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■ Lecture 8 – Innovation Management and Decision Making

Innovation Management and Decision Making

Learning Objectives

After you complete this lecture, you will be familiar with the following concepts:

- Innovation Management and Decision-Making: An Introduction
- Innovation Management Process: A Decision-Making Focus
- Case Example: IBM in the 21st Century – The Coming of the Globally Integrated Enterprises
- Innovation Management and Decision Support Tools
- Corporate Management, Innovation Management, and Decision-Making Explained With the Help of the Business Running Case and the Business Simulation

Innovation Management and Decision Making: An Introduction

Management decision making with regard to embracing a potential invention or innovation can be made on an individual, a group or an organizational level and often involves a great deal of judgmental decision making since the availability of data, particularly for a new invention or innovation, is often nonexistent. Frequently, the decisions to move forward with the development of an innovation is made on a subjective or "gut" non-rational level where a visionary is able to see a potential "hit" based on experience or instinct rather than on a rational computational and financial basis and an understanding of clear risks regarding the likelihood of success.

For example, the ability of Apple Computer to continue to develop leading edge products in a very competitive market is a tribute to the ability and decision making of top management to develop a fundamental concept in an open decision making environment. On the other hand, a lack of vision can often result in a judgmental decision that declines to embrace a potentially great product or concept. For example as mentioned in Module 1, the case of Western Electric Company's lack of vision in the late 1800's led to the missed opportunity of a lifetime; the chance to develop and capitalize on the telephone.

In this lecture, we will discuss decision making with regard to product, process and service innovation which revolve around the key question of whether a company should decide to build or not to build a new product, or undertake a new production or service process. The applicability of advancing technology in the realm of invention, innovation

and diffusion as impacting decision making by first describing these different but related processes, and then applying various scenarios to our cases.

Invention

To begin with, the most basic element of technological advance is invention, which is defined by McConnell & Brue as "the first discovery of a product or process through the use of imagination, ingenious thinking and experimentation and the first proof that it will work". Invention is often described as a process but the product is also called an invention. For example, the first prototype of the telephone and the automobile are inventions. An invention is usually based on scientific knowledge and is the product of individuals either working alone or as part of corporate or university teams. Inventions are also protected and fostered through government issued patents which fosters the environment in which additional inventions can take place.

Innovation

Innovation is technological change that relies directly on invention. While invention is the "first discovery and proof of workability", innovation is "the first successful commercial introduction of a new product, the first use of a new method or the creation of a new form of business enterprise". It is also often defined as the 'process of introducing a new idea, or inventing/creating something which has not yet been discovered or developed by the market.

Innovation is often divided into product, process and service innovation. Within each of these categories, innovation can be of three types:

- an extreme or radical innovation which involves a breakthrough product, process or service,
- distinctive innovation in which substantial improvements in the existing product, process or service have been made, and
- incremental innovation where small improvements to an existing product, process or service have been made.

The process of extreme innovation involves a major change in the existing process, product or service to meet a change in consumer demand, or could involve taking an entirely new approach.

Distinctive and incremental innovation involves making small improvements and additions to existing products, processes and services. The aim of such innovations is to increase efficiency through higher quality, reduced time and lowered costs.

Product innovation involves new and improved products and services while process innovation involves new and improved production or distribution methods. Unlike inventions, innovations cannot be patented, but they often have a profound impact on competition. For example, innovations in hardware retailing such as Home Depot, have threatened smaller, more traditional hardware stores. On the positive side, the benefits of innovation, most economists believe, far outweigh the negatives. Innovation can have the effect of spurring research and development, such as in the cases of Reynolds aluminum cans, Hewlett-Packard calculators and others.

Therefore, innovation occurs when a change in the product, process or service results in a better solution for an existing need. Innovation has become the key growth driver behind the evolution of civilization across the globe.

Innovation has become the basis for business survival and development.

