CPET 575 Management Of Technology

Challenges of Managing in High Technology

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Course Description

CPET 575 Management of Technology, Class 3, Cr. 3

This course introduces conceptual foundation and the method for managing technology and innovation. Topics include technology and society; technology development infrastructure; technology and strategy; technology competitive analysis, forecasting and assessment; techniques for dealing with risk, uncertainty and change; tools and best practices for technology lifecycle management; government, societal, and international issues. A combination of lectures, reading, presentation and reports, a variety of case studies and group discussions is used.
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Required Text Book (Case studies and readings)


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References (Case studies and readings)

- MIT Technology Review, Web site:
Class Activities, Expectations, Grading

- The class format will be 3 hour lecture each week, 16 weeks total.
- Active student participations in presenting case studies and papers from the recent literature, class case studies/discussion, and a team-based final project and presentation are expected.
Class Activities, Expectations, Grading (continue)

- Student assignments include assignments on case studies and reading technical papers an/or technical articles and writing short summary.
- Case studies and presentations: Each student will take responsibility for “leading” the discussion of a minimum of two case studies (details and sign-up will be discussed in first class).

Class Activities, Expectations, Grading (continue)

- Term project: students will complete a term project working in groups of 2-3 students, prepare progress reports, present projects in class and complete a written project report. Guidelines for the project will be provided in the class.
Terms Defined in Webster’s New Collegiate Dictionary

Technology

- Systematic treatment of a technical method of achieving a practical purpose
- The totality of the means employed to provide objects necessary for human substance and comfort

Technology – Other Definitions

- What is Technology, http://www.aber.ac.uk/media/Modules/MC10220/whattech.html
Terms Defined in Webster’s New Collegiate Dictionary (continue)

- Management
  - The act or art of managing
  - The conducting or supervising of something (as a business)
  - The collective body of those who manage or direct an enterprise

Terms Defined in Webster’s New Collegiate Dictionary (continue)

- Strategy
  - The science and art of employing the political, economic, psychological, and military forces of a nation or group of nations to afford the maximum support to adopted policies in peace or war
  - The science and art of military command exercised to meet the enemy in combat under advantageous conditions
Terms Defined in Webster’s New Collegiate Dictionary (continue)

- **Strategy**
  - A careful plan or method
  - The art of devising or employing plans or stratagems toward a goal

Terms Defined in Webster’s New Collegiate Dictionary (continue)

- **Project**
  - A specific plan or design
  - A tasks or problem engaged by a group of students to supplement and apply classroom studies

- **Design**
  - A preliminary sketch or outline showing the main features of something to be executed
  - a particular purpose held in view by an individual or group
History of Technology$^1$

- Technology in Archaeology
  - Material technologies (stone tools, wood, pottery, copper, bronze, iron (steel))
  - Agriculture technologies
  - Information technologies (cave art, Venus figures, writing)
  - Energy technologies (fire, irrigation, sailing ships, wheeled vehicles)


History of Technology$^1$ (continue)

- Transportation Technology
  - Horse, wheeled vehicles
  - Ship, stream boat, submarines
  - railroads, steam locomotive,
  - Cars, trucks
  - Air planes, rocket

- Energy Technology
  - Man power
  - Animal power
  - Wind power
  - Coal, steam power
  - Fossil fuel power

History of Technology\(^1\) (continue)

- Technology – Military Conflicts
  - Ancient warfare (weapons and armor; clubs, spears, knives, bow and arrows)
  - Medieval warfare (military tactics, cavalry-based forces)
  - Gun power warfare (first developed in Song Dynasty (960 – 1279) China)
  - Industrial warfare (mass-conscription armies; rapid transportation – railroads, sea, and air; telegraph and wireless communications)
  - Modern warfare (variety of tools and methods available to modern battlefield commanders)


Managing in Today’s High-Tech Business Environment\(^1\)

- Activities
  - Cluster around projects with team efforts that span organizational lines involving a broad spectrum of
    - Personnel
    - Support groups
    - Subcontractors
    - Vendors
    - Partners
    - Government agencies
    - Customer organizations

Managing in Today’s High-Tech Business Environment\textsuperscript{1}

- Critical Needs for Success in High-Tech Business
  - Effective linkages, cooperation, and alliances among various organizational functions are critical for proper communication, decision making, and control.

