SDM **system** DESIGN AND MANAGEMENT

15.905 Technology Strategy

Overview of the course

Michael A M Davies

2 April 2007

Massachusetts Institute of Technology

Agenda for today, Monday 2 April 2007

~13:00
- Brief introduction to the course
  - introductions
  - objectives
  - overview

~13:15
- E Ink
  - 1998: initial challenges for Jim Iuliano
  - 1999: money and partners
  - …

~14:15
- Brief summary of some key concepts

Michael A M Davies

- From New Zealand, educated in the UK, lived in US >10 years
- 2 Masters in Engineering

- ~20 years ago, got very interested in how high-tech businesses make strategic decisions

- …did an MBA at London Business School

- Worked in industry
- Founded (and sold) consulting business that works for tech businesses

- Recently working closely with faculty from MIT Sloan (and elsewhere)

- …and teach New Technology Ventures, consult, and start-up CTO

Rebecca M Henderson

- Eastman Kodak Professor of Management at the Sloan School of Management
- Specializes in technology strategy and the broader problems faced by firms in high technology industries
- Experience in machine tools, semiconductor capital equipment, computers, aerospace and consumer goods
- Current research focuses on pharmaceutical and biotechnology industries
- Expert Witness for the DoJ in Microsoft case
- Board of Whitehead Institute for Biomedical Research
- In 2001, "Teacher of the Year" at the Sloan School

This course provides a framework for the strategic management of technology businesses

Technology businesses

- Complex
- Dynamic - and unstable
- Uncertain

- Co-evolution of technological innovation, demand opportunities and business ecosystems
- Value creation and value capture

This course

- Ways of thinking
- Mental models

- Bring clarity to complexity

- Insights and anticipation
- Better decisions

- Improve (significantly) the odds of success

It uses both cases and presentations, focused on domains in which *systems* are important

- Products part of larger and more complex systems

- Products are comprised of multiple (sub-)systems

- Computing
- Communications
    - mobile
    - IP
- Consumer electronics
- Industrial networking
- Automotive
- Aerospace

- not so much biotech or pharmaceuticals

Guidelines and grades, deliverables and deadlines

- **Be ready to start on time**
- **Do not disrupt the class**
- Please sit in the same seats

- Read and review the cases
- Do the <u>required</u> readings
- We also recommend the recommended readings
  – square brackets […]
  – a long-term resource

- Group work is not just acceptable, but encouraged

- **40%** for class participation
  – quality not quantity
- 20% for 2 short papers
  – in groups of 3 or 4
  – **Thu 12** April
  – 13:00 Mon 30 April

10%

- **40%** for final paper
  – in (same) groups
  – **interim review on Tue 1 or Wed 2 May**
  – 13:00 Monday 14 May
  – **and** presentation ready

E Ink (1)

- What are the key characteristics of electrophoretic displays?
- What implications do the novel characteristics of electrophoretic displays have for the systems of which they are a component?
- What are your views on E Ink's approach to commercializing the technology?

E Ink (2)

- Which of the possible applications for electrophoretic displays do YOU think E Ink should be targeting?
- How do you think E Ink should/\prioritize and sequence the demand opportunities that it decides to pursue?
- In particular, it is targeting a small niche initially - is this the right thing to do, and is this the right niche?

E Ink (3)

- What do you believe are the key challenges that E Ink faces in growing the business?
- In particular, what do you think E Ink could be doing or should be doing to build up its capabilities?
- What other things should E Ink be doing in parallel with this, to make sure that it is well positioned for the medium and long term?
- As part of this, what should be the scope of activities for E Ink's business, how should this evolve over time, and how fast should E Ink be trying to grow?

