Course Syllabus

Program : Bachelor of Business Administration (BBA)
Course Title : Management of Technology (MOT)
Course Duration : 16 Weeks (48 Hours), 2 Sessions Per week, 1h30mn Per Session
Course Facilitator : Say Punnareay, MBA
Telephone : 012 890 465 / 012 566 331
E-mail Address : Punnareay@yahoo.com

Text and Others Reading Materials:


1. Course Description

Since there are rapidly increasing importance of technology in business, it clearly is that most of the companies are facing difficulties in understanding how technology is to be assessed, acquired, and/or developed and managed their own firms. More than that, especially, for less developed countries like Cambodia is absolutely difficult that what kind of technology is appropriate to be used and its environment.

2. Course Objectives

Technology is the know-how for the creation of goods and services or the way of doing things or the means by which objectives of an organization are achieved. Engineers in particular are the people who are to manage the change in technology as an important resource. This subject deals with fundamental aspects related to technological management. The objectives of the course will cover on how importance is technology for competitiveness at country and organization levels.
3. Course Outline

- Chapter 1  Introduction to Management of Technology
- Chapter 2  Technology and Economic Development
- Chapter 3  Technology and Competitiveness
- Chapter 4  Components of Technology
- Chapter 5  Review of Technology Management
- Chapter 6  Technology Strategy
- Chapter 7  Development of Technological Capabilities
- Chapter 8  Managing Innovation

From Chapter 1 to Chapter 8 are Lecturing

- Chapter 9  Technology Management, Operational Systems Strategy, and Business Competitiveness Interfaces
- Chapter 10  Decisions and Implementation of New Technology
- Chapter 11  Organizing for Technology
- Chapter 12  E-Business Development

From Chapter 9 to Chapter 12 are Case Study

4. Teaching Methods

The course will be using various approaches including lecturing, group discussion, and group assignment and presentation.

5. Evaluating Student Performance

- Attendance and Class Participation  10%
- Group Assignment and Presentation  15%
- Mid-Term Examination  15%
- Final Examination  60%

In case of absence with permission more than 10 sessions and without permission for 7 sessions, the absentee will not be allowed to take final examination. Seeking for permission for two session break, students need to submit a request with relevant materials at least two days in advance.

6. Teaching Plans

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<td>1</td>
<td>Introduce my self to Students and Course Syllabus</td>
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<td>Chapter 1: Introduction to Management of Technology</td>
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<td>3</td>
<td>- MOT: An Entrepreneurial Perspective</td>
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<td>- Implications for Firms and Countries</td>
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| 7 | **Chapter 2: Technology and Economic Development**  
|   | - Effects of Technological Change on Economic Growth | 1h 30mn |
| 8 | - Effects of Technological Change on Productivity | 1h 30mn |
| 9 | - Effects of Technological Change on Inflation | 1h 30mn |
| 10 | - Effects of Technological Change on Employment | 1h 30mn |
| 11 | - Effects of Technological Change on Balance of Trade | 1h 30mn |
| 12 | - Effects of TC on Corporate Profitability and Growth | 1h 30mn |
| 13 | **Chapter 3: Technology and Competitiveness**  
|   | - Influence of Technology on Competitiveness | 1h 30mn |
| 14 | - Porter’s Value Chain | 1h 30mn |
| 15 | - Porter’s Industry Structure | 1h 30mn |
| 16 | **Chapter 4: Components of Technology**  
|   | - The Object-Embodied Tech Compo “Technoware” | 1h 30mn |
|   | - The Human-Embodied Tech Compo “Humanware” | 1h 30mn |
| 17 | - The Institution-Embodied Tech Compo “Orgaware” | 1h 30mn |
|   | - The Document-Embodied Tech Compo “Inforware” | 1h 30mn |
| 18 | - Product Design Inforware | 1h 30mn |
| 19 | - Product Usage Inforware | 1h 30mn |
| 20 | MID-TERM EXAMINATION | 1h 30mn |
| 21 | **Chapter 5: Review of Technology Management**  
|   | - A review of Technology Management | 1h 30mn |
| 22 | - A General Manager Perspective on Managing Tech Flexibility and Technology | 1h 30mn |
| 23 | **Chapter 6: Technology Strategy**  
<p>|   | - Technology Strategy-Definition | 1h 30mn |
| 24 | - Technology Strategy-Objectives | 1h 30mn |</p>
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<td>Technology Strategy-Classification - Business Competitiveness and Technology Strategy</td>
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<td>The Strategic Technology Management Process</td>
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<td>Chapter 7: Development of Technological Capabilities - Definition and its Importance - Developing Technology-Based Capability</td>
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<td>Technological Capability Development: Diffu and Adapt</td>
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<td>Chapter 8: Managing Innovation - Definition - Nature of Innovation</td>
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<td>Innovation at 3M - Innovation Practices</td>
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<td>Assignment and Presentation for Groups (1+2)</td>
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CHAPTER I
INTRODUCTION TO MOT

