



## MANAGEMENT 237: MANAGEMENT OF TECHNOLOGY\*

FALL 2016

Professor Rahul Kapoor

2207 Steinberg Hall-Dietrich Hall

[kapoorr@wharton.upenn.edu](mailto:kapoorr@wharton.upenn.edu)

Office hours: Wednesday, 4:30 p.m. - 6:00 p.m. (or by appointment)

### COURSE DESCRIPTION

The course is designed to meet the needs of future managers, entrepreneurs, consultants and investors who must analyze and develop business strategies in technology-based industries. The emphasis is on learning conceptual models and frameworks to help navigate the complexity and dynamism in such industries. This is not a course in new product development or in using information technology to improve business processes and offerings. We will take a perspective of both established and emerging firms competing through technological innovations, and study the key strategic drivers of value creation and appropriation in the context of business ecosystems.

Some overarching questions that the course will help answer are:

- What are the evolutionary patterns of technology development and market adoption, and how they shape strategic considerations for pursuing existing as well as new technologies?
- Why do firms struggle to embrace and compete with new technologies, and what can they do to create successful performance outcomes?
- How does the recent shift from industries and products to business ecosystems and technology platforms affect firm's competitive and cooperative strategies?
- What are the different types of business models that firms can use to innovate and appropriate value from their technology, and how should firms choose which business model to use?

The course uses a combination of cases, simulation, and readings. In addition, guest speakers will be invited to share their perspectives on contemporary issues. The cases are drawn primarily from technology-based industries. Note, however, that case discussions are mainly based on strategic (not technical) issues. Hence, a technical background is not required for fruitful participation.

### EVALUATION

#### Individual

Class participation including participation in online polling (35 points)

Back Bay Battery write-up (10 points)

Bonus assignment (Details to be provided in the first class)

#### Team

Application project

- Proposal (5 points)
- Draft (10 points)
- Presentation (10 points)
- Paper (30 points)

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\* Please note that this syllabus is subject to change with prior announcements.

## **CLASS PARTICIPATION**

This is designed to be an interactive discussion-based course. Hence, class participation is a crucial component of not only the evaluation but also the learning in the course. It is expected that you are well-prepared for each class session. To help you prepare, discussion questions and online polls related to the specific cases and topics will be provided in advance. Everyone will be individually responsible for responding to the poll by **8 a.m. the day of class**. Answering the poll will not take much time beyond your normal preparation for the class. If you do not respond to the poll, I will assume that you have not prepared for the class. I may call upon you to justify your answer in the poll.

In general, four factors determine high quality comments in the class. First, is a given comment clearly related to the case and/or topic being discussed? Second, does the comment move the class discussion forward? Third, does the comment reflect consistent and logical reasoning or are there gaps in the logic? Fourth, does the comment draw on specific facts from the case or readings or personal experience to support the assertion? Note that quality, not quantity, will determine the effectiveness of your comments. “Airtime hogs” will not be rewarded.

Of course, the underlying condition for class participation is attendance. I expect you to attend all sessions. Specifically, according to the MBA office, there is no recruiting reason for which you should miss class. I will be taking attendance. Arriving late is disrespectful to your colleagues and, for attendance purposes, is treated as a distinct event from being present at the start of class. Note that unexcused absences and tardiness will adversely affect class participation marks. A maximum of three excused absences will be accepted.

## **BACK BAY BATTERY SIMULATION WRITE-UP**

Firms face many challenges and tradeoffs with respect to their technology investment decisions. The case of Back Bay Battery will help us engage deeply with such challenges and tradeoffs in a real business situation. You will play the role of the President at Back Bay Battery Company, a manufacturer of nickel metal hydride (NiMH) batteries. The President’s responsibility is to determine the appropriate timing and level of R&D investments between existing and new battery technologies under uncertain real-world conditions. Your decisions are of course subject to corporate-level financial constraints. You are required to play a single run of the simulation and submit the individual write-up before the class on **September 19**. You will play another slightly modified run in class. Note that each run includes making decisions over an eight year period. The write-up should be about 2000 words (12 pt. Times Roman font, single spaced, with margins no less than 1 inch), and should answer the following questions:

- What was the initial strategy and the logic underlying that strategy? Please be explicit about the assumptions that formed the basis for the initial strategy
- How did the strategy change over time (i.e., between the first and the eighth year), and what were the reasons for those changes?
- What were the main challenges that you faced while making decisions?
- What additional information you would have liked to have before making decisions? Please be explicit about how might that information be collected and how would it improve decision-making
- What did you takeaway from the simulation?

