

Columbia University
School of Engineering and Applied Science
Department of Industrial Engineering and Operations Research

IEOR 4998
Spring 2016

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Managing Technological Innovation

Introduction

This course provides an introduction to and overview of technological innovation in small, fast-growing enterprises. We will explore both the theories of innovation as well as the strategic and tactical approaches and processes that these theories entail. We will discuss, both amongst ourselves and with speakers from startups, venture capital firms, and established companies, the practical realities of implementing these approaches and processes in today's entrepreneurial environment.

Course Requirements

The final grade for the course will be a weighted average of your grades on two group project papers, an individual paper, in-class participation, and homework.

Group Project

You will form a group of three or four people from the class. The group will choose an idea for a startup business and will use the strategies and processes we learn to explicate this business opportunity. There will be two group papers submitted, one on ____, and one on ____.

Individual Paper

You will critique the business plan of a startup company (list of companies to be provided towards the end of the semester) using the ideas, tools, and techniques taught in this class. This paper will be an individual effort and will be due ____.

In-class participation

You are expected to read regularly the assigned material before each lecture and participate in the general discussion during the lecture. Participation in case-study discussions and in-class group assignments is critical to the learning process. We will pass out cards for you to write your names on in the second class. Bring these with you so we know your name when you participate.

Homework

There will be written assignments to be handed in for each class. These will typically be short and are meant to familiarize you with the problems to be discussed in the next class. As such, they will be graded with a

check, a check minus, or 'not handed in.' A check will be given if you seemed to understand the problem posed, whether or not you got the right answer.

Homework should be handed to the TA on paper, in class, by you. There will be no credit otherwise unless you have emailed about not attending that class.

Attendance

Attendance is mandatory. Our teaching method is interactive, if you don't come to class, you don't learn. If you can't make it and have a good reason, email me and Supriya. If there is an assignment due that day, attach it to the email.

Everything you hand in should have your uni and name on it. Group and individual papers emailed to me should also copy the TA and must be in PDF form. Homework may not generally be emailed. Each file emailed should have a filename that start with your uni and then says what it is. If you have to resend a second file to replace the first, mark it in the filename with 'v2'.

Readings

The textbooks for the class will be:

1. Aulet, Bill, **Disciplined Entrepreneurship: 24 Steps to a Successful Startup**, Wiley, 1st edition (August 12, 2013).
2. Osterwalder, Alexander, and Yves Pigneur, **Business Model Generation**, John Wiley and Sons; 1st edition (July 13, 2010).
3. Fitzpatrick, Rob, **The mom test : how to talk to customers & learn if your business is a good idea when everyone is lying to you**, CreateSpace Independent Publishing Platform; 1 edition (September 10, 2013).

There will be several handouts and case-studies distributed through courseworks. There will also be several case-studies you will need to buy through the Harvard Business School site, use this link to find the coursepack: <https://cb.hbsp.harvard.edu/cbmp/access/40691799>. In addition, there will be readings assigned for each class, along with URLs to access them.

The readings do not generally duplicate what we say in class. Because we are teaching in large part through case studies, we need you to do the readings so you can participate in a meaningful way. The readings provide you with the tools to do the analyses we will work through in the class case-studies.

Grading

Group paper I	25%
Group paper II	25%
Individual paper	25%
Participation	15%
Homeworks	10%

Note

This class is unlike most engineering classes: we are teaching a way of engaging with society across a broad range of poorly-specified problems. As such, the ability to communicate is important, both in writing and verbally. Your personal opinion on issues will be given little weight, unless you happen to be an expert on the issue being discussed; real-world data, analysis of extant data, and expert third-party opinions are more convincing. For clarity and conciseness, we prefer a writing style that is heavier on bullet points, charts and other graphical demonstrations, and analytical argument, not the essay-style writing taught in high-school English class. But all good non-fiction writing has this in common: have something to say, say it, back it up with evidence, and draw strong conclusions. If you need help with this, we have examples and resources; just ask.