1. WHAT IS TECHNOLOGY?

- Technology can be defined as all the knowledge, products, processes, tools, methods, and systems employed in the creation of goods or in providing services.
- Whether supports or condemns, there is total consensus that managing technology effectively is critically important to the success and survival of companies and to national economic well-being and growth.

2. WHAT IS MANAGEMENT OF TECHNOLOGY?

It is ironic that until recently the subject of management of technology did not, in general, receive the popular attention that it should have in management development programs, business, and government. Management of technology refers to the design and use of the means needed in organizations to achieve economic and social objectives through technological innovation.

3. MOT: AN ENTREPRENEURIAL PERSPECTIVE

Technology itself does not produce commercial results. It is its application that brings commercial benefits. Such as application comes about the activities of entrepreneurs. Any economy needs both paper entrepreneurs and product entrepreneurs. Paper entrepreneurs are trained in law, administration, finance, accountancy, etc. Establishing joint ventures, holding companies, investing in commodities, encouraging in buying and selling securities in both private and public sectors, etc. Product entrepreneurs are engineers and scientists involved in production sector, researchers and designers, production managers, marketers, and businessmen in production for producing goods and services people want.

They innovate by:
Creating better products at lower cost. Bringing new technology into the firm for more efficient manufacture, distribution, and sales. Finding the cheaper sources of suppliers, new markets, and consumer needs. Providing better training of employees, attention-getting advertising, speedier consumer service, reliable warranty coverage and repair. Paper entrepreneurs ensure efficient allocation of capital, and better coordination among product entrepreneurs. While paper entrepreneurs readjust and realign supply and demand, they cannot directly enlarge the economic pie. It is product entrepreneurs who can enlarge the economic pie. For a nation to maintain its economic health, we need both types of entrepreneurs. The USA lost its competitive edge during 80th decade in manufacturing to Japan by not developing enough product entrepreneurs to meet the global manufacturing challenge. Today, Thailand and some other ASEAN countries (with the exception of Singapore) are in an economic crisis because they lack product entrepreneurs.

“The bubble economy has burst! sustainable development of industry is not possible without our own technological capability.” The Nation, 23 August 1997

“Thailand is facing the recent financial crisis because, instead of using foreign savings to finance export-oriented industries, borrowers recklessly spent it to speculate in the property and stock markets.” The Nation, 02 September 1997
Nations that are technologically advanced always have high GDP/capita and the strength to withstand economic shocks. Nations that try to raise their GDP/capita by selling natural resources, relying on cheap labor, and speculating face great dangers both in the short term and in long run.

Today, the only way for firms and countries to progress is to create sufficient product entrepreneurs who can work together with paper entrepreneurs and set in motion a process of sustainable development.

4. SIGNIFICANT GLOBAL TRENDS

Unprecedented socio-political changes then the rise of new trading nations. Shift from complementary trade (establishing partnerships) to competitive trade (creating customer) to adversarial trade (dominating industry). Increased globalization of national economics and the emergence of a borderless world due to the flows of 4 “I”s: Investment, Industry, Information, and Individuals.