## **APPLICATION PROJECT**

The semester-long group project is intended to give you the opportunity to apply your learning from the course to a context that is most interesting and relevant to you. The project should be worked on in a team of four or five students from the same section. It could focus on one of the three topics:

- Compare two different technological innovations that were introduced in the same industry, one successful and the other unsuccessful, by two different firms (e.g., Nokia’s vs. Apple’s Smartphone; Sony’s Betamax vs. JVC’s VHS Video Cassette Recorder).
- Study the technological innovations of the different players in an industry that is undergoing a technology discontinuity (e.g., Cloud-based Services, Electric Car, Distributed Energy, Personalized Medicine).

- Conduct a historical case study of a single firm focusing on how it competed through different episodes of technological innovations over time (e.g., Apple, General Electric, IBM, Microsoft).

The topic should be well-researched, based on an extensive review of publicly-available information as well as specialized databases available through Penn Libraries. I strongly encourage you to attempt to gain access to the firms being studied to collect data and conduct interviews, since this can lead to a uniquely rich and insightful analysis.

Each team should provide two different proposals preferably on different topics. These should be uploaded as a single document on Canvas by **October 03**. The proposals can be rank ordered. I will get back to you with a confirmed project topic within a few days. We will also meet after a couple of weeks to discuss your progress on the project. For each of your two proposals, please write one paragraph explaining why you believe this is a suitable topic for the team project and then provide the following information:

- Brief synopsis of focal firm(s)
- Brief synopsis of focal technological innovations
- General list of sources of data that team expects to use (for private firms, please clearly identify at least one data source)

A draft of your project is due by **November 17** on which you will receive written feedback. This draft is to be in presentation form, but with sufficient detail to enable it to be read as a coherent document (as is common in corporate strategy, consulting and investment circles).

The project presentations are meant to showcase your analysis to your classmates and to receive feedback that can be incorporated into the final paper. The presentation should last for about ten minutes followed by five minutes for Q&A. It should provide a brief overview of the industry/technology but mostly focus on analysis, recommendations, and lessons learnt. All presentations should be uploaded on Canvas by **9am on December 02**.

The final paper should be about 10,000 words (excluding references and exhibits). It should be submitted by **December 15**. The paper will be evaluated on four dimensions: First, the insight offered by the analysis – does it go beyond describing what happened to shed light on the fundamental causes of strategies/outcomes in a logically consistent manner. Second, the quality of the analysis and how well it integrates the concepts discussed in the course. Third, how relevant, useful, and well supported are the lessons and recommendations presented. Fourth, the readability of the paper and readers' access to the ideas presented.

While you are probably aware of the conventions of properly citing material and ideas, I believe a short note on the subject is worthwhile. Material reproduced verbatim should be enclosed in quotation marks, with proper attribution made to the source. Ideas and concepts even if not quoted verbatim should be attributed to the author/source, also via proper citation.

### **FEEDBACK**

I strongly encourage anyone with specific or general questions regarding the course structure, content or discussions to drop by my office (during office hours or by appointment) or to contact me via email or phone. There will be a detailed mid-course evaluation whose results I will present in class. If needed, we can also form a quality circle to anonymously gather additional feedback.

## ETHICS

Below is the Ethics matrix for the course. Please go through it carefully and let me know if you have any questions.

	Materials							People				
MGMT 731 Technology Strategy	Approved calculator	Laptop / other electronics	Summary sheet	Readings/ class notes	Past notes / summaries	Past exams / assignments	Internet content / other outside materials	Learning team / approved work team	Other student(s) in same section	Student(s) in other sections (same term)	Wharton student not taking the class this term	Person outside of Wharton
Readings & Cases	A	A	A	A				W	W	W		
Team Assignments	A	A	A	A			A	W				
Individual Assignments	A	A	A	A			A					
	A = Allowed material Blank Cell = Not allowed							W = Allowed to work together Blank Cell = Not allowed				
<p>The information above covers many common situations but will not cover every circumstance. Remember: The <a href="#">Wharton MBA Code of Ethics</a> that you accepted requires, among other things, that you represent yourself and your work honestly, don't try to gain unfair advantage over other students, follow the instructor's guidelines and respect confidentiality of your work and the work of others.</p>												

## COURSE OUTLINE<sup>†</sup>

### 08/31 Session 1 - Introduction; What is Technology Strategy?

### 09/05 Labor Day (No Class)

### 09/07 Session 2 - Technology Dynamics

Reading: (1) Schilling, M. A. (2011), "Types and patterns of innovation," Chapter 3 in *Strategic Management of Technological Innovation*; (2) Cooper, A. C., & Smith, C. G. (1992), "How established firms respond to threatening technologies," *Academy of Management Executive*, 6(2): 55-70.