Historically, the process of innovation was largely unpredictable and unmanageable, and no formalized innovation process was in existence up through the early 1900s. Traditionally, companies believed innovation was an expensive activity, with a payback period in the long run. Hence, companies failed to retain their interest in it for the required period of time and often abandoned innovation projects midway. In organizations that did maintain interest, most innovations were restricted to new products that were largely the efforts of development by corporate research and development (R&D) departments, such as AT&T's Bell Labs, IBM's Watson Research Center or RCA's Sarnoff Labs or by academic researchers and individuals.

Diffusion

Finally, the spread of an innovation to other countries or markets through imitation or copying is diffusion. To take advantage of new profit potential or slow the decline of profits in existing products, firms often copy previously made successful innovations. After McDonald's successfully introduced the fast-food burger, Burger King, Wendy's and other firms soon followed that idea. In other cases such as these, innovation has led to widespread imitation, or diffusion.

With definitions of these terms, we next explore the nature of product and service design which are frequently all about invention and innovation. Product and service design follow naturally from invention and innovation. These aspects represent the tangible high production outcomes of the previous discussion.

The Nature of Product and Service Design

Product and Service Design

Product and service design are the creation or enhancement of an organization's product or service.

The benefits of designing, or redesigning, the products a firm will manufacture and market, are considerable. Possibly the most obvious is control. Control of the design process means that a firm can decide upon and adopt whatever design strategies for their products best suit them. Demand-increasing features can be built-in, costs can be controlled to make the price as attractive as possible, and profits will be maximized.

Reasons for Product or Service Design

- Be Competitive
- Increase business growth & profits
- Avoid downsizing with development of new products
- Improve product quality
- Achieve cost reductions in labor or materials

Product quality has, over the last few decades, become one of the most important elements in the differentiation of a firm's product offering from that of the competition. Deming, Juran, Baldrich and a host of others brought product

quality to forefront of corporate thinking. All stressed the importance of designing quality into the product, not finding the mistakes that faulty design had allowed.

Product and service design combined with proper decision making can improve competitiveness. Every advantage must be explored and exploited in a marketplace. Designing a product to meet and beat the competition is not just good business it is good sense.

Product and Service Design Strategy

The major decision making factors for the design of the product and service strategy of a company are:

- Cost
- Quality
- Time-to-market
- Customer satisfaction
- Competitive advantage
- Other product design decision making considerations

Cost and **customer satisfaction** have been already discussed in Lecture 7.

Quality: Designing a product that will meet or exceed a customer's expectations for performance.

Time-to-market: Shortening the development time of a product to speed it to market before the competition.

Competitive Advantage: Designing a product that enters a market with features that immediately place it ahead of the competition.

