

TE 565: Technology Innovation & Strategy

Technology Entrepreneur Center
GRAINGER ENGINEERING



Fall 2022

- 2 credit hours

Instructor

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Course Site

uofi.box.com

Course Purpose

This course is designed to help students develop strong conceptual foundations for understanding technological innovations. Through case studies, a student project, and several analytical frameworks explored in class, this course equips students with a broad perspective on the central issues involved in innovation throughout the product lifecycle. It aims to help students become even better leaders of technology and innovation.

Learning Objectives

Upon completion of this course, you will:

1. be able to apply concepts and frameworks to analyze how firms create, commercialize, and capture value from technology-based products and services, and
2. understand why some firms have successfully commercialized technology products as a new entrant, then fail to sustain their success as technology changes and evolves around them.

Course Texts

Required:

- ENG 565 Course Packet
- Additional readings and Harvard Business School cases will be handed out throughout the semester.

References:

- *Innovator's Dilemma*, Clayton M. Christensen, 2003, ISBN 0060521996
- *Crossing the Chasm*, Geoffrey A. Moore, 2002, ISBN 0060517123
- *Strategic Management of Technology & Innovation*, Burgelman, Christensen, and Wheelwright, Fourth Edition 2004, ISBN 0-07-253695-0

Grading

- 10% - Attendance
- 20% - Class participation
- 40% - Midterm exam
- 30% - Group project

Requirements and Grading

Contact hours:

One 100-minute lecture-discussion per week. A 100-minute session is counted as 2 contact hours. Thus, there are 2 contact hours per week x 14 weeks = 28 total contact hours.

Grades:

Grades for on-campus students will be determined on the basis of attendance/class participation, midterm exam, and a final group project.

1. Class participation:

Heavy emphasis will be placed on class attendance and active, thoughtful classroom participation. What does that mean? All students are expected to have completed each session's readings and have prepared an analysis of the issues raised in each case without exception. In evaluating classroom participation, I look for students who clearly articulate their analysis, back up their views with any relevant facts, and move the analysis forward.

2. Midterm:

There will be a 90-minute midterm exam (closed book, closed notes). This will consist of a set of short-answer questions and/or short cases to be read, analyzed, and turned in at the end of the period.

3. Group project:

Students will also be required to finish a group project. These will consist of students in groups of three or four, exploring a topic related to the dynamics of technical innovation. The final deliverable for the group project will be a 15 minute in-class powerpoint presentation and submission of the powerpoint slides for grading. The group presentation will be 15 minutes in duration and will be followed by 5-10 minutes of Q&A. I may also ask each participant to evaluate the contribution of the other group members (peer review).

Working in groups of three, you will explore a topic of particular interest related to the management of technology and innovation.

Project options include:

- Analyze a contemporary (or anticipated near future, 0-5 year) disruptive innovation, and present action plan(s) for one or more key players involved (Music and video distribution over the web, IPTV, Inorganic semiconductors, hybrid automobiles, Active suspension technologies, Alternative Energy, Mashups, WiMax, Mobile TV streaming, Online education, Online peer to peer lending, etc.)
- Other options that tie directly to the course material

Above all else, I want this project to be directly *relevant*, *interesting* and *beneficial* to you. As such, I am prepared to give considerable topic leeway, provided you establish a direct connection to the topics presented by the course in both your proposal and final deliverables. For instance, if you have an idea for a new process or product innovation in a *new* firm or within an *existing* entity and want to use this as an opportunity to explore and further refine it, by all means do so.

There are two deliverables for this project:

- Short 1–2-page proposal.
- PowerPoint presentation for on-campus students.

