

15.912: TECHNOLOGY STRATEGY

Fall 2009-2010

Professor Jason Davis

Office hours: Tuesday 1:30-3:00 (signup sheet on door / email Petra for appt.)

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This course provides a series of strategic frameworks for managing high-technology businesses. The emphasis throughout the course is on the development and application of conceptual models which clarify the interactions between competition, patterns of technological and market change, and the structure and development of organizational capabilities.

This is not a course in how to manage product or process development. The main focus is on the acquisition of a set of powerful analytical tools which are critical for the development of a technology strategy as an integral part of business strategy. These tools can provide the framework for deciding which technologies to invest in, how to structure those investments and how to anticipate and respond to the behavior of competitors, suppliers, and customers. The course should be of particular interest to those interested in managing a business for which technology is likely to play a major role, and to those interested in consulting or venture capital.

The course utilizes lectures, case analyses, simulations, and independent reading. The readings are drawn from economics, and from research in technological change and organizational theory. The case studies provide an extensive opportunity to integrate and apply these abstract tools in a practical, business policy context.

Grades will be determined by class participation, four two-page papers, and a final paper based on a group project. The group project – which may be written in groups of 3 people – consists of an in-depth exploration of technology strategy in an industry of your choice. Many students chose to focus their two page papers and final paper on the same topic and, thus, “build up” to the final paper due at the end of the semester. There is no final exam.

This is an advanced course. I draw extensively on the material presented in 15.900, Strategic Management and 15.011, Introduction to Economics as prerequisites, although some exceptions can be made with permission of the instructor. Knowledge or work experience of basic concepts in innovation and entrepreneurship in high technology settings is also useful for background to this course.

As markets become more interdependent and dynamic, partnerships between firms have become a critical aspect of technology strategy. Therefore, another important theme of the course content is how high technology firms create, capture, and deliver value through inter-firm relationships such as alliances, collaborations, and joint ventures.

COURSE REQUIREMENTS AND EXPECTATIONS

Grading

Class attendance and participation	50%
Four two-page papers	20%
Final paper	30%

Class Attendance and Participation:

Most of your participation grade will be based on attending class on time and adding value during the case discussions.

Of course, we understand that sometimes absences are necessary (e.g., sickness, interviews, etc.). Therefore, to give you a chance to make up the missed day's participation, we ask that you do the following: please write a 1 page memo either answering the questions (if it is a case day) or applying the frameworks in the lecture notes online to a company or industry of your choice. While making up absences with memos is optional, please do remember that participation is a big component of your grade. These memos should be handed to your TA before class the week after your absence. Also, we please ask that you let us know (email Professor Davis and your TA) before a class absence if possible.

Four Two-Page Papers:

Papers are due on the following dates and on the following topics. Papers should be one to three pages long, excluding tables or figures, double or 1.5 spaced, 11 or 12 point font and 1 inch margins. Papers are due before class on these dates.

Due date	Topic
September 16	Sketch the relevant S curve(s) for your industry. Is the industry likely to be subject to "natural technological limits"? Why or why not? Has it experienced "disruptions"? Is it likely to do so soon?
September 30	What are the principle drivers of industry evolution in your industry? What are the main market segments and how are customer needs likely to evolve?
October 14	How have the firms in your industry captured the value that they have created historically? What has been the relative role of uniqueness and complementary assets? Does this differ across firms? Will this change in the future?
November 16	What role do standards, platforms, and partnerships play in how value is captured in your industry?

Final Paper and Class Presentation

The final paper should illustrate the application of one or more of the frameworks developed in the

class to an industry or firm of your choice. A brief paragraph outlining your topic and listing the people with whom you hope to work is **due in class on November 2nd**.

The final paper is due December 9th. No extensions can be given, so please plan ahead. It should be roughly ten to fifteen pages in length and can be completed either individually or in groups of two or three.

Also, all groups must also prepare a 15 minute (maximum) presentation of the findings of their project (in 5 slides or less). These **slides are due December 2nd** before class (email to your TA) and should be viewed as a “trial run” or brief summary of your paper’s findings. Selected groups will be asked to present their slides during class on December 7th so please come prepared to present if you are called upon.