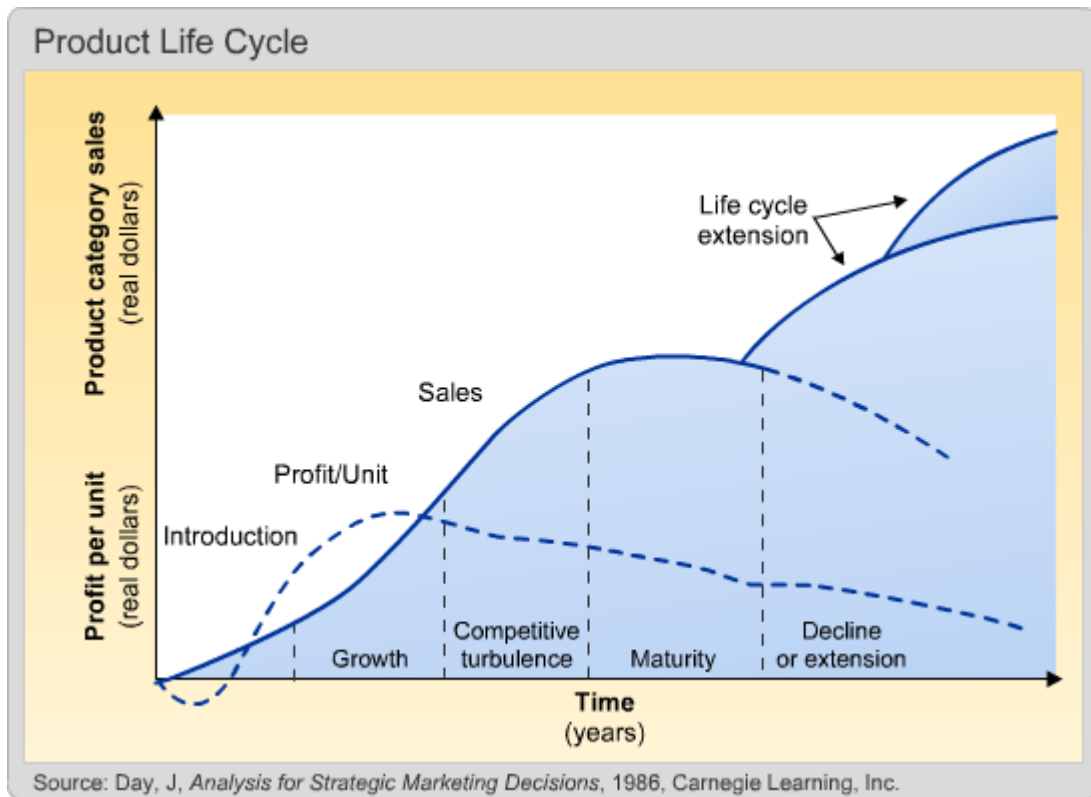
Product Design Decision Making Considerations

- Product Life Cycles
- Standardization – designing for mass customization
- Reliability
- Concurrent Engineering
- Computer-aided Design
- Re-manufacturing

Product and Technology Life Cycles

In Lecture 7, as part of the discussion how companies are developing strategic marketing programs, we discussed the importance of product and service decisions and the role of the product life cycle¹ (and the sales history of the

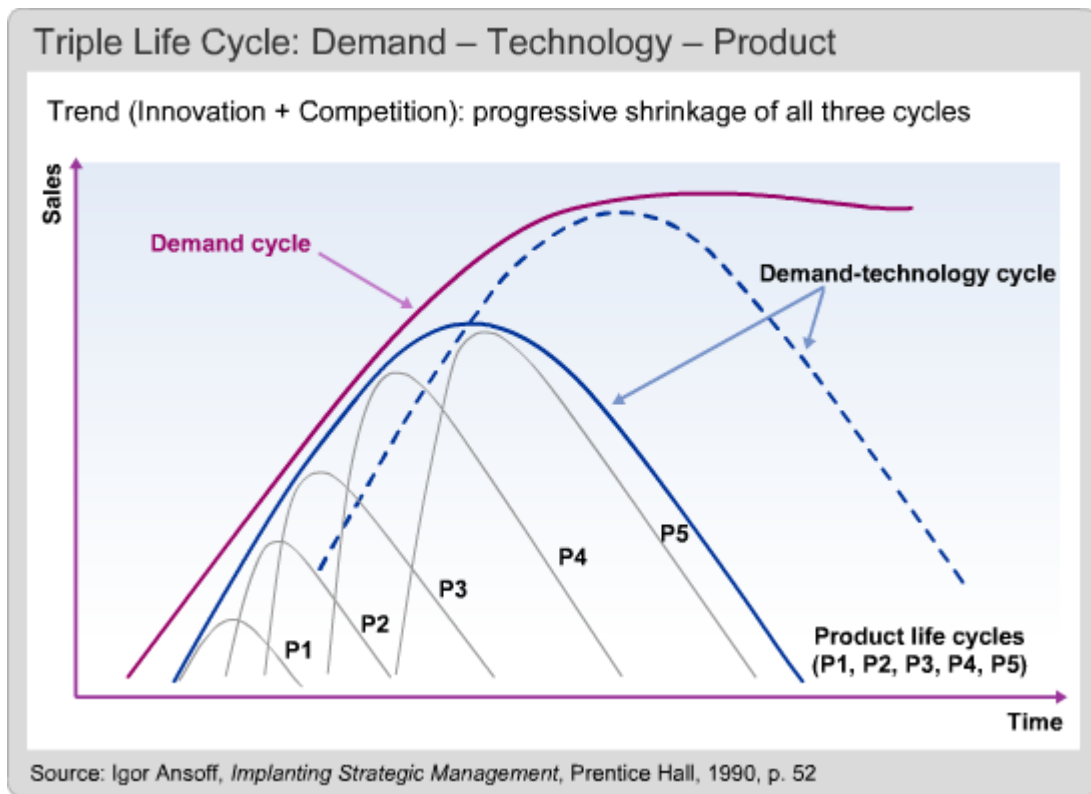
product over time) approach in this decision making process – see the diagram, below.