Schedule of Meetings, Readings, and Assignments

	<p>Part 0: Introduction to MTI</p> <p>A. What is technology? What is innovation?</p> <p>B. Where does innovation come from?</p> <ol style="list-style-type: none"> 1. Micro/macro 2. Established firms/outside 3. Technological change/societal change <p>B. What is entrepreneurship?</p> <p>C. What is a startup?</p> <ol style="list-style-type: none"> 1. Difference between innovation driven enterprises and small and medium size businesses 2. When does a startup become just a company, and what changes? <p>E. Why should we care? Innovation and economic growth</p> <p>F. Class overview</p> <ol style="list-style-type: none"> 1. Goals 2. Structure 3. Assignments 4. Grading
	<p>G. On thinking less deterministically</p> <p><u>Readings:</u></p> <ul style="list-style-type: none"> • Psychology of Intelligence Analysis: http://1.usa.gov/12K7Wc1 <ul style="list-style-type: none"> ○ Chapter 1 - Thinking about Thinking ○ Chapter 2 - Perception ○ Chapter 4 - Strategies for Analytical Judgment ○ Chapter 6 - Keeping an Open Mind • Habits of Mind: http://bit.ly/1f0FokF • The Psychology of Human Misjudgment: http://bit.ly/15tDI1N • Teaching Smart People How to Learn: http://bit.ly/1zm4vWQ <p><u>Assignment:</u></p> <ul style="list-style-type: none"> • Group picked (not graded)
	<p>Part I: Innovation</p>
	<p>A. Stages of new technology introduction</p> <ul style="list-style-type: none"> • Science • Discovery/Invention • R&D • Commercialization • Diffusion • Obsolescence <p>B. What determines the pace and direction of innovation?</p>

- Perez and technological systems
- S-curves & measures of performance
- Extrinsically specified vs. socially constructed
- GPTs

C. Innovation at the firm level

- Sources of innovation
- Arthur and architectural innovation
- Radical v. sustaining innovation
- The S-curve
- Christensen and disruptive innovation

Readings for this class:

- Google case (on courseworks)
- Christensen “The Evolution of Innovation” In *Technology Management Handbook*, edited by Richard Dorf. Boca Raton, FL: CRC Press, 1998. <http://www.eee.ufg.br/~lguedes/moodle/get/2.pdf>
- Christensen, Clayton M., “Disruptive Innovation”. In: Soegaard, Mads and Dam, Rikke Friis (eds.). *The Encyclopedia of Human-Computer Interaction, 2nd Ed.* http://www.interaction-design.org/encyclopedia/disruptive_innovation.html
- Perez, “Technological revolutions and techno-economic paradigms”, <http://cje.oxfordjournals.org/content/34/1/185>
- MacKenzie, Donald, “Missile Accuracy: A Case Study in the Social Processes of Technological Change”, in *The social construction of technological systems : new directions in the sociology and history of technology* (available online through CLIO: <http://site.ebrary.com.ezproxy.cul.columbia.edu/lib/columbia/docDetail.action?docID=10578668&lpg=189>)

Assignment:

- Case questions
- Industry picked (not graded)

D. The competitive environment, incumbents

1. Innovation at established companies
2. Why do incumbents miss large market opportunities?
3. Christensen’s descriptive view
4. Teece’s prescriptive view

E. The competitive environment, entrants

1. How many entrants?
2. ‘First-mover advantage’
3. The product innovation phase
4. Dominant design
5. The process innovation phase

	<p><u>Readings for this Class:</u></p> <ul style="list-style-type: none"> • Utterback, J.M, F.F. Suarez, "Dominant designs and the survival of firms", <i>Strategic management journal</i>, Volume 16, Issue 6, September 1995, Pages 415-430. (Can be found through CLIO.) • Teece, David, "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy", <i>Research Policy</i>, Volume 15, Issue 6, December 1986, Pages 285–305. (Can be found through CLIO: http://www.sciencedirect.com.ezproxy.cul.columbia.edu/science/article/pii/0048733386900272) • “Who Profits from Innovation? Startups or Incumbents?”, http://reactionwheel.net/2014/09/whoprofits.html • iTunes case, on courseworks <p><u>Assignment:</u></p> <ul style="list-style-type: none"> • Case questions
Part II: Opportunity Generation and Recognition	
	<p>C. Opportunity generation/ideation D. Opportunity Assessment</p> <ol style="list-style-type: none"> 1. Porter’s Five Forces model 2. Industry analysis 3. Competitive analysis <p><u>Readings for this class:</u></p> <ul style="list-style-type: none"> • Porter, Michael, “The Five Competitive Forces That Shape Strategy”, <i>Harvard Business Review</i>, 2008. http://hbr.org/2008/01/the-five-competitive-forces-that-shape-strategy/ar/1 • Porter, Michael, “What is Strategy?”, (Can be found through CLIO: http://ezproxy.cul.columbia.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&bquery=IS+00178012+AND+TI+(%26quot%3bWhat+is+strategy%26quot%3b)+AND+DT+%26quot%3b1996%26quot%3b+AND+AU+%26quot%3bPorter%26quot%3b&type=1&site=ehost-live&scope=site) • David Teten on Market Research (video and slides) http://teten.com/speaker/market-research/ • W. Chan, Kim, and Renée Mauborgne. "Blue Ocean Strategy: FROM THEORY TO PRACTICE." <i>California Management Review</i> 47.3 (2005): 105-121. <i>Business Source Alumni Edition</i>. Web. 9 Sept. 2015. (Can be found through CLIO.) <p><u>Assignment:</u></p> <ul style="list-style-type: none"> • None
	<ol style="list-style-type: none"> 4. Market sizing 5. Product comparison/market positioning 6. Customer analysis