5. SIGNIFICANT TECHNOLOGICAL TRENDS

- Development of new materials:
  - Increased competition, substitution of traditional materials generated from natural resources. Traditionally, technology has been used to progress materials found in the ground or growing from it. Now, need-based generation of materials with desired attributes has become possible. These new materials are super-polymers, composites, fiber optics, fine ceramics, and others now being developed in industrialized and advanced countries.

- Staggering advancements in information technology:
  - Faster access to accumulated knowledge because of the fusion of “computer and telecom” technologies. Better experimentation through simulation and expert system.
  - Process and product technology are becoming instantly transferable through global computer-telecom links. Close and interactive relationship between suppliers of goods and services, and customers. Switchover from provision of ready-made products and services to customer-made products and services. Therefore, these developments reduce the significance of geographic distance and the response time needed to meet changing customer demand.

- Shift from economics of scale to economics of scope due to CAD (computer-added design), FMS (flexible manufacturing system), and CIM (computer-integrated manufacturing):
  - Shorter product lifecycles. Demand for simultaneous attainment of quality, cost, and delivery target. Recapturing of the price competitiveness by industrialized nations and firms due to labor displacement.

- Improvements in transportation:
  - Bringing production centers and markets much closer. Greater competitiveness of air transport and others.

- Biotechnology developments may open the way for major advances in the production:
  - Food
  - Industrial processes
  - Management of wastes
  - Memory technology
  - Animal and human characteristics
6. IMPLICATIONS FOR FIRMS AND COUNTRIES

- Nations, firms and individuals will be forced to face accelerating changes, intensifying power shifts, increasing complexity, and rising competition.
- Economic growth is brought about by the productive sectors of a country. Unless the productive sectors can meet the above challenges effectively, and sustained growth will be impossible.
- Perhaps the only way to meet these challenges would be to introduce initiatives to move from a competitive strategy based on factor costs to one based on technology.
- This requires interventions by the government, academic and professional institutions, and the private sector in a careful and coordinated manner.
- Examples of interventions at national and firm levels:
- At a national level, there must be a refocusing of public policy away from traditional material-based industries and toward emergence of entirely new industries and processes.
CHAPTER II
TECHNOLOGY AND ECONOMIC DEVELOPMENT

1. INTRODUCTION

- Technological change (TC) has been an important factor in economic growth, both in developed and developing countries.
- We must also remember that it is through R&D efforts and technology transfer that firms bring about TC.
- In this session, our objectives will examine the impact of TC at the macro level and the micro (firm) level.

2. EFFECTS OF T.C ON THE NATIONAL ECONOMY

- In examining the effect of TC on the national economy we shall look at its effect in terms of the following:
  o Effect of TC on economic growth
  o Effect of TC on productivity
  o Effect of TC on inflation
  o Effect of TC on employment
  o Effect of TC on balance of trade
- The common approach used was:
  o Rate of Economic Growth = F (K, L, E…, r)

Where:

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<tr>
<td>K</td>
<td>Capital</td>
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<td>L</td>
<td>Labor Inputs</td>
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<td>E</td>
<td>Resources Extraction</td>
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<td>r</td>
<td>Residual</td>
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- The residual factor r was considered to represent the impact due to technological change.
- Solow found that, in the U.S.A, between 1909 and 1949, 90% of the growth was due to the residual.
- This was criticized on the grounds that is could have included effects due to economies of scale; changes in product mix, improved education, health and nutrition, etc.
- Denison tried to correct for these. He concluded that between 1929 and 1957, in the U.S.A, technological innovations accounted for 40% of economic growth.
- Based on many studies, there is evidence to believe that the introduction of technological innovation has had a significant impact on economic growth.
- In fact, there is evidence to link the growth of the Japanese economy with increased R&D expenditure and decline in the U.S economy with decreased R&D spending.
- Effect of TC on productivity
Economic society uses input factors of labor, capital, and natural resources to produce outputs of goods and services to meet its needs. Technology is the means by which the various inputs are used to produce an output.