Lecture Topics and Reading List for Online Students

Week	Readings	Case
WEEK 1: COURSE OVERVIEW AND INTRODUCTION TO KEY CONCEPTS		
Week 1	<ul style="list-style-type: none"> Peter F. Drucker, "The Discipline of Innovation", Harvard Business Review, November-December 1998. Clayton Christensen, Michael Overdorf, "Meeting the challenge of Disruptive change", Harvard Business Review, Vol. 78, Issue 2, Mar/Apr 2000. 	•
WEEK 2 AND WEEK 3: DISRUPTIVE INNOVATION AND MANAGING TECHNOLOGICAL TRANSITIONS		
Week 2	<ul style="list-style-type: none"> Sanjiv Chopra, "Choose To Disrupt", Silicon India Magazine, May 2007. Remember Lowly Memory Chips? They're Back Changing Industries, Wall Street Journal, 2005. Clayton Christensen, Matt Verlinden, "Disruption, Disintegration and the Dissipation of Differentiability", Industrial and Corporate Change, Volume 11, November 5, 2002 pp. 955-993. (SKIP SECTIONS: 4.1, 4.2, 4.4, 4.6, 5.1, 5.2, 5.4). Clayton Christensen, Joseph Bower "Customer power, strategic investment, and the failure of leading firms", Strategic Management Journal, March 1996, Volume 17, Issue 3. 	• Continuous Casting at USX Corporation
Week 3	<ul style="list-style-type: none"> Clayton Christensen, et. al, "Innovation Killers: How Financial Tools Destroy Your Capacity To Do New Things", Harvard Business Review, Jan 2008. James Utterback, Happy Acee "Nanotechnology: A disruptive technology?" MIT Working paper, 2002. Henderson and Clark, (1990), "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms," Administrative Science Quarterly 35. 1990 pp. 9-30. Sanjiv Chopra, "Focus On Architectural Innovation" Silicon India Magazine, June 2007. 	•
WEEK 4 AND WEEK 5: CROSSING THE CHASM		
Week 4	<ul style="list-style-type: none"> Geoffrey Moore "Crossing the Chasm and beyond", pp 362-368, Strategic Management of Technology and innovation, 4th edition, Robert Burgelman, et. al. Geoffrey Moore, "Crossing the Chasm", Harper Collins: NY, pp. 12-25, 30-83 	• Documentum, Inc.
Week 5	<ul style="list-style-type: none"> Geoffrey Moore "Darwin and the Demon", Harvard Business Review, July/Aug 2004 	•
WEEK 6 AND WEEK 7: INTRODUCTION TO STRATEGY		
Week 6	<ul style="list-style-type: none"> Porter, Michael (1996), "What is Strategy?" Harvard Business Review, November 1996 pp. 61-78. Volume 74 Issue 6 Prahalad, C.K. and Hamel, Gary (1990), "The Core Competence of the Corporation", Harvard Business Review 1990. Volume 68 Issue. Michael Porter, "The Five Competitive Forces That Shape Strategy", Harvard Business Review, Jan 2008. Clayton Christensen, Scott Anthony "Solving the Dilemmas of Growth", Strategy and Innovation, July 2003. Honda, in a Funk, Tries to Revive the Civic's Virtues, Wall Street Journal, 2005 For U.S. Airlines, A Shakeout Runs Into Heavy Turbulence, Wall Street Journal, 2005 Optional: Robert S. Kaplan, David P. Norton, "Mastering The Management System", January 2008. 	• Due in class: One page proposal for final project and identification of team members.
Week 7	<p>Strategy issues in environments of rapid technological change</p> <ul style="list-style-type: none"> David J. Collis, Cynthia A. Montgomery, "Competing on Resources", Harvard Business Review, July 2008. David Teece, Gary Pisano, Amy Shuen, "Dynamic Capabilities and Strategic Management" Strategic Management Journal, Vol. 18:7, 1997. Kathleen M. Eisenhardt, Donald N. Sull, "Strategy as simple rules", Harvard Business Review, Jan 2001. 	• Power Play (A): Nintendo in 8-bit Video Games