	<p><u>Readings for this class:</u></p> <ul style="list-style-type: none"> • Circle Lending case, in HBS coursepack • “Market Sizing: Is There a Market Size Formula?”, http://www.b2binternational.com/publications/market-size-techniques/ • Blank, Steve, “Market Size Hypothesis” (pdf), http://ultralightstartups.com/wp-content/uploads/2012/04/Steve-Blank-Market-Sizing.pdf • Gentshev, Greg, “A Full Market Sizing Example”, https://web.archive.org/web/20150308082649/http://www.brekiri.com/blog/193/a-full-market-sizing-example/ <p><u>Assignment:</u></p> <ul style="list-style-type: none"> • Case questions
	<p>7. Business model</p> <ol style="list-style-type: none"> “How you make money” Business model canvas <p><u>Readings for this class:</u></p> <ul style="list-style-type: none"> • Osterwalder, pp. 14-119 <p><u>Assignment:</u></p> <ul style="list-style-type: none"> • None
	<p>8. Financial feasibility</p> <ol style="list-style-type: none"> Fixed v. variable costs Unit economics and break-even Cost of customer acquisition Lifetime Value Building a financial model <p><u>Readings for this class:</u></p> <ul style="list-style-type: none"> • Zipcar case, in HBS coursepack • Lifetime Value Summary on Courseworks • Answer on Quora to “Financial Modeling: Where can web startups learn about financial modeling that accounts for the important metrics and costs?”: http://qr.ae/JBf11 <p><u>Assignment:</u></p> <ul style="list-style-type: none"> • Case questions 2
	<p>Part III: De-Risking</p>
	<p>A. De-risking overview</p>

	<p>B. Lean</p> <p><u>Readings for this class:</u></p> <ul style="list-style-type: none"> TBD <p><u>Assignment:</u></p> <ul style="list-style-type: none"> Group Paper I
	<p>C. Customer Development</p> <p><u>Readings for this class:</u></p> <ul style="list-style-type: none"> <i>The mom test</i> <p><u>Assignment:</u></p> <ul style="list-style-type: none"> None
<p>Part IV: Managing Growth</p>	
	<p>A. Product management</p> <ol style="list-style-type: none"> User archetypes User stories Wireframing <p><u>Readings for this class:</u></p> <ul style="list-style-type: none"> Dropbox case study, in HBS coursepack Srinivasan, Balaji, “Market Research, Wireframing, and Design” (https://spark-public.s3.amazonaws.com/startup/lecture_slides/lecture5-market-wireframing-design.pdf) Bussgang, J. et al, “The Product Manager”, in HBS coursepack <p><u>Assignment:</u></p> <ul style="list-style-type: none"> Case questions
	<p>B. Funding the business</p> <ol style="list-style-type: none"> Corporate structure overview Corporate governance overview Corporate ownership Financing with equity and debt Venture capital <ol style="list-style-type: none"> Who, why, when How: preferred equity, typical major control terms Advantages and disadvantages of venture capital <p><u>Readings for this class:</u></p>

	<ul style="list-style-type: none">• Corporate structure and Venture Capital handouts on Courseworks• “The Early Pitch Decks of 5 Startups Before They Became Billion-Dollar Companies”, https://www.cbinsights.com/blog/billion-dollar-startup-pitch-decks• Davidson, Taylor, “How-to: Cap Tables, Liquidation Preferences and Exit Proceeds”, http://foresight.is/learn/cap-table <p><u>Assignment:</u></p> <ul style="list-style-type: none">• None
	<p>Summary & Overview</p> <p><u>Assignment:</u></p> <ul style="list-style-type: none">• Group Paper II
	<p>No Class!</p> <p><u>Assignment:</u></p> <ul style="list-style-type: none">• Individual Paper