- The productivity of a factor of production is defined as the ratio of the total output to the amount of that input used.
- An improvement in the productivity of any one of the factors of production, is therefore,
- A reduction in the amount of that factor required to produce a fixed amount of output.
- An increase in the amount of output that could be produced using a fixed amount of the input.
- Since technology is the means by which conversion is achieved, it seems reasonable to suppose that TC is responsible for productivity growth.
- Many analysts notably Kendrick, Grilinches, Mansfield, Minasian and others carried out study to try and statistically quantify the link between TC to productivity growth in the manufacturing and agricultural sectors.
- Kendrick in his studies found that in the U.S.A, between 1919 and 1953, an industry's total factor productivity was related in statistically significant way to its R&D expenditure expressed as ratio of sales.
- Griliches obtained similar results in agriculture.
- Mansfield and Manasian in their studies in the chemical and petroleum industries showed that the measured rate of productivity changes was related in a statistically significant way to the rate of growth of cumulated R&D expenditures made by the firm or industry.

**WEAKNESS**

- Firstly, the firms studied may not have used the same definitions to quantify their R&D expenditure.
- Secondly, a large percentage of R&D carried out by many industries is directed at productivity increase in other industries.
- Problems of measurement with regard to output and productivity also raise questions regarding the rigor of the analysis.
- Effect of TC on inflation

Inflation is defined as the rate of change in the overall price level of goods and services.

The classical explanations for inflation are:

- National budgetary deficits
- Expansion of the money supply
- Excessive wage demands by labor
- Excessive price demands by industry
- Excessive consumer demands for goods and services

Klein has offered a fundamental explanation for persistent inflation as following:

- He argues that increasing rate of inflation results from a failure to introduce more productive technologies that could reduce the inputs needed to produce goods and services, thus lower costs and prices.
Klein further argues that the lack of competition, and protectionist pressures discourage investment in R&D to generate new and more productive technologies.

**Inflation usually:**

- Leads to a decrease in the purchasing power of those whose earnings do not rise at a faster than inflation.
- Makes a country’s products less competitive at international markets.
- Makes lower price imports more attractive.
- Discourages investment.

**Effect of TC on employment**

- Impact of TC on employment has controversial:
  
  View 1: TC eliminated jobs.
  
  View 2: TC created jobs.
  
  View 3: is that both are correct depending on time horizon.

- If R&D is carried out to produce new production technology that makes more productive then fewer workers will be needed. Thus, in the short-run jobs are lost with all the associated social problems.
- If the higher labor productivity is translated into lower price for the products then the demand for the products could increase and more labor will be needed to produce them.
- Whether this production increasing would offset the original job loss would depend on the demand elasticity for product.
- In industries with low demand elasticity (metals, agriculture, textiles, and railroads) demand expansion is unlikely to replace the jobs lost due to increase in labor productivity. Industries with high demand elasticity, the jobs could gains.
- When productivity and sales increase due to lower price for the products, profits become available for reinvestment.
- This reinvestment could be used to create new jobs and new industries.
- This could absorb workers who have lost their jobs due to increase in labor productivity. But, whether they can be absorbed or not would depend on whether they have the necessary skills to accept new jobs.
- Retaining of old workers and creating a fresh workforce with the requisite skill is a crucial task of government human resource development policy. TC can also introduce technologies that can have a positive or negative impact on the quality of a job.
- Monotonous, alienating, reductive jobs (like assembly line work). Interesting jobs require multifunctional skills (MFS).
- **Effect of TC on balance of trade Not Yet**
- The product lifecycle theory of international trade have been used to explain how trade patterns change with the maturity of technologies and industries.
- Work done by Pavitt and Soete have shown that countries export strongly, related to the intensity of R&D efforts and technological innovation in that industries – ability to introduce TC.
Studies carried out by some of the UN agencies that countries export high technology intensity products, must get more comfortable, sustained and favorable growing balance of trade situation when compared to countries that export low technology intensity products.