Supplementary Reading: Foster, R. (1986), "The S-curve: A New Forecasting Tool," Chapter 4 in *Innovation, The Attacker's Advantage*.

### 09/12 Session 3 - Technology Discontinuities: A Firm-level Perspective

Case: Kodak and the Digital Revolution (HBS 9-705-448)

Reading: McGahan, Anita (2004), "How Industries Change," *Harvard Business Review*, 82(10): 86-94.

Supplementary Reading: Tushman, M., Smith, W., Wood, R., Westerman, G., & O'Reilly, C. (2010), "Organizational designs & innovation streams," *Industrial and Corporate Change*, 19(5): 1331-1366.

### 09/14 Session 4 - Technology Discontinuities: An Ecosystem-level Perspective

Case: E-Books in 2009: Did the Long Heralded Revolution Finally Arrive? (Wharton Case-48)

*Back Bay Battery write-up to be uploaded on Canvas before the class session on Sep 19*

### 09/19 Session 5 - Managing Existing & New Technological Opportunities (In-class simulation)

Simulation: Back Bay Battery (HBS 7015-HTM-ENG)

### 09/21 Session 6 - Back Bay Battery Simulation Debrief

### 09/26 Session 7 - Creating Value from New Technology I

Case: Hewlett-Packard: The Flight of the Kittyhawk (HBS 9-606-088)

Reading: Christensen, C. (1997), "Value Networks and the Impetus to Innovate," Chapter 2 in *Innovator's Dilemma*.

### 09/28 Session 8 - Creating Value from New Technology II

Case: E Ink in 2005 (HBS 9-705-506)

Reading: Moore, G. (1999), "High-tech Market Illusion" and "High-Tech Marketing Enlightenment," Chapters 1 and 2 in *Crossing the Chasm* (Skim).

*Complete Team Sign-Up and Upload Project Proposal on Canvas by Oct 03*

### 10/03 Session 9 - Innovation Ecosystems

Case: previous (E Ink; HP); Better Place - [ted.com/talks/shai\\_agassi\\_on\\_electric\\_cars?language=en](http://ted.com/talks/shai_agassi_on_electric_cars?language=en)

Reading: Adner, R. (2006), "Match your innovation strategy to your innovation ecosystem," *Harvard Business Review*, 84(4) 98-107.

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<sup>†</sup> Please note that slides will be posted after each class in the course web site set up for this course. The syllabus also includes supplementary readings. These readings provide a deeper treatment of the specific issues within a given topic. I will cover them in the class and while they are not expected to be read before the class, they may serve as useful post-class reference.

Supplementary Readings: (1) Adner, R. and Kapoor (2010), "Value Creation in Innovation Ecosystems: How the Structure of Technological Interdependence Affects Firm Performance in New Technology Generations," *Strategic Management Journal*, 31(3): 306-333; (2) Adner, R. and Kapoor, R. (2015), "Innovation Ecosystems and the Pace of Substitution: Re-examining Technology S-curves," *Strategic Management Journal*.

**10/05 Session 10 - Technology Forecasting**

Reading: Quinn, J. B. (1967), "Technological forecasting," *Harvard Business Review*, 45(2), 89-106

Supplementary Readings: (1) Saffo, P. (2007), "Six rules for effective forecasting," *Harvard Business Review*, 85(7/8):122-131; (2) Jackie Fenn (2014), "Applying Lessons From 20 Years of Hype Cycles to Your Own Innovation and Forecasting Strategies," Gartner. Inc.

**10/10 Session 11 - Emerging Technologies: Trends, Opportunities and Challenges**

Guest Speaker: TBD

**10/12 Session 12 - Capturing Value from Technology I**

Case: Abgenix and the Xenomouse (HBS 9-501-061)

Reading: Teece, D. J. (1986), "Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy," *Research Policy*, 15(6): 285-305.

Supplementary Reading: Teece, D. J. (1998), "Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets," *California Management Review*, 40:55-79.

