Australian Centre for Innovation Limited

MASTER OF PROFESSIONAL ENGINEERING

Engg5214

MANAGEMENT OF TECHNOLOGY

Semester 2
2009

Australian Centre for Innovation Limited

MASTER OF PROFESSIONAL ENGINEERING

Engg5214 MANAGEMENT OF TECHNOLOGY

1. Outline of the Course.

What is Management of Technology?

Management of Technology is concerned with understanding technology as a corporate resource that shapes both the strategic and operational capabilities of the firm in designing and developing products and services to meet market demands, productivity, profitability and competitiveness. Increasingly, technology plays a key role in corporate development and the competitive positioning of firms, not only in technology-based manufacturing firms but also in companies in financial services, logistics, publishing and other services-oriented firms, where technology has become the decisive competitive edge.

Approach to the Management of Technology (MOT)

This course focuses on the key topics in the management of technology. It has been designed to complement courses that focus on management in technology-based organizations and the management of innovation.

The course is concerned with such questions as:

- What drives technological change?
- What role does technological opportunity play in corporate strategies?
- How can technological change best planned and managed?
- Are the same competencies and approaches appropriate to all types of technological change?
- How can we predict and understand the impacts of change on firms, economies & society

Overall Course Structure.

Module	Component
1. The Evolution of technology, firms and the economy	Evolution of Technology and Industry
	The Evolution of firms and industries: Sustaining and disruptive innovation
	Project: Cases on the Evolution of Technologies
2. Key Concepts in Technology Management	Knowledge and Firms Context: Value Chains and Networks, Technology and Value creation
	Markets and Competition: Building key competencies
	Challenges in Technology Management: Introducing new technology
3. Key Challenges in Technology Management	Types of Technology Challenge: Continuous improvement
	Types of Technology Challenge: Radical Innovation
	Types of Technology Challenge: New Venture
	Case Study Report on new Technology Venture Formation
4. Technology Management Tools	MOT Tools: Forecasting, Foresight
	MOT Tools: Roadmapping
	Group Project – Technology Management tools
	Solutions: the growth in services orientation in manufacturing firms.
	Group Project: Technology Management Challenge.

2. Lecturer

Don Scott-Kemmis, Senior Fellow, Australian Centre for Innovation, Faculty of Engineering, University of Sydney. dsk@eng.usyd.edu.au. Tel.: 0404836387. Meetings by appointment.

3. Learning Objectives

- Understanding of the concurrent and interactive evolution of technology, firms and the economy
- Mastery of the key concepts of the management of technology and an ability to apply them
- Competencies required for the effective management of technology in an organisational environment
- Familiarity with the key challenges in technology management
- Competence in the appropriate application of a range of technology management tools

4. Assessment

Assessment -Topic	Week Due	Type	Mode
Evolution of a Technology	4	Presentation	Group
Case Study on New Technology Venture Formation	7	Report	Group
Essay on Technology Management Tools	10	Essay	Individual
Technology Management Challenge	13	Report	Group

Description	***Weighting(%)***
1. Presentation on evolution of technology	15
2. Case study on new technology venture formation	20
3. Essay report on technology management tools	25
4. Technology management challenge	40

5. Nominal Course Dates

Week	Date	Component	
1	27 -31 July	Evolution of Technology and Industry: S curve, diffusion	
2	3 -7 Aug	The Evolution of firms and industries: Sustaining and disruptive innovation	
3	10-14 Aug	Project: Cases on the Evolution of Technologies	Group Presentation
4	17- 21 Aug	Knowledge and Firms Context: Value Chains and Networks, Technology and Value creation	
5	24-28 Aug	Markets and Competition: Building key competencies	
6	31 Aug-4 Sept	Challenges in Technology Management: Introducing new technology	
7	7-11 Sept	Types of Technology Challenge: Continuous improvement	Case Study Report on new Technology Venture Formation
8	14-18 Sept	Types of Technology Challenge: Radical Innovation	
9	21-25 Sept	Types of Technology Challenge: New Venture	
10	5-9 Oct	MOT Tools: Forecasting & Foresight	Essay on Tools
11	12-16 Oct	MOT Tools: Roadmapping	
12	19-23 Oct	Solutions: the growth in services orientation in manufacturing firms	
13	26-30 Oct	Technology Management Challenge -Group Project:	Group Report

6. Detailed Course Structure and Reading.

NB.
All required reading will be provided either on a CD or through the course website. Some optional reading will also be provided through these mechanisms.