High Technology Products = High Valued Added Products

3. EFFECT OF T.C ON CORPORATE PROFITABILITY AND GROWTH

The main objectives of bringing about TC in a firm are:

- To support current business
- To provide new business venture
- To explore new technology bases
- T.C intended to support current business
- Extending of the product lifetimes of current products
- Lowering costs of the production of current products
- Creating new models of existing products
- T.C intended to provide new business venture: the creation of new product lines to enter new business.
- T.C intended to explore new technology bases: the deepening and broadening of the existing and potentially new technology bases of the company.

Therefore, the effect of technological change on corporate profitability and growth mean that all of firms must introduce technology to survive, increase profits, and grow.

Example: packed like sardines

The cargo division at Japan airline (JAL) has devised a new air cargo container which keeps fish alive, but in a state of suspended animation without seawater. To keep fish alive at room temperature they must be transported in 20 times their own weight of seawater. Water weighing four times the weight of the fish can be used if the temperature is reduced with ice. However, using seawater has disadvantages due to its weight and corrosive properties.

JAL has found that by chilling the seawater further makes the fish comatose and their demand for oxygen virtually drops to zero. Thus water can be dispensed with, and the fish flown more economically. This process is called “anabiosis”. Their revival can be accomplished at the destination by putting them back into slowly warming seawater.

JAL estimate that by this method a package of five sloe weighing 5kg can be shipped USD 8.70 whereas the old method would have cost approximately USD 60.00. This new technology has great benefits for JAL, customers and fish producers close to Japan (Philippines and Vietnam).
CHAPTER III
TECHNOLOGY AND COMPETITIVENESS

1. INFLUENCE OF TECHNOLOGY ON COMPETITIVENESS

Though a firm may have many strengths and weaknesses vis-à-vis its competitors, it attains competitive advantage either due to:

- Cost advantage strategy
- Differentiation strategy

Competitive advantage = cost advantage + differentiation

- In a cost advantage strategy, a firm tries to become the lower-cost producer in the industry. However, its product must be seen as comparable to the quality of products, and other expectations of the buyers.
- In differentiation strategy, a firm tries to produce something that is unique with respect to certain dimensions which are widely valued by buyers. Firms may adopt these strategies in specific segments of the industry and specialize in niches.
- In implementing these strategies a firm should look at the influence of technology on the following:
  - Its value chain
  - Its industry structure
- A clever firm tries to use technology to configure its value chain in such a way that it can help it to reduce cost or improve uniqueness.
- In this context it should examine its technological core competencies. The influence of technology on industry structure should be seen from the perspective of firms already existing in the industry and also from the perspective of potential entrants, suppliers, and buyers. When firms go in for new technology they should assess it from these perspectives as well and not only on conventional aspects such as how much its cost to buy or how modern/old it is.
**Primary activities:** inbound logistics, operations, outbound logistics, marketing and sales, and services:

- **Inbound logistics:** activities associated with receiving, storing, and disseminating inputs to the products. Such as material handling, warehousing, inventory control, vehicle scheduling, and returns to suppliers.
- **Operations:** activities associated with transforming inputs into the final product form. Such as machining, packaging, assembly, equipment maintenance, testing, printing, and facility operations.
- **Outbound logistics:** activities associated with collecting storing, and physically distributing the products to buyers. Such as finished goods warehousing, delivery vehicle operation, order processing, and scheduling.
- **Marketing and sales:** activities associated with providing a means which buyers can purchase the products including them to do so. Such as advertising, promotion, sales force, quoting, channel selection, channel relations, and pricing.
- **Services:** activities associated with providing services to enhance the value of the products. Such as installation, repair, training, parts supply, and product adjustment.