WEEK 8 AND WEEK 9: TECHNOLOGY EVOLUTION

Week 8	<p>Technology Evolution and Dominant Design</p> <ul style="list-style-type: none"> • Utterback, James (1994), "Dominant designs and the survival of firms". Chapter 2 in Mastering the Dynamics of Innovation, Harvard Business School Review Press pp. 23-55 and pp.79-102 • Sanjiv Chopra, "In Pursuit of Dominant Design", Silicon India Magazine, March 2007. • As Hybrid Cars Gain Traction, Industry Battles Over Designs, Wall Street Journal 	•
Week 9	<p>S-Curves for component and architectural technologies</p> <ul style="list-style-type: none"> • Clayton Christensen, "Exploring the limits of the Technology S-Curve. Part I: Component Technologies". Journal of Production and Operations Management 1, no. 4 (Fall 1992) • Clayton Christensen, "Exploring the limits of the Technology S-Curve. Part II: Architectural Technologies". Journal of Production and Operations Management 1, no. 4 (Fall 1992) 	• Hewlett-Packard's Merced Decision

WEEK 10: MIDTERM EXAM**WEEK 11: PROFITING FROM TECHNOLOGY INNOVATION**

	<ul style="list-style-type: none"> • Teece, David "Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing, and public policy." Research Policy 15, no. 6 (Dec. 1986): pp. 185-219. Volume 16. 	• Abgenix and the Xenomouse
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WEEK 12: LEAD USER RESEARCH

	<ul style="list-style-type: none"> • Stefan Thomke, Ashok Nimgade, "Note on Lead User Research" pp 794-800, Strategic Management of Technology and innovation, 4th edition, Robert Burgelman, et. al. • Got a Better Letter Opener, Wall Street Journal, July 2006. • Clayton Christensen, Scott Cook, Taddy Hall, "Marketing Malpractice: The Cause and the Cure", Harvard Business Review, December 2005. 	• Innovation at 3M Corporation (A)
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WEEK 13: FALL BREAK**WEEK 14: STANDARDS AND NETWORK EXTERNALITIES**

	<ul style="list-style-type: none"> • Shapiro, C. and H. Varian (1999). The art of Standards Wars, California Management Review, 41(2): pp. 8-32. • Thomas Eisenmann, Geoffrey Parker, Marshall W. Van Alstyne, "Strategies for Two-Sided Markets" Harvard Business Review, October 2006. • David, (1985), "Clio and the Economics of QWERTY", American Economic Review. Vol 75, No. 2, May 1985. pp. 332-337. • Pekka Rantasaari, "Network Effects and Adoption of new Technology", Helsinki University of Technology. 	• Adobe Systems Incorporated
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WEEK 15: GROUP FINAL PRESENTATIONS

Preparation Questions for In-class Discussion (on-campus students)

Disruptive innovation:

1. Why do most large successful companies lose the ability to enter small emerging markets?
2. Why are established firms better positioned to introduce sustaining innovations as opposed to disruptive innovations?
3. How can a large company develop new capabilities to embrace and initiate disruptive change?
4. Why are vertically integrated firms generally dominant at the early stages of an industry?
5. What gives rise to move away from vertical integration to specialization (or disintegration)?
6. How does the locus of profits shift at various stages of an industry's evolution?

Crossing the Chasm:

1. What is the technology adoption life cycle?
2. What is the recommended high technology marketing strategy?
3. What is the problem of this strategy?
4. What is the main reason that companies cannot overcome the "chasm", and the recommended approach to cross the chasm?

Introduction to Strategy

Basic strategy:

1. Why is Operational Effectiveness alone not sufficient to achieve superior profitability?
2. What are the three key elements that drive competitive advantage through strategy?
3. What is the growth trap and what are the ways to avoid the trap?
4. What are core competencies and how do you identify something as core competence?

Five Forces:

1. Discuss Porter's five forces that determine competition in an industry?

Strategy in environments of rapid technological change:

1. What is the alternative view of strategy in high velocity markets?

Technology Evolution

Dominant Design:

1. What is a dominant design? How is it established?

S-Curve:

1. How does dominant design relate to the S-curve?
2. When is an S-curve analysis helpful, and how should it be used?

Profiting from Technology Innovation

1. What are some of the elements that determine whether or not the innovator will receive significant economic returns from innovation?
2. How does the relative importance of appropriability and complementary assets change over the life cycle of an industry?
3. What is the relationship between Teece's concept of "complementary assets" and "barriers to entry" as defined by Porter?