Component	Sources
Background and Foundation	This course aims to develop a deep understanding of the dynamics of technological change in an industrial context. If you have had little prior background in the management of technology and innovation we strongly encourage you to make good use of these background readings. Required Reading ❖ Fagerberg Innovation – A Review of the Literature. Chapter 1 in Fagerberg (Ed) The Oxford Handbook of Innovation. Additional Optional Reading ❖ Chapter 1 Key Issues in Innovation Management & Chapter 2 Innovation as a Management Process. In ***Managing Innovation: Integrating Technological, Market and Organisational Change.*** ❖ Design and Implementation of Technology Strategy: An Evolutionary Perspective: pp35-48. in Burgelman, RA, Maidique, MA, and Wheelwright, SC (eds.). ***Strategic Management of Technology and Innovation***. McGraw Hill. Irwin Third Edition. 2001. For Your Information ❖ Dorf (2000) Ed. The Technology Management Handbook [A pdf of this book is provided for your reference – some parts of this book are listed as additional reading for some topics] ❖ ICS On-line Web book for Technology Management http://www.ics.trieste.it/TP_TechnologyManagement/ ❖ Special Issue on University Education for Engineering and Technology Policy. May 2001. International Journal of Technology Policy and Management.
Evolution of Technology and Industry	The constant processes of improvement and innovation, in the context of competition and changing market demand, lead to the evolution of technologies. There are some recurring patterns in the evolution of technologies and these provide a basis for forecasting and strategy. This topic explores these patterns and discusses their implications for firms.

	Required Reading ❖ Conway, Steve (2009). The Patterns of Innovation within the Life Cycle of a Technology. Chapter 4 in **Managing and Shaping Innovation**. Conway, S and Steward. F. Oxford University Press. ❖ Foster, R. "The S Curve: A New Forecasting Tool." Chapter 4 in ***Innovation: The Attacker's Advantage***. New York, NY: Summit Books, 1986. ❖ 'Technology and Strategy: A General Management Perspective'. in Burgelman, RA, Maidique, MA, and Wheelwright, SC (eds.). ***Strategic Management of Technology and Innovation***. McGraw Hill. Irwin Third Edition. 2001 pp3-14 Additional Optional Reading ❖ Christensen 'Exploring the Limits of the Technology S Curve'. Reading II-4A & Abernathy & Utterback Reading II-5 'Patterns of Industrial Innovation.' in Burgelman, RA, Maidique, MA, and Wheelwright, SC (eds.). ***Strategic Management of Technology and Innovation***. McGraw Hill. Irwin Third Edition. 2001 pp 124- 155 ❖ Dorf (2000) Ed. **The Technology Management Handbook** Part 3 Innovation and Change 3.1 The Evolution of Innovation *Clayton M. Christensen* 3.8 Technology Life Cycles *Mario W. Cardullo* 3.9 Dominant Design *Philip Anderson* ***Discussion Questions:*** *What is the value of technological innovation?* *What drives the evolution of technology?* *What limits the improvement in technology?* *What is a dominant design? How does it relate to the "S-curve"?* *When is an S-curve analysis helpful, and how should it be used?* *What are the issues involved in managing technological innovation?*
The Evolution of firms and industries: Sustaining and disruptive innovation	One important aspect of the evolution of technologies is that of the continuous improvement of performance – a process termed 'creative accumulation'. However, from time to time the pattern of evolution is characterized by sharp discontinuities where a new technology displaces and old technology. In some cases these changes can involve major technologies relevant to a wide range of specific applications (eg IT, the chip) and in these cases the disruption can be deep and long lasting. This topic will review these processes of disruptive evolution and the responses of firms. Required Reading ❖ Conway, Steve (2009) 'Technological Regimes, Trajectories, Transitions,