Support activities is firm infrastructure, human resource management, technology development, and procurement:

- **Firm infrastructure:** consists of activities including general management, planning, finance, accounting, legal, government affairs, and quality management.
- **Human resource management:** consists of activities involved in the recruiting, selecting, training, development, and compensation of all types of personnel.
- **Technology development:** it is know-how, procedures, or technology embodied in process equipment, it tends to be associated with engineering department or development group such as R&D and IT.
- **Procurement:** refers to the function of purchasing inputs but not purchased by themselves. Purchased inputs include raw materials, machinery, laboratory equipment, office equipment, and buildings.

### 3. PORTER'S INDUSTRY STRUCTURE

![Porter's Industry Structure Diagram](image-url)
- Porter’s industry structure or the five competitive forces determine industry profitability because they influence the prices, costs, and required investment of firms in an industry—return on investment.
- Porter’s industry structure shows about the perspective of potential entrants, suppliers, and buyers.
- Technological core competencies may be defined as the collective knowledge in an organization about how to coordinate the multiple technologies required for product design in production.
CHAPTER IV
TECHNOLOGY COMPONENTS

1. PROCESS TECHNOLOGY

The object-embodied COT “Technoware”

All manufacturing operations consist of transformations and decisions. The technoware carries out the necessary transformation based on set of decision that has been taken to generate desired output. Transformation operations of the simplest technoware—manual tools are powered by humans, in general, the complexity of any transformation could be desired in terms of four attributes namely:

- Extent of power delivered
- Complexity reaction, treatment, and handling required
- Output rate
- Degree of precision achievable

So, technoware increase in “transformation sophistication” as the power, process complexity, rate and precision it can deliver increases.

The human-embodied COT “Humanware”

Technoware, if not express through proper intervention, does not lead to the production of desired outputs. It is humanware that through its insight of the functional capabilities, limitations, and extent of manipulability of the technoware, causes desired outputs to be produced by the technoware.

The type of humanware needed to manage technoware would depend on the characteristics of job to be carried out:

- **Skill variety**: the degree to which a job requires a variety of different activities in carrying out the work and involves the use of a number of different skills and talent of the individual.
- **Task identity**: the degree to which the job requires completion of a whole and identifiable piece of work—that is, one that involves doing a job from beginning to end with a visible outcome.
- **Task significance**: the degree to which the job has a substantial impact on the lives or work of other people elsewhere in organization or in the external environment.
- **Autonomy**: the degree to which the job give the individual substantial freedom, independence, and discretion in scheduling the work and in determining the procedures to be use in carrying it out.
- **Feedback**: the degree to which carrying out the work activities required by the job results in the individual obtaining direct and clear information on the results of his or her performance.

The higher degree of these core characteristics, the greater will be the enrichment of the job. In manufacturing activities, the humanware needed to express the technoware could be classified into contact humanware and support humanware. Contact humanware refers to the operators of the technoware, operators of related ancillary technoware such as material handling equipment, and shop
floor supervisors. Support humanware refers to the maintenance crew, technoware use planners (production planning and control staff), quality assurance staff, and production mgt staff.

- The institution-embodied COT “Orgaware”

Orgaware refers to effective organizational practices, linkages, and related arrangements needed to make the best use of the technoware and humanware. It may even be said that the effective use of technoware and humanware really depend on the virtuosity of the orgaware used by the firm. One way to overcome this difficulty would be to look at orgaware as a support set of principles, practices, and arrangement that govern what called work conventions, work organization, work facilitation, work evaluation, and work modification in an organization so that effective use of technoware can be made by the humanware.

These five elements are elaborated.

1. Work conventions refers to the value creating and corporate culture defining philosophies adopted by the management of the firm.
2. Work organization refers to roles that each members of an enterprise is expected to perform and the relations between the members so that their combined efforts will lead to the most effective use of the available technoware by the humanware.
3. Work facilitation refers to the practices that may be regarded as supportive measure. There are communication, information sharing, skill development, incentives, and rule.
4. Work evaluation refers to the practices used to verify whether work organization has led to desired results, and the taking of necessary action to correct deviations.
5. Work modification has two important characteristics of work modification approach, and time frames.