E Ink beyond 2005

- Lexar uses eInk in its JumpDrive
- Sony announces and then launches its Portable Reader System
- Motorola uses a <u>segmented</u> eInk display for its low cost Motofone
  - great standby time
  - outside viewable
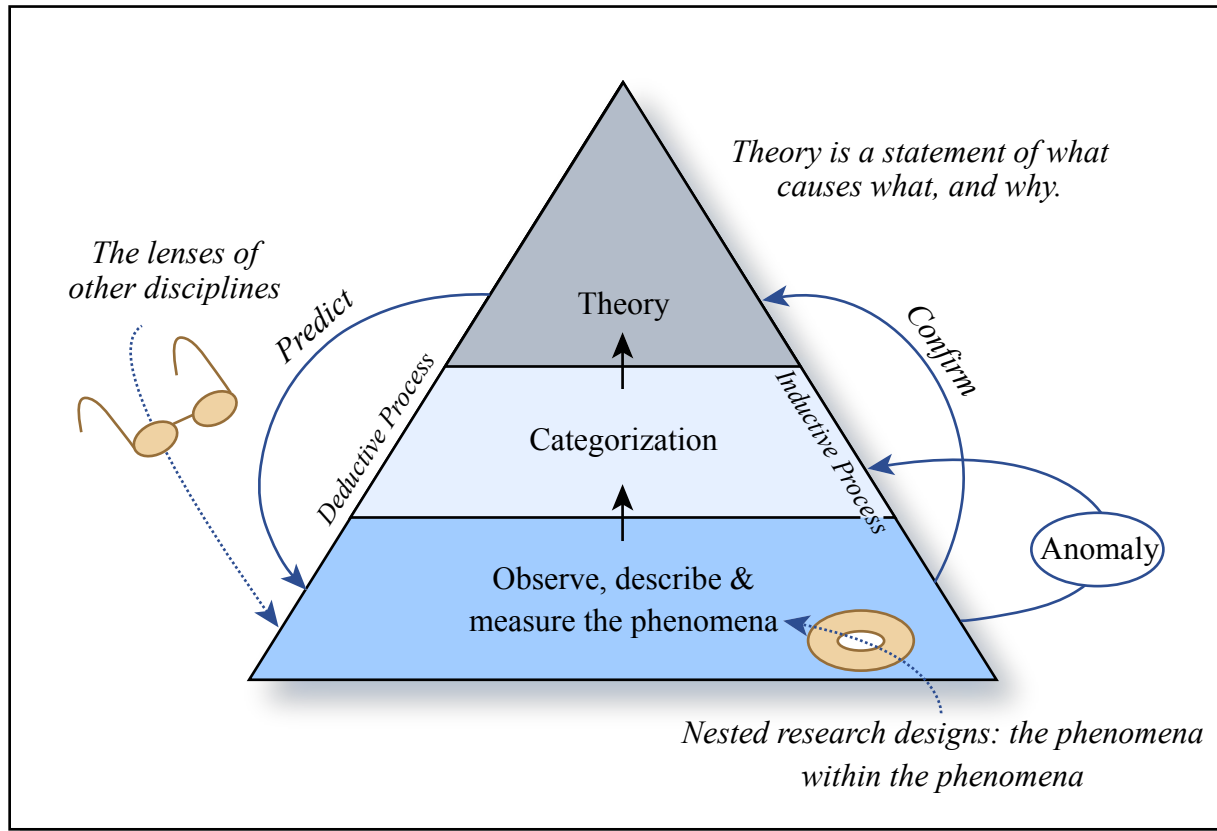
The process of *theory*-building

Theory is a statement of what causes what, and why.

The lenses of other disciplines

Predict

Deductive Process

Inductive Process

Confirm

Theory

Categorization

Observe, describe & measure the phenomena

Anomaly

Nested research designs: the phenomena within the phenomena

Image by MIT OCW.