	Discontinuity and Long Waves',. Chapter 5 in **Managing and Shaping Innovation**. Conway, S and Steward. F. Oxford University Press. ❖ Notes on Long Waves of Economic Development Additional Optional Reading ❖ Klepper, S (1997) 'Industry Life Cycles.' Industrial and Corporate Change. 6(1): 145-181 ❖ Chapter 5 Paths:' Exploiting Technological Trajectories'. In Tidd, Bessant and Pavitt. **Managing Innovation: Integrating Technological, Market and Organisational Change** ❖ Dorf (2000) Ed. **The Technology Management Handbook** Part 3 Innovation and Change 3.2 Discontinuous Innovation *Christopher M. McDermott* 3.3 Business Process Reengineering *Thomas H. Davenport* 3.4 Diffusion of Innovations *Andrew B. Hargadon* ❖ Utterback, James (1994), "Dominant Designs and the Survival of Firms," Chapter 2 in **Mastering the Dynamics of Innovation**, Harvard Business School Press, pp. 23-55 and 79-102. ❖ Henderson and Clark, "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms," Administrative Science Quarterly, 1990 ❖ Christensen, Clayton. ***The Innovator's Dilemma***. Boston, MA: Harvard Business School Press, 1997. ISBN: 9780875845852. (Chapter 3) ❖ Afuah, A., and J. Utterback. "Responding to Structural Industry Changes: A Technological Evolution Perspective." *Industrial and Corporate Change* 6 (1997): 183-202. ❖ Göransson, B. and and Johan Söderberg, J. (2005) Long waves and information technologies—on the transition towards the information society.Technovation Volume 25, Issue 3, March 2005, Pages 203-211 ❖ Castellaccij, F. (2006) Innovation, diffusion and catching up in the fifth long wave Futures. Volume 38, Issue 7, September 2006, Pages 841-863 ***Discussion Questions:*** *What is "creative destruction", and why does it happen?* *What determines the timing of technological revolutions? Can they be predicted?* *What determines the failure or success of incumbent firms in responding to discontinuous change?*
Project: Cases on the Evolution of Technologies	For this group project, each group is to select a technology (which could be narrowly or broadly defined) and analyse its evolution over a significant period of time. We encourage each group to find a technology that interests them and to research the information required. We also suggest, but do not require,

	that a focus on the evolution of environmental technologies or of the recent evolution of technological systems in response to increasing energy/ environmental pressures would make a useful focus. If you are unable to find a case and suitable material we would be prepared to assist in the provision of research materials. Each group is to make a presentation of at least 45 minutes. The presentation should address, inter alia: 1. The drivers of change, including patterns of demand; 2. The factors that shaped the direction or type of change (eg regulation, limits to improvement of the technology, limits to available components); 3. The sources of knowledge that enabled technological change; 4. The lessons of this case for technology management. For your information only Pacala, S., and R. Socolow. "Stabilization Wedges: Solving the Climate Problem For The Next 50 Years with Current Technologies." *Science* 305, no. 5686 (August 13, 2004): 968 - 972. Socolow, R., R. Hotinski, J. Greenblatt, and S. Pacala. "Solving the Climate Problem: Technologies for Curbing CO2 Emissions." *Environment* 46, no. 10 (2004): 8-19. Optional (but highly useful): The entire issue of *Scientific American*, September 2006.
Knowledge and Firms Context: Value Chains and Networks Technology and Value creation	Firms introduce technological change in order to create and capture value. Increasingly the processes of developing and implementing new technologies are carried out jointly with others – ie the change process is increasingly collaborative and distributed across firms and other organizations. But the context in which new technologies are applied is also more complex – often firms focus on a narrow 'slice' of the value chain. This topic is concerned with understanding the increasingly complex context in which technologies are developed and applied. Required Reading ❖ Networks and Communities. Chapter 5 in Dodgson, M. Gann, D. and Salter, A. (2008) **The Management of Technological Innovation**. Oxford U.P. ❖ Linden, G. Kraemer, K. and Dedrick, J. (2007) Who Captures Value in a Global Innovation System? The case of Apple's iPod. Personal Computing Industry Center (PCIC) (skim) ❖ Gulati, The Wireless Value Chain and Infrastructure. In Gulati, et al.

	Kellogg on Technology and Innovation. John Wiley. (skim) ❖ Dorf (2000) Ed. **The Technology Management Handbook** Part 3 Innovation and Change 3.10 Technology Integration: Matching Technology and Context. *Marco Iansiti* Additional Optional Reading ❖ Ritter, Thomas and Gemünden, Hans Georg (2003), 'Network competence: its impact on innovation success and its antecedents', *Journal of Business Research*, Vol. 56 No. 9, pp. 745-755. ❖ Delivering Value from Innovation, Chapter 9 in Dodgson, M. Gann, D. and Salter, A. (2008) **The Management of Technological Innovation**. Oxford U.P. ***Discussion Questions:*** What is a value chain? What is a business model and what is the relationship with technologies? Why do firms collaborate in developing new technologies? What are the implications for technology management of the increasingly complex context of technological change?
Building competencies for Technological Change	To be competitive firms must build and renew their capabilities to acquire, develop, and improve technology. What are these capabilities and how do firms develop them? In this topic we will assess the nature of competence and identify the most important mechanisms through which firms can build competencies. We will also analyse and discuss the situation of 'late comer' firms in industrializing economies. Required Reading ❖ Prahalad, C.K., (1997) The Role of Core Competencies in the Corporation. Chapter 12 in Tushman and Anderson (Eds) Managing Strategic Innovation and Change. Oxford UP. pp172-182 ❖ Tidd, Joe (2001) The Competence Cycle: Translating Knowledge into New Processes, Products and Services. Chapter 1 in .From Knowledge Management to Strategic Competence. Imperial College Press. Pp5-25. ❖ Cohen, W and Levinthal, D. Absorptive Capacity: A New Perspective on Learning and Innovation. Reading III-3 in Burgelman, RA, Maidique, MA, and Wheelwright, SC (eds.). ***Strategic Management of Technology and Innovation***. McGraw Hill. Irwin Third Edition. 2001: pp 613-629 ❖ **Case Study**: Wei Xie and Steven White 'Sequential learning in a Chinese spin-off: the case of Lenovo GroupLimited' **R&D Management** 34 (4) 2004