- The document-embodied COT “Inforware”

Even with orgaware, humanware, cannot express the technoware effectively on sustained basis without adequate information back-up. Effective technoware utilization by humanware requires information to interpret, plan, implement, monitor, diagnose, and rectify value-addition activities that may be undertake by manufacturing enterprises. This information component of technology may be called inforware. Inforware represents the accumulation of knowledge by human beings. Inforware is not data. Inforware refers to information that has been tested and if necessary, refined so that it can be used for value-addition activities. Inforware, as applied to manufacturing technology, could be considered in term of three categories namely: technoware-specific-inforware (TSI), humanware-specific-inforware (HSI), and orgaware-specific-inforware (OSI).

1. PRODUCT TECHNOLOGY

Design foundation inforware: information that provides the requirements of the product design, design concepts, simulation techniques, and analytical procedures needed for understanding and predicting product performance such as computer-added design tools and customer needs.

Design back-up inforware: inforware such as organized technical data needed for designing a product. This includes information like tables of engineering data, documentary standard, state-of-the-art measurements, and national and international performance standard. Design specification inforware:
information such as engineering drawings of the product, design specifications, and design calculations used.

- Product usage inforware
  - Product operating inforware: information like standard operating procedures (software installing needed to use the producing goods and computer-based training).
  - Product maintenance inforware: information needed to maintain, repair, and service product and related software. This includes maintenance manuals for both hardware and software.
  - Product performance-enhancing inforware: knowledge is a heuristic nature that is involved in information needed for upgrading product performance.
CHAPTER V
REVIEW OF TECHNOLOGY MANAGEMENT

Management of technology refers to the design and use of the means needed in organizations to achieve economic and social objectives through technological innovation. Mechanism through which humankind has leveraged their efforts, both individually and collectively, to improve its quality of life.

Key factors in defining competitive advantage. Most CEOs said “People are our most important resources”. And technology resources are very important indeed to many companies. We invest it, protect it, develop and nurture it, and try to exploit it for commercial advantage. Competence in the technical content of technology is not enough. Managerial condition, systems, decisions, that surround the technology. Adoption and implementation of technology is one important aspects of innovation.

- Burgelman and Maidique (1998)-Variable associated with innovation:
  - Resources available and allocation
  - Organization’s ability to understand its competitors’ innovative and industry evolution.
  - Business’s technological environment
  - Structural and cultural context of the business
  - Business’s strategic management capacity in dealing with entrepreneurial behavior.

- Technology should be considered in the organizational or corporate context (Fusfeld).

**Seven quality as determining the success of any technology in industry (Fusfeld):**

1. Functional performance
2. Acquisition cost
3. Ease of use characteristics
4. Operating costs
5. Reliability
6. Serviceability
7. Compatibility

- Technological innovation: a framework
  - Discovery or new ideas or development of an understanding of a market need and opportunity.
  - The processed ideas or design concept emerge.
  - Verification of the theory and design.
  - Prototyping or laboratory demonstration of the idea
  - Evaluation and considering alternative version of idea
  - Commercial introduction or initial operation of the innovation take place.
  - Widespread adoption of the innovation
  - Extension for new markets or new applications of the original innovation.
CHAPTER VI
TECHNOLOGY STRATEGY

1. TECHNOLOGY STRATEGY

Technology strategy refers to the choices that companies make in acquiring, developing, and developing technology to achieve their business goals (Samson, 1991). It involves:

- The technology choice that firms make
- Which technology are embodies into new products and production processes.

2. TECHNOLOGY STRATEGY - OBJECTIVES

- Betz (1993) has articulated the objectives of technology strategy:
  - Maintaining technological capabilities in existing business.
  - Expanding markets in existing businesses or launching new businesses.
  - Securing distinctive technological capabilities from external sources.