- Requires
  - Sophisticated teamwork
  - The ability to manage across functional lines with little or no formal authority
  - Dealing effectively with resource sharing
  - Multiple reporting relationships and accountabilities


Managing in Today’s High-Tech Business Environment\textsuperscript{1}

- Characteristics and Challenges of Today’s Technology-Based Business
  - High task complexities, risks, and uncertainties
  - Fast-changing markets, technology, regulations
  - Intense competition, open global markets
  - Resource constraint, tough performance requirements
  - Tight, end-date-driven schedules

Managing in Today’s High-Tech Business Environment\textsuperscript{1}

- Characteristics and Challenges of Today’s Technology-Based Business (continue)
  - Total project life-cycle considerations
  - Complex organizations and cross-functional linkages
  - Joint venture, alliance and partnerships; need for dealing with different organizational cultures and values
  - Complex business process and stakeholder communities


Managing in Today’s High-Tech Business Environment\textsuperscript{1}

- Characteristics and Challenges of Today’s Technology-Based Business (continue)
  - Need for continuous improvements, upgrades, and enhancements
  - Need for sophisticated people skills, ability to deal with organizational conflict, power, and policies
  - Virtual organizations, markets, and support systems
  - Increasing impact of IT and e-business

Managing in Today’s High-Tech Business Environment

- Resulting in demand for
  - High market responsiveness
  - Fast developments
  - Low cost
  - High levels of creativity, innovation, and efficiency


MOT Scope and Focus

- Different meaning to different people
- Scope is very broad and diverse
  - MOT relates to specific research and development of new concepts
  - MOT means engineering design and development, manufacturing, or operations management
- Over the last 20 to 30 years,
  - management literature has shifted its technology focus from R&D to new product development and then to product enhancement.

MOT Scope and Focus

- In more current times, it emphasis has been gravitating toward
  - Market development and
  - E-commerce
- MOT includes the
  - Planning
  - Organizing coordinating, and
  - Integrating
  of all the resources needed to achieve the enterprise-specific goals and objectives

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MOT Scope and Focus

- MOT vs. other established fields of organization and management
  - Special knowledge and skill requirements for applying the technology, including organizing and coordinating technology resources, and directing the people involved with it.
- MOT Definition – a broad sense
  - The art and science of creating value by using technology together with other resources of an organization

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**MOT Scope and Focus¹**

MOT should not be confined to
- R&D,
- Engineering, or
- Scientific work, but

Includes many other facets of the enterprise and its environment.

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**Definition of Management of Technology**

“Management of technology links engineering, science, and management disciplines to plan, to develop, and to implement technological capabilities to shape and accomplish the strategic and operational goals of an organization.”

(National Research Council, 1987)

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A Formal Definition - MOT

- MOT is multidisciplinary

![Figure 1.1 Dimensions of MOT](image)


A Formal Definition - MOT

- MOT involves
  - The management of engineering, natural science, and social science
  - Administrative science in planning, decision making, development, and implementation of technology
  - Operational processes, tools and techniques, and people who make it all happen
  - Guidance and leadership aim toward the development of products and services
  - Managing many interdisciplinary components and managing their integration into a whole system
  - Managing the system

A Formal Definition - MOT

- MOT focuses on
  - The development of operational capabilities such as manufacturing, distribution, and field services
- MOT is influenced by
  - Business strategy
  - Organizational culture, and
  - The business environment, and vice versa


All About Technology

- Technology Development Processes
  - Identification of a specific need
  - Assessment
  - Strategy, Funding, Plan, etc
  - Design
  - Prototyping
  - Transfer (Intellectual property)
  - Commercialization
    - Production
    - Marketing
    - Sales
    - Distribution
    - Customer support
    - Maintenance
  - User/customer/consumer
Classification of Technology

- **State-of-the Art Technologies**
  - Technologies equal or superior to competitive offering

- **Proprietary Technologies**
  - Technologies protected by patents, and so forth

- **Known Technologies**
  - Technologies common to many companies but used uniquely

- **Core Technologies**
  - Technologies essential for maintaining competitive positions

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Classification of Technology (continue)

- **Leveraging Technologies**
  - Technologies that support several products or classes of products