	Additional Optional Reading Processes: Integration for Strategic Learning Chapter 6:; Learning from Markets, Chapter 7: &, Learning through Alliances, Chapter 8. In ***Managing Innovation: Integrating Technological, Market and Organisational Change*** Bohn, "Measuring and Managing Technological Knowledge", Sloan Management Review, 1994. **Case Study:** Crisis Construction and Organizational Learning: Capability Building in Catching up at Hyundai Motor. Linsu Kim. ***Discussion Questions:*** What types of competency do firms require to be effective in technology management? Where do these competencies come from? What strategies can firms pursue to build these competencies?
Challenges in Technology Management: Introducing new technology	Technology related change, such as introducing a new process or new IT system, is a complex process and the outcomes are often far less successful than anticipated. Many major IT system and change projects fail to deliver. A major reason for this failure is poor management of the social/people dimensions of change. The identification and assessment of options, the planning of projects and the design of the system, are relatively easy compared with effective implementation. It is critical to engage the participants in a process that develops their understanding of and their commitment to the changes. Required Reading ❖ Carlopio, James (2003) Changing Gears: The Strategic Implementation of Technology. Palgrave. Chapters 4-6 (pp69-124). in Part II Implementation. See also www.implementer.com James Carlopio's website. ❖ The Management of Product and Service Innovation, Chapter 7 in Dodgson, M. Gann, D. and Salter, A. (2008) **The Management of Technological Innovation**. Oxford U.P. Additional Optional Reading ❖ Narayanan, V.K. (2001) Process Innovation, Value Chains and Organisation. Chapter 6 in Narayanan, V.K. (2001) Managing Technology and Innovation for Competitive Advantage. Prentice Hall. Pp157-196. ❖ von Hippel (1986), "Lead Users: A Source of Novel Product Concepts," Management Science, Vol. 32, No. 7. (Jul.), pp. 791-805. ❖ Managing Engineering Design. Chapter 10 in Babcock, D.L. and LC Morse, Managing Engineering and Technology. 4th. Prentice Hall 2006

	Discussion Questions: What are the key strategic challenges in planning technological change? What are the key management challenges in implementing technological change.? What types of capability are required for effectively managing the introduction of a new technology?
Challenges in Technology Management: Continuous improvement	One of the important changes in technology management over the past 20 years has been the development of management approaches that support the continuous improvement of quality and efficiency. A major source of this improvement is incremental technical change and over long time periods the cumulative impact of these changes is substantial. This topic discusses approaches to the management of continuous improvement. Required Reading ❖ Bessant, J. (2001) Learning and Continuous Improvement Chapter 11 in Tidd, J. (Ed) From Knowledge Management to Strategic Competence. Imperial College Press., pp295-320. ❖ **The EFQM model –European Foundation for Quality Management** http://ww1.efqm.org/en/Home/aboutEFQM/Ourmodels/tabid/132/Default.aspx http://grc.engineering.cf.ac.uk/lrn/resources/briefings/PDFs/EFQMmodel.pdf ***Discussion Questions:*** What is incremental innovation? What types of innovation contribute to improving product and production performance? What systems and capabilities support continuous improvement?
Challenges in Technology Management: Radical Innovation	Radical innovations involve major shifts in performance and often also in the technological knowledge base. These shifts are a major challenge for incumbent firms and major opportunities for new firms. This topic aims to develop an understanding of these threats and opportunities. Required Reading ❖ Christiansen, C. and Overdorf, M. (2000) Meeting the Challenge of Disruptive Change Harvard Business Review. March/April. ❖ Teece, D., "Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy," Reading II-6 in Burgelman, RA, Maidique, MA, and Wheelwright, SC (eds.). ***Strategic Management of Technology and Innovation***. McGraw Hill. Irwin Third Edition. 2001.