Note: you do not have to do this final project (paper + presentation) with the same people (or about the same industry) with whom you wrote your “2 pagers”, although many groups in the past have found this to be an effective strategy to gradually build up their knowledge about a firm or industry of interest over the semester. My goal is to support you in writing about a topic that interests you.

Previous titles have included:

The future of fuel cells -- What happened to GO?-- Structuring Corporate Research at Otis Elevator -- Seiko-Epson's Message Watch in the Taiwan Market -- Red Hat and Linux: The battle for a standard – Sony vs Microsoft in the video game market – The future of Nanotechnology

Summary of Course Deliverables:

September 16, September 30, October 14, November 16: Two-Page Papers (hardcopy to TA)

November 2: Paragraph Outlining Final Paper Topic (hardcopy to TA)

December 2: Presentation Slides (please email to TA on Dec. 2nd; be prepared to present them on Dec. 7th)

December 9: Final Paper (hardcopy to TA)

Collaboration

Group work is not only acceptable but actively encouraged. Indeed *I would strongly recommend that you form a study group* with a few friends who can meet to discuss the readings before each class. My experience suggests that this will significantly increase both your enjoyment of the course and the amount that you find yourself learning.

Reading Packets & the Web

Teaching notes will be available on the course web site, while other assigned readings are available from Graphic Arts, with the exception of those cases which are noted in the syllabus as being distributed in class. When you pick up your course packet, please check to be sure that it is complete. The transparencies from each lecture, links to points of interest (e.g., company web sites) and critical course information such as due dates will also be posted on the web.

Supplementary Reading

Supplementary readings are used to illustrate key concepts in each section of the course. Some of these concepts may be familiar to those who have taken 15.350/15.351 “Managing Technological Innovation and Entrepreneurship”. If you have not taken either 15.350 or 15.351, and if you are

otherwise unfamiliar with the following concepts:

The S curve & the determinents of industry evolution
Tools for exploring new markets: The nature of the innovator's dilemma
Capturing value: Uniqueness & complementary assets
Core concepts in network externalities
Why responding to discontinuous technological change is so difficult and what to do about it

...then you may wish to read ahead in the papers that follow (which are all in the course reader).

The S curve & the determinents of industry evolution

McGahan, Anita, 2004, "How Industries Change". Harvard Business Review, October: 87-94.
Foster, Richard "The S-curve: A New Forecasting Tool" Chapter 4 in Innovation, The Attacker's Advantage, Summit Books, Simon and Schuster, New York (NY), 1986, pp 88-111.
Utterback, James "Invasion of a Stable Business by Radical Innovation," Chapter 7 in Mastering the Dynamics of Innovation, Harvard Business School Press, 1994, pp 145-166.

Tools for exploring new markets: The nature of the innovator's dilemma

Moore, Geoffrey "High-Tech Marketing Illusion" Chapter 1 & "High-Tech Marketing Enlightenment" Chapter 2 in Crossing the Chasm, Rev. Ed., NY: Harper Collins, 1999, pp 9-59.
Christensen, Clayton "How can great firms fail? Insights from the hard disk industry" Chapter 1 in The Innovator's Dilemma, Harvard Business School Press, 1997, pp 3-28.

Capturing value: Uniqueness & complementary assets

Henderson, Rebecca "Making Money from Innovation" Chapter 3 in Strategy and Technology (forthcoming).

Network externalities

Shapiro, Carl and Varian, Hal, 1999, "The Art of Standards Wars." California Management Review, 41, (2): 8-32
Brandenburger, Adam and Nalebuff, Barry "War and Peace" Chapter , "Co-opetition" Chapter 2, & "Added values" Chapter 5 in Co-opetition, New York, Doubleday, 1996, pp 3-39, 110-158

Why responding to discontinuous technological change is so difficult and what can be done about it

Tushman, Michael and Smith, Wendy "Organizational Technology" Chapter 17 in J. Baum (ed) Companion to Organizations, Blackwell, 2001, pp 386-414.
Henderson, Rebecca "Going for Growth: Managing Discontinuous Innovation" Chapter 7 in Strategy and Technology (forthcoming).