3. TECHNOLOGY STRATEGY - CLASSIFICATION

- Maidique and path (1988) define technology strategy as consisting of six dimensions:
  - Types of technology
  - Desired level of competencies
  - Make vs. buy decision for technology
  - R and D investment
  - Timing of technology introduction
  - R and D organization

Firm should propose technology strategies that are compatible with its business strategies such as first-to-market, second-to-market, late-to-market, or market segmentation.

4. BUSINESS COMPETITIVENESS AND TECHNOLOGY STRATEGY

- Clark (1989) has proposed five precepts for firm strategy that impact the technology management the manager should:
  - Understand the technology base and envision that base as strategic advantage.
  - Discipline their business function around the function of production.
  - Focus on time as the critical factor in using innovation for competitive advantage.

Technology leader were able to either price their innovation products higher or lowering costs of their products. Technology leader excelled in four key areas of technology management: (technology strategy, technology portfolio management, technology planning, and technology development and transfer processes.)
CHAPTER VII
DEVELOPMENT OF TECHNOLOGICAL CAPABILITIES

1. DEFINITION AND ITS IMPORTANCE

- Technological capabilities refer to those technological assets possessed by a firm that have strategic significances, the process and practices by which assets are development and exploited. Those assets may be developed by the following:
  - Introducing and diffusing a new technology
  - Upgrading the technical skill and knowledge of employees.
  - Improving the organizational routines, structures, process, and value.
  - Enhancing relationships with suppliers, customers, company affiliates, and other organization.

- The core technological capabilities compose of:
  - A set differentiated skills (which reside in human capital)
  - Organizational routines
  - Specific assets that underlines competitive advantages (manufacturing technologies, CAM etc.)
  - Developing technology-based capability
  - Jaikumar and Bohn model (1986)

Phase 1:
- Recognition of prototypes
- Recognition of attributes within prototypes
- Discrimination across attributes
- Discrimination within attributes
- Local control of attributes

Phase 2:
- Fine-tuning the system and developing and considering the reaction of the system to change.

Phase 3:
- Remaining in the control of the process under changing conditions.
- Having complete understanding and knowledge of all possible contingencies.

2. TECHNOLOGICAL CAPABILITY DEVELOPMENT

Hamilton (1992) has defined technology transfer as: the process of movement or transfer of information, technological know-how, and people among corporate technological functions such as R&D, engineering and manufacturing, and non-technical functions such as marketing and sales in order to yield innovative products and services that meet corporate business goals and fulfill customers needs.
CHAPTER VIII
MANAGING INNOVATION

1. DEFINITION

Souder (1987) innovation is a high risk idea that is new to the sponsoring organization. The innovation process is any system of organized activities that transforms a technology from idea to commercialization.

- The three types of innovations (Samson 1991):
  1. Product innovation
  2. Process innovation
  3. Managerial and system innovation

2. NATURE INNOVATION

S Betz (1993) risk taking, a tolerance of ambiguity, an increased customer and market orientation, a high degree of employees motivation and commitment, teamwork, effective horizontal communication channels, and vesting decision-making authority with entrepreneurs have become the hallmark of innovation. Schumpeter (1934) argued that developing market and large firms are the driving forces behind innovation.

3. INNOVATION AT 3M

- Six attributes (Mitsch, 1990):
  1. Development of core technical capabilities.
  2. Technological differentiation from competitors.
  3. Establishment of proprietorship positions.
  4. Leveraging existing strengths
  5. Entering segments where company can win.
  6. Augmenting the business thru acquisitions and licensing.

4. INNOVATION PRACTICES

- Quinn (1985) found that:
  - Firms pay close attention to their user’s needs and desire.
  - Avoid excessive detail in early technical or marketing plans.
  - Allow entrepreneurial teams to pursue competing alternatives within clearly conceived framework of goals or limit.
  - Entrepreneurial firms adopt different practices than traditional firms for project justification, decision making, and incentive scheme.

The End! Good Luck!