	❖ Morison, E. 'Gunfire at Sea' Chapter 9 in Tushman and Anderson (Eds) Managing Strategic Innovation and Change. Oxford UP. Additional Optional Reading ❖ Macher, J. et al. (2004) Organisational Responses To Discontinuous Innovation: A Case Study Approach. International Journal of Innovation Management. Vol. 8, No. 1 (March 2004) pp. 87–114 ❖ O'Connor; G. Ayers, A. (2005**) Building A Radical Innovation Competency.** *Research Technology Management;* Jan/Feb 2005; 48, (1) ❖ McDermott, Christopher (1999), 'Managing radical product development in large **manufacturing** firms: a longitudinal study', *Journal of Operations Management*, Vol. 17 No. 6, pp. 631-644. ❖ McDermott, Christopher and Colarelli O'Connor, Gina (2002), 'Managingradical innovation: an overview of emergent strategy issues', *Journal of* Product *Innovation Management*, Vol. 19, pp. 424-438. Additional Optional Reading Managing Transitions at the System Level. ❖ Loorbach,D. & Rotmans, J. (2006) - Understanding Industrial Transformation, 2006 ❖ Kemp,R. J Rotmans (2005) The management of the co-evolution of technical, environmental and social systems. InTowards Environmental Innovation Systems, 2005 – Springer. ❖ Elzen,B and Wieczorek, A (2005) **Managing transitions for** sustainable **development**. Technological Forecasting & Social Change, 2005 ❖ Berkhout, F. (2002 Technological regimes, path dependency and the environment- Global Environmental Change, 2002 – Elsevier ***Discussion Questions:*** *Why are radical changes a challenge for incumbents?* *How can firms best manage radical innovation?* *How does a firm capture the economic returns from innovation?* *What is the role of complementary assets?* *Why do the initial innovators often fail to capture the benefits from being pioneers?*

Challenges in Technology Management: Commercialisation and Forming New Ventures	Technological change has become more rapid and more complex and firms have generally become more specialized. Some major innovations are also derived from research in large firms and in research organizations. In the context of more rapid and more discontinuous change new ventures play a key role in introducing new products and services. This topic focuses on the commercialization of new technology and the formation of new ventures. It is particularly concerned with the management of these processes and the competencies required. Required Reading ❖ Jolly, V. J. (2002) From Mind to Market. Chapter I in Commercialising New Technologies. Harvard Business School Press. ❖ Moore, G.A. (2001) Crossing the Chasm. Reading II-7 in Burgelman, RA, Maidique, MA, and Wheelwright, SC (eds.). ***Strategic Management of Technology and Innovation***. McGraw Hill. Irwin Third Edition. 2001. pp265-272. Additional Optional Reading ❖ Winter, S. (2002) Appropriating the Gains from Innovation. Chapter 11 in Day, et al (Ed) Wharton on Managing Emerging Technologies. ❖ Hamm, John (2002), "Why Entrepreneurs Don't Scale," Harvard Business Review, Dec2002, Vol. 80 Issue 12, p110-116. ❖ Roberts, E.B. (1994), "Technological Entrepreneurship: birth, growth and success," Chapter 12, Entrepreneurs in High Technology: Lessons from MIT and Beyond, Oxford University Press, pp 339-357 ❖ Dorf (2000) Ed. **The Technology Management Handbook** Part 3 Innovation and Change 3.11 New Ventures for Technological Innovation, *Frederick Betz* 3.14 New Rules for the New Economy: Twelve Dependable Principles for Thriving in a Turbulent World, *Kevin Kelly* ***Discussion Questions:*** *What is involved in adding value to a product concept?* *What is involved in crossing the chasm?* *What determines the success or failure of entrepreneurial high-tech firms?* *What are the issues in obtaining funding for entrepreneurship, and in dealing with "angels" and Venture Capitalists?*
Case Study Report on new Technology Venture Formation	***New Technology Venture Formation Case Study*** Each group will prepare a report on based on a case study of new venture. Groups are encouraged to identify a case study on which to focus. However, we can assist in identifying case studies if required. The case study is to focus on such issues as the following issues: ❖ The origins of the technology, the entrepreneurs, the capital and the