Course Outline

0. Introduction

Creating, Capturing, and Delivering Value with Technology Strategy September 9

I. Creating Value: Technology, Market, and Organizational Perspectives

Case: eInk September 14

Case: Apple 2006 September 16

Industry Life Cycles and Evolution of Markets September 21

Case: Novartis September 23

Partnership Case: Intel (A): Photolithography Strategy in Crisis September 28

Organization of Innovation: Structure, Processes and Incentives September 30

II. Capturing Value: Appropriability, Competition, and Interdependence

Case: Abgenix and the Xenomouse October 5

Appropriability: Uniqueness and Complementary Assets October 7

Case: Ember: Developing the Next Ubiquitous Network Standard October 13

Open Standards, Increasing Returns, and Proprietary Control October 14

SIP (October 19-23)

Case: Red Hat and the Linux Revolution October 26

Partnership Case: Google & AOL October 28

Horizontal/Vertical Strategies and the Evolution of the Value Chain November 2

Case: Nokia; Apple iPhone & Google Phone November 4

Strategic Management of Platforms and Ecosystems November 9

III. Delivering Value: Organizational Dynamics and Inter-Firm Relationships

Partnership Case: Alza/Ciba (1): Structuring a Deal? November 16

Partnership Case: Alza/Ciba (2): Managing the Relationship, 1977-1979 November 18

Case: We've got Rhythm! Medtronic Corporation's Cardiac Pacemaker Business November 23

Organizational Dynamics: Overload, Time-Pacing, Simple Rules, and Probing November 25

Case: Toyota Motor Corporation: Launching Prius November 30

IV. Practicing Technology Strategy

Case: Kodak and the Digital Revolution (A) December 2

Selected Student Presentations December 7

Conclusions and Reflections December 9

TECHNOLOGY STRATEGY
PROF. JASON DAVIS
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0. INTRODUCTION:

Class 1: Introduction: Defining “Technology Strategy”

September 9

“The Way of the Warrior,” The Economist, October 16th, 2004

Questions for Discussion

Is the strategy outlined for Motorola *useful*? Why or why not? In your view, how should one define a strategy for a technology driven company? How should such a strategy differ from a technology strategy? What should be the relationship between them? When is a technology strategy useful? What should be its role?

I. CREATING VALUE: TECHNOLOGY, MARKET, AND ORGANIZATIONAL PERSPECTIVES

Class 2: eInk: Financing Growth

September 14

Questions for Discussion

What are the critical characteristics of electrophoretic displays? What implications do these characteristics have for systems of which they are a component?

Which possible applications should eInk be targeting?

How should eInk prioritize its opportunities? Should they target a smaller niche initially?

Which capabilities should eInk build?

Suggested pre-readings

The S curve & the determinants of industry evolution

McGahan, Anita, 2004, “How Industries Change”. Harvard Business Review, October: 87-94.

Foster, Richard "The S-curve: A New Forecasting Tool" Chapter 4 in Innovation, The Attacker's Advantage, Summit Books, Simon and Schuster, New York (NY), 1986, pp 88-111.

Utterback, James “Invasion of a Stable Business by Radical Innovation,” Chapter 7 in Mastering the Dynamics of Innovation, Harvard Business School Press, 1994, pp 145-166.

Class 3: Apple, 2006

September 16

Questions for Discussion

What are the critical technological trajectories in the personal computer industry over the last 20 years?

Who are the relevant customers and how have their preferences evolved over the last 20 years?

How has Apple’s PC strategy evolved? What technology trajectories do they emphasize? What customers do they target? What capabilities have they built over time? How do these capabilities differentiate their offering?

How has Apple's iPod and iTunes strategy evolved? What technology trajectories are emphasized? What customers do they target? What capabilities have they built over time? How do these capabilities differentiate their offering?

How does the iPhone fit into the iPod/iTunes strategy? How do technologies and customers differ for this product?

What is your recommended next step for the iPod/iTunes business?

Suggested Pre-readings

Moore, Geoffrey "High-Tech Marketing Illusion" Chapter 1 & "High-Tech Marketing Enlightenment" Chapter 2 in Crossing the Chasm, Rev. Ed., NY: Harper Collins, 1999, pp 9-59.

Christensen, Clayton "How can great firms fail? Insights from the hard disk industry" Chapter 1 in The Innovator's Dilemma, Harvard Business School Press, 1997, pp 3-28.