Managing Technological Transitions

1. How are the phenomena outlined by Christensen related to Foster's S-curve?
2. What determines the success or failure of incumbent firms in Henderson-Clark?

Technology Marketing: Crossing the Chasm, Lead User Research

1. What is the "chasm"? How do you know you are in a "chasm"?
2. What techniques does the author recommend for "chasm management"?

Standards and Network Externalities

1. How do standards and network externalities affect technological competition?
2. What are tradeoffs faced by managers in such markets?

Continuous Casting at USX Corporation

1. Do you think Kappmeyer should sign the proposal, and why?

Documentum, Inc.

1. What did Documentum learn from its experience with the first two customers?
2. Should Documentum accept the Marsh and McLennan deal?
3. What is your reaction to Moore's method of selecting the target market?
4. What is the difference between a horizontal and vertical strategy?

Power Play (A): Nintendo in 8-bit Video Games

1. Nintendo successfully recreated the home video game business following the Atari-era boom and bust. How did it do so?
2. How was Nintendo able to capture value from the home video game business?

Hewlett-Packard's Merced Decision

1. Does the market need the Merced chip?
2. Who will benefit the most from the introduction of the Merced chip in the markets served by ESG? Who will benefit least, and why?
3. What should Jim Davis recommend?

Abgenix and the Xenomouse

1. Does Pharmacol or BioPart represent a better way to go for Abgenix? Why?
2. What should Scott Greer do?
 - a. Go it alone through the end of phase II trials?
 - b. Sign with Pharmacol?
 - c. Sign with Biopart?
 - d. Something else?

Innovation at 3M Corporation (A)

1. How does Lead user research process differ from and complement other traditional market research methods?
2. Has the Medical-Surgical team applied the lead user research process successfully? Why or why not?
3. What are the risks to the new lead user process at 3M?

Adobe Systems Incorporated

1. How was Postscript established as a de facto standard? How did Adobe make money from Postscript, despite it being an “open” standard?
2. Which firm is currently in a stronger position to control de facto standards in the eBook space: Adobe or Microsoft?
3. What should Adobe do? How can they win the standards war? Should they focus on eDocs or eBooks? Will the eBooks market tip or will there be multiple standards? How can Adobe make money in this market?

Key Concepts

1. **Technological innovation and business strategy.** How do innovating firms extract economic returns from an innovation and what are some of the barriers to it? Introduce the ideas of business strategy, core competence, and industry analysis aimed at understanding ways to capture the biggest slice of the value that is generated. In addition to the traditional ideas of strategy the importance of fostering dynamic firm capabilities in environments of rapid technological change will also be introduced.
2. **Disruptive Innovation.** Christensen's disruptive innovation framework helps explain why successful companies often lose out in the face of disruptive innovation. Too often successful companies introduce new products whose performance overshoots market need. They do this via sustaining innovations, in search of higher margins and to keep current customer happy. They often engage in sustaining innovation at the expense of developing disruptive products that have lower performance and cheaper but target emerging markets with high growth potential.
3. **Technology evolution and dominant design:** In the early stages of industry development, product designs are in a state of flux. At some point after considerable trial and error in the marketplace a design emerges that meets a whole set of user needs in a relatively complete fashion. This is called the dominant design, which by its very nature is product-defining. No one asks whether a car has a steering wheel or electric wipers! Once a dominant design emerges, the dynamics of competition change dramatically from the fluid phase to competition focused on price, quality and some differentiation leading companies to focus on different types of activities.
4. **Crossing the chasm.** Technology ideas don't often fail to transition from a promising, nascent early adopter phase to mass market. The gap between these two phases is called the chasm. What is the secret to crossing the chasm? Identify a single beachhead (product application) of pragmatist customers in a mainstream market segment and accelerate the formation of 100% of their "whole" product needs. The typical product development prioritization process usually results in new features (something) for everyone, but a complete solution for no one.
5. **The Technology S-Curve.** S-Curve is a useful framework describing the substitution of new for old technologies at the industry level. According to the S-curve, in early stages of a technology the rate of progress in performance is relatively slow. As the technology becomes better understood, controlled, and diffused, the rate of technological improvement increases. In its mature stages, the technology will asymptotically approach a natural or physical limit. The S-curve framework can be used in both component as well as architectural level technology development.
6. **Lead user research.** Lead users are not the same as early adopters. They have a specific need and they actually adopt or change the product to fit their needs. A wealth of information pertaining to product development resides in lead users. However, it is not easy to find them and there are challenges in using this methodology.
7. **Network externalities and standards:** Adoption of new technology may be influenced by Network Effects (the utility derived from the consumption of a service/good for a given user of a network depends upon the number of other users on the same network). Various consumer applications (Web, mobile, and community) often exhibit positive network externalities. First mover advantage, assembling allies, and availability of complementary products can help establish technology standards in market with strong network effects.