- **Supporting Technologies**
  - Technologies that support core technologies

- **Pacing Technologies**
  - Technologies that control the product or service development

- **Emerging Technologies**
  - Technologies under consideration for future application

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January 13, 2009
Classification of Technology\textsuperscript{1} (continue)

- Scouting Technologies
  - Technologies tracked for potential applications
- Unknown Technologies
  - Technologies currently unknown, but believed of considerable benefits

\textsuperscript{1}Hans J. Thamhain, \textit{Management of Technology},

Other Classifications of Technology

- Sustaining Technology
  - Improving on existing technologies, most often in the areas of performance
  - Compatible with existing standards and address current market needs
  - Examples
    - Microsoft Windows OSs
      - Windows 3.0, 3.1
      - Windows 95, 98
      - Windows 2000, XP, Vista
      - Windows 7
    - Palm’s PDA; Pocket PCs, etc
Other Classifications of Technology (continue)

- **Disruptive Technology**
  - Andy Grove, Intel co-founder, define its as “a time in the life of a business when its fundamentals are about to change”
  - The needs of the customer can no longer met inside the current technology parameters
  - Radical change at a system level with paradigm-shifting innovations
  - Huge positive impact on the economy, new categories of products and services, new companies and jobs

Other Classifications of Technology (continue)

- **Disruptive Technology - Examples**
  - Transistor-based devices
    - Battery-powered transistor radio introduced by Sony in 1950
    - Over time, the transistor radio became cheaper, smaller, and better quality of sound
  - Integrated Circuits
    - Microprocessor (MOS-based) in 1970’s
    - Microcontrollers
    - Intel CPUs for PCs
Other Classifications of Technology (continue)

- Disruptive Technology -Examples
  - Personal Computer
    - not disruptive to the mini-computer industry (DEC, Wang Computer);
      disruptive to companies making terminal connect hardware
    - altered paradigm: a computer on every desk vs. a computer in every office
  - Storage Devices
    - Magnetic memory/RAM/DRAM
    - Floppy disk/Zip Disk/Flash Drive

- Disruptive Technology -Examples
  - Internet Technology
    - Computer-computer communications
    - Collaboration, resource sharing
    - Information sharing/publishing
    - E-learning and education
    - Advertisement
    - Business automation
    - Communications
    - E-business/E-commerce
    - Services
    - Social networking
    - etc
Other Classifications of Technology

Specific Applications
- Aerospace Technology
- Biological Technology
- Business Technology
- Computer Technology
- Energy Technology
- Information Technology
- Material Technology
- Military Technology
- Medical Technology
- Transportation Technology
- Vehicular Technology
- Nanotechnology
- etc

Business, Firms, Enterprise & Technology

High-Tech – Strategy, Marketing, High-Tech Production

Technology Oriented: high-tech products

Competitive advantages
- Value creation by applying technology: growth potential
- Lower barriers to entry

Improve efficiencies
- Using technology as solutions for business problems: automation
- Replacing manual labors: automation, AI
- Reducing time-to-market

Infrastructure: IT, networking, Internet, etc

Business Intelligence and Decision Making Support
Resources

- Others

Assignments

- Chose a question listed below.
- Prepare your answer (1 page min) in MS Word format, save it as *.doc file
- Prepare a MS PowerPoint slide to lead the class discussion (5 to 10 min max), save the file as *.ppt.
- Submit your answer and ppt file as an email attachment: lin@ipfw.edu, before 4:30 PM, on Jan. 20.
Assignments

Questions p. 14 of the text book:
1. What is the role of technology in today’s enterprises?
2. What characteristics differentiate high- and low-technology companies?
3. What are the benefits of establishing a chief technology officer (CTO) position?
4. How does technology affect the “globalization of business”?

Questions p. 14 of the text book:
5. Should the U.S. government develop a strong national technology policy and influence “desirable” technology developments?
6. Why are traditional management style with emphasis on central control apparently ineffective in high-technology organizations?
7. Analyze your company in terms of its technology-supporting infrastructure and resource functions. What changes would you recommend?
Assignments

- Questions p. 14 of the text book:
  8. Analyze your company in terms of organizational structure and the effectiveness of its management style. What changes would you recommend?
  9. What kinds of changes in organizational structure and leadership style do you see for companies 10 years (or 20 years) from now?