Class 4: Industry Life Cycles and Evolution of Markets

September 21

Questions for Discussion

Bring your questions and/or reflections on the content so far to class.

Class 5: Novartis Pharma: The Business Unit Model

September 23

Questions for Discussion

How have innovations traditionally been developed at Novartis? How has this changed over time?

What role do biotechnology firms play in the Novartis innovation process?

What are the advantages and disadvantages of centralized R&D?

What other important issues are relevant to the design of Novartis's organizational structures?

How should Novartis restructure now?

Suggested Pre-readings

Tushman, Michael and Smith, Wendy "Organizational Technology" Chapter 17 in J. Baum (ed) Companion to Organizations, Blackwell, 2001, pp 386-414.

Eisenhardt, Kathleen and Galunic, Charles, 2001, "Coevolving: At Last, a Way to Make Synergies Work." Harvard Business Review, January-February: 91-101.

Class 6: Intel Labs (A) Photolithography Strategy in Crisis

September 28

Questions for Discussion

What is Intel's view of basic research?

What are the strengths of Intel's approach to R&D? Do you see any weaknesses?

What would you recommend that Sandy Wilson do? Of the three options outlined on page 10 of the case, which do you think makes the most sense and why?

Suggested Pre-readings

Eisenhardt, Kathleen and Brown, Shona, 1999, "Patching: Restitching Business Portfolios in Dynamic Markets." Harvard Business Review, May- June: 72-82.

Henderson, Rebecca “Going for Growth: Managing Discontinuous Innovation“ Chapter 7 in Strategy and Technology (forthcoming).

Class 7: Organization of Innovation: Structure, Processes, and Incentives **September 30**

No required reading!

Bring your questions and/or reflections on the content so far to class.

II. CAPTURING VALUE: APPROPRIABILITY, COMPETITION, AND INTERDEPENDENCE

Class 8: Case: Abgenix and the Xeno Mouse **October 5**

Questions for Discussion

How do you think Abgenix can best exploit the Xeno Mouse? What should they do now?
Who else could capture value from the Xeno Mouse?

Suggested pre-readings

Henderson, Rebecca “Making Money from Innovation” Chapter 3 in Strategy and Technology (forthcoming).

Class 9: Appropriability: Uniqueness and Complementary Assets **October 7**

No required reading!

Bring your questions and/or reflections on the content so far to class.

Class 10: Case: Ember Corporation: Developing the Next Ubiquitous Network Standard **October 13**

Questions for Discussion

Should Ember integrate into chip manufacturing? Why or why not?
What are Ember’s major competitive threats going forward?
What should Ember’s strategy be?

Suggested pre-reading:

Shapiro, Carl and Varian, Hal, 1999, “The Art of Standards Wars.” California Management Review, 41, (2): 8-32

Arthur, Brian, 1996, “Increasing Returns and the New World of Business.” Harvard Business Review, July-August: 100-109.

Class 11: Open Standards, Increasing Returns, and Proprietary Control **October 14**

No required reading!

Bring your questions and/or reflections on the content so far to class.

Class 12: Red Hat and the Linux Revolution **October 26**

Questions for Discussion

What are the major advantages of Linux over other operating systems? What role do standards play?
What is Red Hat's strategy for creating and capturing value? What role do partnerships play?
What should Red Hat do now?

Suggested pre-reading:

Henderson, Rebecca and Clark, Kim, 1990, "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms." Administrative Science Quarterly, 35: 9-30.

Class 13: Google Inc.

October 28

Questions for Discussion

What value does Google create for users? How does Google capture value?
What are the major turning points in Google's evolution?
What role do partnerships play? What effect did Google's early partnerships (e.g., AOL) have on Google's evolution?
Who are Google's major competitors in every stage of its evolution? What are the major threats to Google's dominance in internet advertising?
What are Google's main competencies? Where does Google fit in the value chain?
What are the most important markets that Google should enter? Why?

Suggested pre-reading:

Brown, Shona and Eisenhardt, Kathleen, 1997, "The Art of Continuous Change: Linking Complexity Theory and Time-paced Evolution in Relentlessly Shifting Organizations." Administrative Science Quarterly, 42: 1-34.

Class 14: Horizontal/Vertical Strategies and the Evolution of the Value Chain

November 2

No required reading!
Bring your questions and/or reflections on the content so far to class.