	key capabilities used by the venture. ❖ The evolution of the product/market concept from first formation. ❖ The initial market and how this was assessed. ❖ The critical decisions in the development of the venture.
MOT Tools Foresight	Over the past 20 years, as technology and innovation management has become more important and more challenging, a wide range of tools have been developed to aid management decision making. In this session we focus on frameworks and tools for seeking to identify the key factors that are likely to shape the future evolution of technologies and markets. Required Reading ❖ Becker, P. (2002) Corporate Foresight in Europe: A First Overview. European Commission. ❖ **UK Cabinet Office (2001)** A Futurist's Toolbox Methodologies in Futures Work ❖ Burgelman, R. and Grove. A. (2001) Strategic Dissonance. In Burgelman, RA, Maidique, MA, and Wheelwright, SC (eds.). ***Strategic Management of Technology and Innovation***. McGraw Hill. Irwin Third Edition. 2001.Reading II-12 pp362-373 Additional Optional Reading ❖ Johnston, R. (2009) Historical Review of the Development of Future Oriented Technology Analysis in Cagnin,C, Keenan, M. and Johnston, R Future-Oriented Technology Analysis: Strategic Intelligence for an Innovative Economy. Springer. ❖ Ruff, F (2006) Corporate foresight: integrating the future business environment into innovation and strategy. International Journal of Technology Management. Volume 34, Number 3-4 / 2006, 278 - 295 ❖ Kameoka, A. (2004)A challenge of integrating technology foresight and assessment in industrial strategy development and policymaking. Technological Forecasting & Social Change 71 (2004) 579–598 ❖ Schwarz J. (2009) Business Wargaming: developing foresight within a strategic simulation. Technology Analysis and Strategic Management. 21(3): 291-305 ❖ **See: International Journal of Foresight and Innovation Policy** ❖ Thomke, S. "Capturing the Real Value of Innovation Tools." *MIT Sloan Management Review* 47, no. 2 (2006): 24-32. ***Discussion Questions:*** *What are the different approaches to Foresight?* *What are the information bases that foresight draws on?*

	What are the limitations of foresight?
MOT Tools Roadmapping	Over the past 20 years, as technology and innovation management has become more important and more challenging, a wide range of tools have been developed to aid management decision making. In this session we focus on tools for linking detailed technology planning with strategies and with external patterns of market demand. Effectively linking investments in capability development and in the development of new technology, with corporate strategies is one of the most difficult management tasks. Required Reading ❖ Phaal, R., Farrukh, C.J. & Probert, D.R. ,Technology Roadmapping: Linking Technology Resources To Business Objectives Available from: http://www.ifm.eng.cam.ac.uk/ctm/publications/tplan/trm_white_paper.pdf (Institute for Manufacturing) ❖ Pieter Groenveld, P. (2007) **Roadmapping Integratesbusiness And Technology. Research Technology Management** Additional Optional Reading ❖ Phaal, R. et al (2004) Technology roadmapping—A planning framework for evolution and revolution. Technological Forecasting & Social Change 71 (2004) 5–26 ❖ Irene J. Petrick, I.J. and Ann E. Echols, Technology roadmapping in review: A tool for making sustainable new product development decisions. Technological Forecasting and Social Change. Volume 71, Issues 1-2, January-February 2004, Pages 81-100 ❖ Kostoff, R.N.Schaller, R.R. (2001) Science and technology roadmaps.Engineering Management, Volume: 48, Issue: 2): 132-143 ***Discussion Questions:*** *What can roadmapping be used for?* *What are the information bases that roadmapping draws on?* *What are the limitations of roadmapping?*
Technology Management tools	This is a major individual essay component. The topic will be a review of one or more major technology/innovation management tools. The essay will: Provide a careful guide to the nature of the tool and explain its uses. Identify the frameworks and assumptions behind the tool Provide an example of the application of the tool. Assess the limitations of the tool as a guide to practical action. One reasonably good guide to MOT tools is available at: http://www.managing-innovation.com./toolbox.php [See also the wider resources available at: http://www.managing-

	innovation.com./] We will provide a more detailed resource supplement during the course, but we expect you to also search for information.
Producing Solutions: the growth in services orientation in manufacturing firms.	In highly competitive markets a strong trend is for manufacturing firms to increasingly provide services in addition to products, in order to offer the customer a 'solution'. This is major challenge for firms to develop the competencies to become also service firms- a trend sometimes termed *servicification*. Required Reading ❖ Davies, Andrew; Brady, Tim and Hobday, M. (2006), *Charting a Path Toward Integrated Solutions*, MIT Sloan Management Review. 47(3): 39-48 ❖ Kowalkowski, C. and Brehmer, P-O, (2008) Technology as a Driver for Changing Customer-Provider Interfaces. Management Research News. 31(10): 746-757 Additional Optional Reading ❖ Oliva, R., Kallenberg, R. (2003), "Managing the transition from products to services", *International Journal of Service Industry Management*, Vol. 14 No.2, pp.160-72. ❖ Davies, Andrew (2004), 'Moving base into high-value integrated solutions: a value stream approach', *Industrial and Corporate Change*, Vol. 13 No. 5, pp. 727-756. ❖ Galbraith, Jay R. (2002), 'Organizing to deliver solutions', *Organizational Dynamics*, Vol. 31 No. 2, pp. 194-207. ❖ Gebauer, Heiko; Fleish, Elgar and Friedli, Thomas (2005), 'Overcoming the **service** paradox in **manufacturing** companies', *European Management Journal*, Vol. 23 No. 1, pp. 14-26. ❖ Mathieu, Valérie (2001), '**Service** strategies within the **manufacturing** sector: benefits, costs and partnership', *International Journal of* ***Service*** *Industry Management*, Vol. 12 No. 5, pp. 451-475. ❖ Matthyssens, Paul; Vandenbempt, Koen and Berghman, Liselore (2006), 'Value innovation in business markets: breaking the industry recipe', *Industrial Marketing Management*, Vol. 35 No. 6, pp. 751-761. ***Discussion Questions:*** *What is driving servicification in product firms?* *What new capabilities are required to be effective service firms?*
Group Project:	**Group Project: Technology Management Challenge.**