Theory
noun

1. a belief or principle that guides action or assists comprehension or judgment[1]
2. a set of statements or principles devised to explain a group of facts or phenomena, especially one that has been repeatedly tested or is widely accepted and can be used to make predictions about natural phenomena[1]
3. a well-substantiated explanation of some aspect of the natural world; an organized system of accepted knowledge that applies in a variety of circumstances to explain a specific set of phenomena

1: American Heritage® Dictionary, © 2000 Houghton Mifflin
2: WordNet®, © 2005 Princeton University

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Technology

noun

1. electronic or digital products and systems considered as a group[1]
2. a technological process, invention, method or the like[2]
3. the practical application of science to commerce or industry[3]
4. the branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society and the environment[2]
5. the sum of the ways in which social groups provide themselves with the material objects of their civilization

1: American Heritage® Dictionary, © 2000 Houghton Mifflin
2: Random House Unabridged Dictionary, © Random House Inc. 2006
3: WordNet®, © 2005 Princeton University

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Strategy
noun

1. a plan, method or series of maneuvers or strategems for obtaining a specific goal or result[1]
2. the science and art of military command as applied to the overall planning and conduct of large-scale combat operations[2]
3. the art or skill of using strategems in endeavors such as politics and business[2]

1: Random House Unabridged Dictionary, © Random House Inc. 2006
2: American Heritage® Dictionary, © 2000 Houghton Mifflin

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Domain

noun

1. a knowledge domain that you are interested in or communicating about[1]
2. a field of action, thought or influence[2]
3. a realm or range of personal knowledge, responsibility and so on[2]
4. a sphere of activity, concern or function; a field[3]

1: WordNet®, © 2005 Princeton University
2: Random House Unabridged Dictionary, © Random House Inc. 2006
3: American Heritage® Dictionary, © 2000 Houghton Mifflin

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What is business strategy?

- Pursuing choices amongst competing options
  - a **different** system of activities that creates unique value and captures it
  - not operational effectiveness or improvement
- Planned and intended, pursued and realized
  - deliberate
  - emergent
- Pattern recognition
  - building the prepared mind
  - capable of making sound decisions

Michael Porter, "What is Strategy", Harvard Business Review, November-December 1996, pages 61-78

Henry Mintzberg, "Crafting Strategy", July-August 1987, pages 66-74

Sarah Kaplan, "The Real Value of Strategic Planning", MIT Sloan Management Review, Winter 2003, pages 71-76

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Why is technology (really, really) important?

- Technological *innovation* drives economic growth
  - why we can be here today
  - why we no longer live in caves
  - escaping the Malthusian trap
  - explaining how economies grow

- Get it wrong - waste a lot of money and people's lives

- Get it right - create (a lot of) wealth, capture (some of) it - and have fun

Economic growth accelerated dramatically by Industrial Revolution - 50x to 150x time faster

