-sent.

*Again, All HW assignments must be sent in by noon the day due.*

**Technology use**

Laptops and cell phones are not allowed in class unless explicitly needed (for instance, as a reference for a case activity). There is no point in attending a participation-intensive class if you are focused on another activity. It is also rude to the Lecturer.

**Flexibility in course plan**

We will do our best to adhere to the schedule but are sometimes forced to adjust the course plan to accommodate unforeseen events. My experience is that no Course progression is completely predictable. We will give you maximum possible warning and current information will be posted on Blackboard.

In addition, we could modify the plan if necessary to accommodate student desires and backgrounds. Special projects are encouraged, upon approval. If you come up with something that would be interesting to the Class, you are invited to share it with a brief (5-minute presentation. This would be a candidate for extra-credit.

**Teams**

**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 your instructor (or the course Teaching Assistant) as early in the semester as possible. DSP is located in STU 301 and is open 8:30am to 5:00pm, Monday through Friday. The phone number for DSP is (213) 740-0776.

**Final**

The Final paper and presentation is due Dec 2 at noon

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| **Class****Date** | **Topics** | **Homework/****Assignment** |
| Lect 18/23 | Introduction of Class and Instructor, Class expectations. Term assignment discussion | Think who you would like to be on your Team |
| Lect 2 8/25 | Introduction of possible projects. Business Ecosystems. Change Drivers | Submit list of 5 technology ideas you are curious about (or are working on) |
| Lect 38/30 | How does a great-functioning Team work?Team Formation and Team Exercise. Mission Statement. | From list of possible Projects, list your first three choices |
| Lect 49/1  | Assignment of Teams and ProjectsWe will discuss candidate ideas and post them on wall. Each student will write name on three ideas. If you would like to be on a Team with friends list names together. After Class, TA and Instructor will list Teams and Projects, working to optimize list you signed. These are the Teams | Research the projects and decide your top 3 in order of priority. Decide on candidate Teammates |
| Lect 59/6 | Creation of Hypotheses. Project LaunchBased upon your beginning knowledge of the technology, what “truth” assumptions would you like to prove/disprove. These hypotheses will live or die depending upon your research. In either case you will move to new hypotheses as the term progresses. This methodology focuses your research. |  |
| Lect 69/8 | Visiting Lecture Rudy Roy HST TechnologiesSolar Energy How will this technology evolve? What is the effect on the electrical system in general? What storage technologies are complementary? | Submit TEAM REVIEW Assignment 1To review the contributions of team members |
| Lect 79/10 | Technology AdoptionProduct Life cycle- Technologies as well as products have natural life spans. How predictable is this process? Where is the “sweet spot” for a transition? What are examples of technologies whose life is limited? |  |
| Lect 89/15 | Case 1 Clair McCloud Can a non-technical manager manage highly technical projects? Does such a person exist and, if so, what would you look for in such a person? | 1. What issues should Claire be considering in her decision to accept or decline the General Manager’s position?2. What are the possible consequences to Claire of saying no? What are the possible consequences of saying yes?3. What does Claire need to know about the technology to do her job effectively?4. What are OWS’s strengths and weaknesses?5. What are Claire’s strengths and weaknesses?6. What are the most immediate long and short-term issues Claire should address?7. Should Claire take the job? |
| Lect 99/20 | Disruptive Technologies LectureHow does a technology that is initially inferior in capabilities end up destroying an existing technology?Breakout session, “Are we missing Something” Why was the effect of fracking” on the energy industry not seen? | Bower and Christensen,“Disruptive Technologies – Catching the Wave”Harvard Business review |
| Lect 109/22 | Visiting Lecture **Rob Manning JPL**LDSD Chief Engineer & former MSL Chief Engineer at NASA/JPLManaging Technology for Space ProjectsRob will share his adventures in making a set of divergent technologies all work in landing missions on Mars.  | Read Rob’s book for class: Mars Rover Curiosity: An Inside Account from Curiosity's Chief Engineer |
| Lect 119/27 | Consider the common statement, “The rapid changes in technological capabilities today, are having a more profound effect on peoples lives than ever before in history” Is this true? An Historical Perspective How has technology affected people’s lives in the last 150 years? How did some of the major changes come about?How do you measure the influence? | Robert J Gordon “The Rise and Fall of American Growth”What was the greatest era for innovations <http://www.nytimes.com/2016/05/15/upshot/what-was-the-greatest-era-for-american-innovation-a-brief-guided-tour.html?emc=eta1&_r=0>Why smartphone don’t add up to an Industrial Revolution BBC <http://www.bbc.co.uk/news/36342723> |
| Lect 129/29  | Case 2 Apple Discussion of How did Apple get to be Apple?As Tim Cook takes over after Steve Jobs, how can he maintain Apple’s competitive advantage? | TEAM REVIEW Assignment 2Apple Case1. What, historically, have been Apple’s competitive advantages?
2. Analyze the personal computer industry. Why did Apple struggle historically in PCs?
3. How sustainable is Apple’s competitive position in PCs, and smartphones?
4. What are Apple’s long-term prospects for the Apple Watch (not in the narrative- but I want to know
5. What advice would you offer the CEO Tim Cook today?
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| Lect 1310/4 | An historical Perspective II- pushed forwardConsider the Silicon revolution. After discussion of its history, Where will it lead? Is Moore’s Law past its prime? Is the revolution nearing its end? | http://www.economist.com/technology-quarterly/2016-03-12/after-moores-law |