Technology Management Challenge.	This is the most important assessable component of the course. Each group will choose one major topic on which they will prepare a major report. More details on the length of the report and its organization will be provided during the course. Groups can select one of the topics below or can propose a topic for approval: ❖ How could improved technology management improve the implementation of IT projects. ❖ How can users contribute to innovation in products and services ❖ What is required for managing transitions at the system level. ❖ What strategies are required for building competencies in firms in developing countries. ❖ How can manufacturing firms best manage the transition to be solution providers – an assessment of case studies.

RESOURCE GUIDE

Useful on Innovation Management:

- Babcock, D.L. and LC Morse . Managing Engineering and Technology. 4th. Prentice Hall 2006
- Friedman, R. S. , DM Roberts, and JD Linton, Principle Concepts of Technology and Innovation Management Premier reference Source, 2007
- Burgelman, R.A., Maidique, M. & Wheelwright, S. (Eds) Strategic Management of Technology and Innovation. 3rd Edition. McGraw Hill Irwin 2001. [BMW]
- Dorf ,R. C. (1998) (Ed) The Technology Management Handbook. CRC Press, IEEE Press. [TMH]
- 27th Annual National Conference of the American Society for Engineering Management 2006: Managing Change: Managing People and Technology in a Rapidly Changing World by American Society for Engineering Management (Paperback - Mar 2007)
- Tidd, J. Besant, J. and Pavitt, K. Managing Innovation: Integrating Technological, Market and Organisational Change. Wiley Third Edition. 2005.
- Schilling, M.A. 2008. Strategic Management of Technological Innovation. 2nd Edition. New York: McGraw-Hill Publishers.
- Betz, F. (2003) Managing Technological Innovation. Wiley and Sons
- Burgelman, RA, Maidique, MA, and Wheelwright, SC (eds.). Strategic Management of Technology and Innovation. McGraw Hill. Irwin Third Edition. 2001.
- Tushman, ML and Anderson, P (eds.). Managing Strategic Innovation and Change. OUP. 1997.
- Christensen, CM, Innovation and the General Manager. Homewood IL: Richard D. Irwin. 1999.
- Schilling, M.A. Strategic Management of Technological Innovation. McGraw Hill 2005
- Davila, T. Epstein, M.J.; and Shelton, R. Making Innovation Work. How to Manage it, Measure it and Profit from it. Wharton School Publishing. 2006
- Mayle, David (2006) Managing Innovation and Change (3rd Edition) Sage/Open University Business School.
- Afuah, A.. ,Innovation Management, Strategies, Implementation And Profit Oxford University Press 2nd Edition. 2003
- Utterback, J. ., Mastering The Dynamics Of Innovation Harvard Business School Press 1994
- Barney, J. Gaining And Sustaining Competitive Advantage Prentice_Hall_2 Nd Edition 2002
- Mckelvey, M.D. , Evolutionary Innovations Oxford University Press_1996 (2003 Reprint)
- Twiss, B. & Goodridge, M. , Managing Technology For Competitive Advantage: Integrating Technological And Organisational Development From Strategy To Action Pitman_1989

- Ulrich, K.T. & Eppinger, S.D. ,Product Design And Development Irwin/Mcgraw-Hill 3rd Edition 2004
- Dussauge, P., Hart, S. & Ramanantsoa, B**. ,** Strategic Technology Management Wiley 1992
- Probert, D. **,** Developing A Make Or Buy Strategy FOR MANUFACTURING BUSINESS Institution of Electrical Engineers 1997
- Sullivan, N. ,Technology Transfer: Making The Most Of Your Intellectual Property Cambridge University Press 1995

Journals

Management Journals with a Strong Relevance to MOT

Academy of Management Journal
Administrative Science Quarterly [web]
American Economic Review [web]
American Sociological Review [web]
Industrial and Corporate Change [web]
Journal of Economics & Management Strategy [web]
Management Science .web .
Organizational Science .web .
Rand Journal of Economics .web .
Strategic Management Journal .web .