**10/17 Session 13 - Capturing Value from Technology II**

Video: Voyage Air <https://www.youtube.com/watch?v=ffylAU4nYIY>

Reading: Somaya, D., Teece, D., & Wakeman, S. (2011), "Innovation in multi-invention contexts: Mapping solutions to technological & intellectual property complexity," *California Management Review*, 53(4), 47-79.

Supplementary Reading: Cohen, W. M., Nelson, R. R., & Walsh, J. (2000), "Protecting their intellectual assets: Appropriability conditions and why US manufacturing firms patent (or not)," National Bureau of Economic Research Cambridge, Mass., USA;

**10/19 Session 14 - Markets for Technology**

Case: Carrot or Stick? Getting Paid for Innovation at Tessera Technologies (HBS 9-610-085)

Supplementary Reading: Arora, A., & Gambardella, A. (2010), "Ideas for rent: an overview of markets for technology," *Industrial and corporate change*, 19(3): 775-803.

**10/24 Session 15 - Student Projects Discussion**

**10/26 Session 16 - Student Projects Discussion**

**10/31 Session 17 - TBD**

**11/02 Session 18 - Strategies for Old Technologies**

Reading: Adner, R., & Snow, D (2010), "Old technology responses to new technology threats: demand heterogeneity and technology retreats," *Industrial and Corporate Change*.

**11/07 Session 19 - Network Effects**

Reading: Shapiro, C. and Varian, H. (1999), "Networks and Positive Feedback," Chapter 7 in *Information Rules: A Strategic Guide to the Network Economy*.

Supplementary Reading: (1) How to get to 30% share in 12 months (<http://www.justice.gov/atr/cases/exhibits/684.pdf>).

**11/09 Session 20 - Technology Platforms**

Readings: (1) Parker, Geoffrey, and Van Alstyne, M.W. (2014), "Platform Strategy Survey," Available at SSRN 2439323; (2) Gawer, A. (2012), "What Managers Need to Know about Platforms," *European Business Review*. [www.europeanbusinessreview.com/?p=4078](http://www.europeanbusinessreview.com/?p=4078)

**11/14 Session 21 - Business Ecosystems**

Readings: (1) Moore, J.F. (1993), "Predators and Prey: A New Ecology of Competition," *Harvard Business Review*, 71; (2) Iansiti M. and Levien R. (2004), "Strategy as Ecology," *Harvard Business Review*, 2(3): 68-78

Supplementary Readings: (1) Kapoor, R. and Agarwal, S. (2015), "Sustaining Superior Performance in Business Ecosystems: Evidence from Application Software Developers in the iOS and Android Smartphone Ecosystems," Wharton School Working Paper; (2) Kapoor, R. (2013), "Collaborating with Complementors: What do Firms do?" *Advances in Strategic Management*, 30: 3-25.

**11/16 Session 22 - Technology Platforms and Business Ecosystems (Case Discussion)**

Case: Apple vs. Google – (1) iPhone Unveiled, AP, Jan 9, 2007 (2) Apple vs. Google, Businessweek, Jan 14, 2010; (3) Android Invasion, Newsweek, Oct 11, 2010; (4) Steve Jobs on Q4'2010 Earnings Call, Oct 18, 2010.

*Project draft to be uploaded on Canvas by Nov 17*

**11/21 Session 23 - From Closed to Open Innovation**

Case: Intel Research (HBS 9-605-051)

Reading: Chesbrough, H. (2003), Chapter 9 in "Open innovation: The new imperative for creating and profiting from technology," Boston: Harvard Business School Press.

Supplementary Readings: (1) Kapoor, R. and Klueter, T. (2015), "Decoding the Adaptability-Rigidity Puzzle: Evidence from Pharmaceutical Incumbents' Pursuit of Gene Therapy and Monoclonal Antibodies," *Academy of Management Journal*; (2) Kapoor, R. and McGrath, P. J. (2014), "Unmasking the Interplay between Technology Evolution and R&D Collaboration: Evidence from the Global Semiconductor Manufacturing Industry, 1990-2010," *Research Policy*.

**11/28 Session 24 - Technology, Economy and Society**

Readings: To be circulated prior to the class session

**11/28 Time for Research (No Class)**

*Copy of all presentations to be uploaded on Canvas by 9am on Dec 2*

**12/05 Session 25 - Project Presentations**

**12/07 Session 26 - Project Presentations**

**12/12 Session 27 - Course Wrap-up**

*Final paper to be uploaded on Canvas by Dec 15*