About the Instructor

Sanjiv Chopra has worked in the technology industry in various Engineering and Management roles for over twenty years. Since 2005, as Entrepreneur-in-Residence in the College of Engineering at the University of Illinois, Chopra has taught two popular graduate courses titled “Technology Innovation and Strategy” and “Venture Funded Startups”. With experience in both large and small companies, Chopra provides a balanced understanding of strategic and tactical issues that confront engineers and entrepreneurs in designing and commercializing technology-based products.

Chopra currently serves as a Senior Director of Cloud Strategy and Business Value at Oracle Corporation where he advises clients on the business benefits of technology-enabled business transformation. Chopra has also served in key management roles and advisory board of several venture funded technology startups. From 2006 until 2008, Chopra served as a business development executive for Xelerated, Inc (now Marvell Technology). Xelerated is a Communications Processor company funded by pre-eminent venture capitalists, including Accel Partners, Sweden based A/P Fund. From 2001 until January 2006 Chopra served as the Chief Operating Officer of Intersymbol Communications (now Optium Corporation). Intersymbol is a venture-backed technology company developing disruptive, mixed signal integrated circuits for optical communications industry. Prior to Intersymbol Chopra was the Co-founder and Vice President of Business Development for CapacityWeb, Inc, a venture backed supply chain software and technology provider. From 1991-1997 he worked in Silicon Valley, California for Integrated Device Technology (NASDAQ: IDTI) designing and developing semiconductor integrated circuits for the personal computer and communications industry. Chopra has also worked as a management consultant at Booz, Allen & Hamilton, a premier management consulting firm.

Chopra holds a B.S. in Electrical Engineering from BIT, India, a Master of Science degree in Electrical Engineering from Iowa State University, and an MBA from Northwestern University, Evanston, IL.

COVID

Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community. Students are also required to follow the campus COVID-19 protocols.

Students who feel ill must not come to class. In addition, students who test positive for COVID 19 or have had an exposure that requires testing and/or quarantine must not attend class. The University will provide information to the instructor, in a manner that complies with privacy laws, about students in these latter categories. These students are judged to have excused absences for the class period and should contact the instructor via email about making up the work.

Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the non-compliant student will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Accumulation of non-compliance complaints against a student may result in dismissal from the University.

Emergency Response Recommendations

Emergency response recommendations can be found at the following website:

<http://police.illinois.edu/emergency-preparedness/>. I encourage you to review this website and the campus building floor plans website within the first 10 days of class.

<http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/>.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidential. Other information about resources and reporting is available here: wecare.illinois.edu.

Academic Integrity

You are expected uphold the highest ethical standards, to be honest, and to practice academic integrity.

This includes doing original work and citing sources, including the work of other students. Please give special care to prepare high-quality submissions with proper grammar and spelling.

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>. Academic dishonesty may result in a failing grade.

Every student is expected to review and abide by the Academic Integrity Policy:

<https://studentcode.illinois.edu/article1/part4/1-401/>. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Religious Observances

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/> to request appropriate accommodations. This should be done in the first two weeks of classes.

Disability-Related Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, email disability@illinois.edu or go to <https://www.disability.illinois.edu>. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

Family Educational Rights and Privacy Act (FERPA)

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

Anti-Racism and Inclusivity Statement

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs.

The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (<https://bart.illinois.edu/>). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.