MOT-Specific Journals

IEEE Transactions on Engineering Management .web .
Innovation: Management, Policy & Practice
International Journal of Technology Management .web .
International Journal of Technology Management and Sustainable Development
International Journal of Technology Policy and Management
International Journal of Technology Transfer and Commercialisation
Journal of Business Venturing .web .
Journal of Engineering and Technology Management .web .
Journal of Product Innovation Management .web .
Journal of Technology Management & Innovation
R&D Management
Research Policy .web .
Research Technology Management .web .
Technology Forecasting and Social Change .web .
The Journal of High Technology Management Research

Other Useful Journals

Academy of Management Review .web .
Business History Review .web .
California Management Review .web .
Harvard Business Review .web .
Journal of Economic Literature .web .
Journal of Economic Perspectives .web .
Journal of Industrial Economics .web .

Quarterly Journal of Economics .web .
Sloan Management Review .

Associations

- Academy of Management TIM Division
- INFORMS Technology Management Section
- International Association for Management of Technology (IAMOT)
- International Society for Professional Innovation Management (ISPIM)
- Product Development and Management Association (PDMA)

PICMET

- Management of Engineering & Technology, 2008. PICMET 2008. Portland International Conference on
- Management of Engineering and Technology, Portland International Center for Technology Management for the Global Future, 2006. PICMET 2006
- Management of Engineering and Technology, 2003. PICMET '03. Technology Management for Reshaping the World. Portland International Conference on
- Management of Engineering and Technology, 2001. PICMET '01. Portland International Conference on
- Management of Engineering and Technology, 1999. Technology and Innovation Management. PICMET '99. Portland International Conference on
- Innovation in Technology Management - The Key to Global Leadership. PICMET '97: Portland International Conference on Management and Technology

Research Institutions and Centers

- Chalmers (Sweden)
- Carnegie Mellon Entrepreneurship Center
- EPFL (Switzerland)
- Intellectual Property Research Institute of Australia
- Kellogg (Northwestern) Center for Research in Technology & Innovation
- MINT (McMaster)
- MIT Center for Innovation in Product Development
- MIT Entrepreneurship Center
- NBER
- SPRU
- U. Maryland Center for Entrepreneurship
- Wharton: knowledge@wharton

Database	Content Notes
ABI / Inform global full-text	Worldwide business periodicals for information on advertising, marketing, economics, human resources, finance, taxation, computers, and more. Also, information on 60,000+ companies.

Business source premier	EBSCOhost provides access to: Australia/New Zealand Reference Centre ; Business Source Premier (1990+) ; World Magazine Bank (1995+), and Econlit (1969+).
Factiva	Factiva is a global news and business information service that combines the content sets of Dow Jones Interactive and Reuters Business Briefing. Coverage is from 1985.
InfoTrac	World Wide Web database service, which provides a single access point to InfoTrac databases, indexes, abstracts and full text journal articles. InfoTrac provides full text and images from a mix of sources such as periodicals, newspapers, directories, handbooks, encyclopedias and investment reports. Databases available are: Expanded Academic and LegalTrac
Connect4	Provides searchable access to Australian company information. University of Queensland Library subscribes to: Annual reports; Company prospectuses; Mergers and acquisitions.
Web of knowledge	ISI Web of Knowledge is a platform for searching individual ISI products or multiple products simultaneously. Access is to Web of Science, Current Contents Connect and ISI Journal Citation Reports.
ScienceDirect	Provides access to more than 1,550 journals across sixteen fields of science, including the social sciences, published by Elsevier Science from 1995 onwards. ScienceDirect includes Academic Press and Harcourt Health Sciences imprints in full text from 1993 onwards.

Exploring further

Start with the following **key internet sites** for this subject -

TechMan	http://www.techman.org/
Australian Science and Technology Online	http://www.asto.com.au/
Biz/ed	http://www.bized.ac.uk/
Management of Innovation and New Technology Research Centre	http://irc.mcmaster.ca/
The World-Wide Web Virtual Library - Knowledge Management	http://www.brint.com/km/
UM TECHTransfer	http://www.techtransfer.umich.edu/
AVEL Sustainability Knowledge Network	http://avel.edu.au/

Websites

Management of Technology Message Board (JISCMAIL)

Searching for Cases

http://www.caseplace.org/mycaseplace.asp