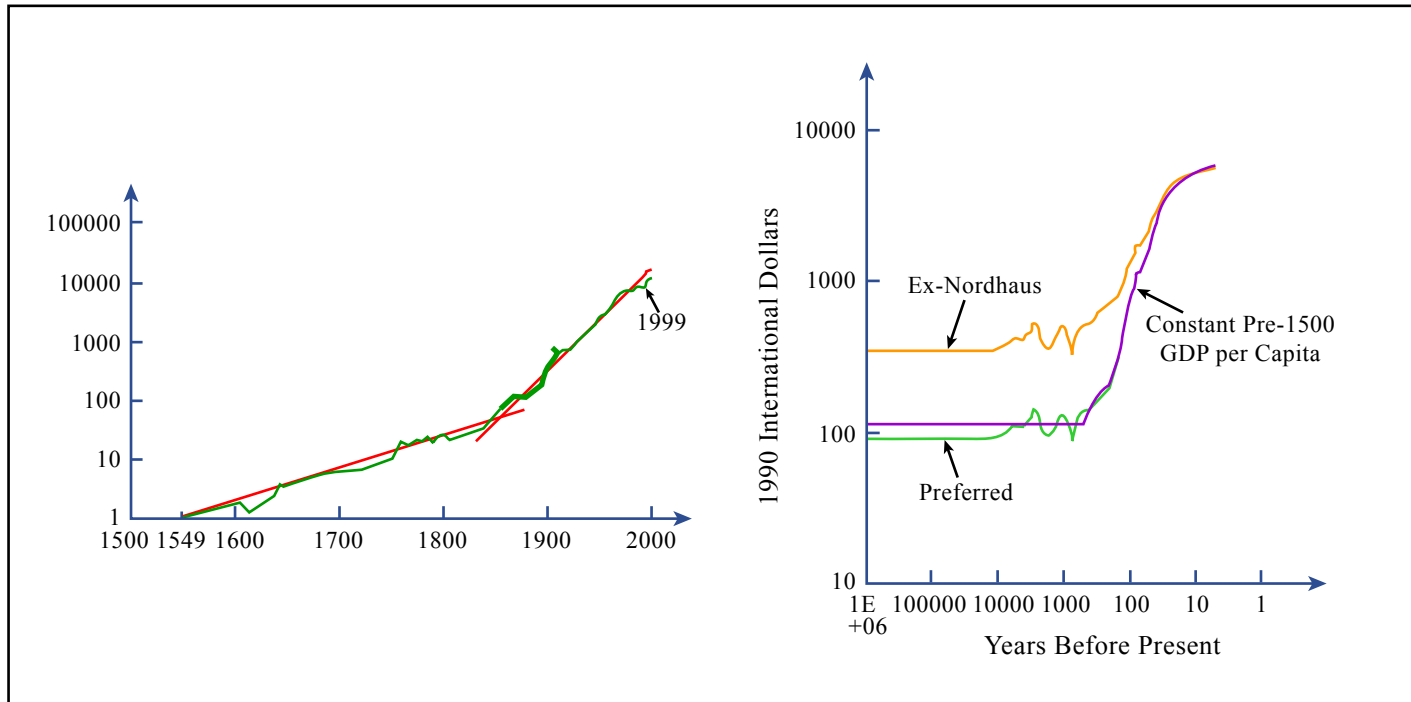Swedish Manufacturing Output (1875 = 100)

World Average GDP per Capita

Image by MIT OCW.

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And knowledge and technological innovation are now recognized as the engines driving growth

- *"Output per hour worked in the United States [in 1990] is 10 times a valuable as output per hour worked 100 years ago."*
- *"Technological change - improvement in the instructions for mixing together raw materials - lies at the heart of economic growth"*
- *"Technological change arises in large part because of intentional actions taken by people who respond to market incentives."*
- *"[I]nstructions for working with raw materials are inherently different from other economic goods. Once the cost of creating a new set of instructions has been incurred, the instructions can be used over and over again at no additional cost."*

Paul Romer, "Endogeneous Technological Change", The Journal of Political Economy, October 1990, pages S71-S102
Paul Romer, "Increasing Returns and Long-Run-Growth", The Journal of Political Economy, 1986, pages 1002-1037

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Technology strategy (very often) determines who survives and thrives

- IBM (mainframe computers)
- Sun Microsystems

- Matsushita, and many others (VHS)
- Sony (transistor radios)
- Nikon (in semiconductor capital equipment)
- Canon (in photocopiers)
- Canon, Nikon and others
- Nokia

- DEC, Wang, Unisys and many others
- Apollo Computer and others

- Sony (Betamax)

- RCA
- Cobilt, Canon, Perkin-Elmer and GCA
- Xerox
- Polaroid and Kodak
- Motorola

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Nine key concepts

1. Technological infrastructure, technologies, innovation, parameters and trajectories
2. Demand opportunity, adoption and diffusion
3. Business ecosystems, niches and co-opetition
4. Co-evolution, life-cycles, epochs and transitions
5. Value creation, value capture and inimitability
6. Systems, architecture, modules, interfaces, standards, platforms, portfolios and pipelines
7. Activities, tasks, competences and capabilities
8. Ambiguity and scenarios, uncertainty and real options
9. Simple rules, prepared mind, active waiting, overload

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A roadmap for the course

<u>A</u> Introduction	<u>B</u> Patterns of change	<u>C</u> Capturing Value	<u>D</u> Deciding and Delivering
Demand opportunity			
Business ecosystems, niches and co-opetition	**Co-evolution, life-cycles, epochs and transitions**	**Value creation, value capture and inimitability**	**Ambiguity and scenarios, uncertainty and real options**
Technological infrastructure			

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