| Lect 1410/6 | **Visiting Lecture Josh Botkin** Professor University of MichiganCorning- the role of chance case 3How did Corning survive the collapse of the fiber optics market in 1999-2000?How do great old companies survive (Corning) or die (Lucent) |  |
| Lect 1510/11 | False Positives- Technologies that didn’t live up to expectations. What went wrong?The list here is long. Big investments big collapses. Anyone heard of Motorola’s revolution in communication, “Iridium”? How about the Digital Equipment Corporation? |  |
| Lect 1610/13 | **Midterm Presentations and Paper** | 10 Minute presentation and 5 Page written1. Summary of what you have learned so far2. Biggest Surprise3. Schedule of work to end of quarter. Use project management tools 4. Biggest Challenge in project in remaining time5. How will you address?6. Rate Team |
| Lect 1710/18 | Kent Kresa Northrup Grumman CEO Emeritus, Guest Lecturer “The Last Supper” Case 4 The Defense Department shows a future with a radically downsized Defense Sector in 1993 At the time of the Last Supper, the defense industry was burdened with "enormous excess capacity," according to Jacques S. Gansler, then undersecretary of defense for acquisition and technology. "The budget was plummeting, particularly [the] procurement account," he said. Gansler noted that an in-house Pentagon study in 1993 determined that the nation needed only two fighter aircraft makers, not five as was then the case. Likewise, DoD concluded it needed only one bomber builder, as opposed to three. It came to similar conclusions regarding tanks, submarines, missiles, satellites, and the like.The DoD suggested a radical industry-administered downsizing | 1. What was driving the DoD to make such a radical suggestion?
2. What are the advantages and disadvantages of this suggestion for the nation?
3. Given this directive, what choices did Kent have for his company? What are the advantages and disadvantages of these choices?
4. What factors should he consider in making a decision?
5. What should Kent do and why? Consider Kent’s vision for Northrop and possible competitor responses.
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| Lect 1810/20 | The Leadership Effect on Technology DevelopmentExperiences with Jack Welch- good, and other leaders - not so good. What are their qualities? Can they be seen? Measured?  | TEAM REVIEW Assignment 3 |
| Lect 1910/25 | Andy Downard “Data Businesses in retail”Guest LecturerHow can we use the wide availability of mobile data to change the sales process, to change the nature of competition? How do we sustain this advantage> |  |
| Lect 2010/27 | Amazon 2016 Case 5So it’s kind of like we built a lemonade stand 20 years ago. The lemonade stand has become very profitable. . But we decided to use our skills and assets that we’ve acquired over time to open a hamburger stand and a hot-dog stand and so on and so on . . .. Jeff Bezos  | “1. Describe the business innovation in this strategy.2.Is there a technology component?3. In which of these stands would you place your bets?4. Why |
| Lect 2110/29 | Henry Kressel Special Limited Partner Warburg PincusBoard of Directors Greatest discoveries are unexpected sidelines of things that weren’t intended.SIRI History- How did it come about? Speech recognition to converse with your phone- what is it’s future?  | [If You Really Want to Change the World: A Guide to Creating, Building, and Sustaining Breakthrough Ventures](https://www.amazon.com/You-Really-Want-Change-World/dp/1625278292/ref%3Dsr_1_1?s=books&ie=UTF8&qid=1470846082&sr=1-1&keywords=henry+kressel) by [Henry Kressel](https://www.amazon.com/Henry-Kressel/e/B001ITYUSU/ref%3Dsr_ntt_srch_lnk_1?qid=1470846082&sr=1-1) and [Norman Winarsky](https://www.amazon.com/Norman-Winarsky/e/B0170C7JU4/ref%3Dsr_ntt_srch_lnk_1?qid=1470846082&sr=1-1)Reas pps 9-24, 171-end |
| Lect 2211/1 | Analysis Tools that really work- or at least organize the discussion of competitive technologies. Taking the big view in comparing technologies. Are there some metrics that you can use that will help organize the discussion? |  |
| Lect 2311/3  | Erik Antonsson Corporate Director of Technology at the Northrop Grumman CorporationWhat is the nature of a competitive advantage in Aerospace technology today? How is thus evolving for tomorrow | TEAM REVIEW Assignment 4 |
| Lect 2411/8 | Student Presentations of projects to date with schedule for the end game. | Midterm Presentation |
| Lect 2711/10 | Case 6 Ethical Considerations“Technology and Ethical Behaviors”How should you deal with an emergent technology, which can have negative effects on people? | Case (to be distributed) “A mere technicality.” An update of Ibsen’s “Enemy of the People”-  |
| Lect 2811/15 | Steve Streit - CEO, Green Dot Corporation Leadership and Innovation in BankingHow to create a business and manage it from small to large, continuously innovating to survive.  |  |
| Lect 2911/17  | KAP - My own views of winning (and losing) Technologies. What I had dead right and what I had dead wrong. Discussion and analysis |  |
| Lect 3011/22 | KAP “Advice on an Industrial Career”Some basic rules for self-management |  |
| 11/24 THANKSGIVING |
| Lect 3111/29 | Summary of Class results. What could we improve? |  |
| **Dec 2** | **Final Presentations** **15 minute summary of key points of Final Paper** |  |
| **Dec 2** | **Final Paper** **Executive Summary****Description of Technology****Assumptions of how the technology will develop (“s curves” are appropriate here)****Reasons to support these assumptions- include market demand, new capabilities enabled, etc. Issues with these reasons****What you think the future of the next 5 years will be****This is the bare minimum. Include anything else to make the story compelling such as a scenario describing future impact of the technology.** **Note: A well-supported null result (This technology is not going to go anywhere) is fine** 15-20 pages double-spaced. Added Appendix OKInclude references! Internet OK and private conversations but reference.You can refer to or summarize HW assignment results but don’t repeat  |