Class 15: Nokia 2003; Apple iPhone; Google Phone

November 4

Today's class will focus on a comparison of the mobile phone technology strategies of Nokia, Apple, and Google. Some reading materials will be handed out in class 14.

Questions for Discussion

What are the critical technology trajectories and customer segments impacting the next generation mobile phone industry?
What types of firms influence mobile technology standards and the adoption of technologies?
Compare Nokia, Apple, and Google mobile phone products and technologies. What differential value do they offer? What customers do they target?
Compare Nokia, Apple, and Google mobility value creation strategies. How do they fit with other lines of

business?

Compare Nokia, Apple, and Google mobility value capture strategies. What role do uniqueness and complementary assets play?

How do the firm's capabilities differ? Compare the partnerships of each firm and describe their positions in the value chain.

What should each firm do?

Who will win the battle? Who will be most successful? Why?

Suggested pre-reading:

Brandenburger, Adam and Nalebuff, Barry "War and Peace" Chapter , "Co-opetition" Chapter 2, & "Added values" Chapter 5 in Co-opetition, New York, Doubleday, 1996, pp 3-39, 110-158

Class 16: Strategic Management of Platforms and Ecosystems

November 9

No required reading!

Bring your questions and/or reflections on the content so far to class.

III. DELIVERING VALUE: ORGANIZATIONAL DYNAMICS AND INTER-FIRM RELATIONSHIPS

Class 17: Case: Alza/Ciba (1)

November 16

Class 17 and 18 focus on a class-based exercise. Details will be provided in Class 16.

Suggested pre-reading:

Hamel, Gary, Doz, Yves L., Prahalad, C.K., 1989, "Collaborate with Your Competitors – and Win." Harvard Business Review, January-February: 133-139.

Class 18: Case: Alza/Ciba (2)

November 18

Class 17 and 18 focus on a class-based exercise. Details will be provided in Class 16.

Class 19: We've got Rhythm! Medtronic Corporation's Cardiac Pacemaker

November 23

Questions for Discussion

Why did things go so badly wrong at Medtronic?

What role does rhythm play in Medtronic's line of business? What simple rules guide strategic decision making at Medtronic?

Of all the things that Medtronic did to "fix" it's process, what do you think was the most important? Why?

What should they do now?

Suggested pre-reading:

Repenning, Nelson and Serman, John, 2001, "Nobody Ever Gets Credit for Fixing Problems that Never Happened." California Management Review, 43(4): 64-88.

Eisenhardt, Kathleen and Sull, Don, 2001, "Strategy as Simple Rules." Harvard Business Review, January: 107-116.

Eisenhardt, Kathleen and Brown, Shona, 1998, "Time Pacing: Competing in markets that won't stand still." Harvard Business Review, March-April: 59-69.

Class 20: Organizational Dynamics: Overload, Time-Pacing, Simple Rules, and Probing November 25

No required reading!

Bring your questions and/or reflections on the content so far to class.

Class 21: Toyota Motor Corporation: Launching Prius

November 30

Questions for Discussion

What capabilities and technologies does Toyota possess related to hybrid technologies? What value does a hybrid car provide?

What are the critical decisions to be made? How should Toyota's executives make these decisions?

Should Toyota launch the Prius at this time or not? Why now? Why not wait?

Suggested pre-reading:

Eisenhardt, Kathleen, Kahwajy, Jean, and Bourgeois III, L.J., 1997, "How Management Teams Can Have a Good Fight." Harvard Business Review, July-August, 77-85.

Eisenhardt, Kathleen, 1989, "Making Fast Strategic Decisions in High-Velocity Environments." Academy of Management Journal, 32 (3): 543-576.

IV. PRACTICING TECHNOLOGY STRATEGY

Class 22: Kodak & the Digital Revolution (A)

December 2

Questions for Discussion

All things considered, did it make sense for Kodak to invest in digital photography? Why or why not?

How would you evaluate their ability to execute their strategy? Why did the firm encounter difficulties?

What might they have done differently?

What should Kodak do next?

Class 23: Selected Student Presentations

December 7

Class 24: Conclusions and Reflections

December 9

No required reading!

Bring your questions and/or reflections on the content so far to class. This is the last required class.