It is also important to discuss the life cycle of a product or service in the context of the evolution of the markets and the demands and the trends and the life cycles of the technology, typical for the products or industry of interest. The graph below presents these connections as a triple life cycle "Demand – Technology – Product".

Using the car industry as an example we can make the following interpretation of the graph. A car manufacturer is:

- Analyzing the current trends and is making forecasts for the market size and the characteristics of the cars (from customer prospective);
- Creating requirements for the technological infrastructure needed for the manufacturing process for the time of the demand cycle (e.g. next five years),
- Asking the research and development departments of the company to design a family of products, considering the advantages and the limitations of the technological cycle(s) and the market demand.



¹ Day, J, *Analysis for Strategic Marketing Decisions*, 1986, Carnegie Learning, Inc.

Forecasting

Forecasting or forecasts are concerned with approaches to determining the future outcomes of events that can't be observed now.

Usually forecasts are presented in form of a statement (and often are also called prediction, estimation, projection, or prognosis).

The statement can be conditional ("the event may happen if...") and/or limited in the time ("the estimations for the next three months are..."). The research on forecasting comes from many disciplines and is well described and monitored².

To determine the future performance potential of the business organization in each of its area of interest, managers are using characteristics and determinants of the characteristics, such as:

Characteristics	Determinants of the characteristics
Growth	Demand stage Market size

	Buying power Trade barriers
Profitability	Buying habits Competitive structure Competitive intensity Distribution system Government regulations
Turbulence	Economic Technological Socio-political
Success factors	Retention of key R&D personnel Reducing supply-chain costs Enhancing quality of services (... and many more)

Forecasting performance in turbulent environments is a very difficult and serious business. Very often the forecasts are based on a combination of analytical techniques and methods, purposely selected and applied with the goal to capture nonlinearity, complexity, and unpredictability of future environments. These methods can be structured in three groups³:

1. Forecasting (business, economic, demographic, sociological, or technological) techniques, designed to develop future trends, or identify significant probable future variables and events
 - Extrapolation
 - Multiple regression
 - Curve fitting
 - Scenarios
 - Corrected extrapolation
 - Delphy
 - Asymmetric analysis
 - Threats/opportunities analysis
2. Modeling techniques, designed to construct a model of reality which can be manipulated by the decision maker to produce different futures by changing inputs and relationships among the variables within the model
 - Input – Output
 - Econometric
 - System dynamics
 - Stochastic
3. Examination of the impact of the results from the forecasting or modeling on the firm
 - Impact analysis
 - Cross-impact analysis

- Deductive analysis (project pattern)
- Force field analysis

² Some of the organizations and journals in the field of forecasting:

- [International Institute of Forecasters](#)
- [International Journal of Forecasting](#)
- [Journal of Forecasting](#)
- [Foresight – The International Journal of Applied Forecasting](#)

³ According to Ansoff, I., McDonnell, E, Implanting Strategic Management, Prentice Hall, 1990, pp.55 - 59

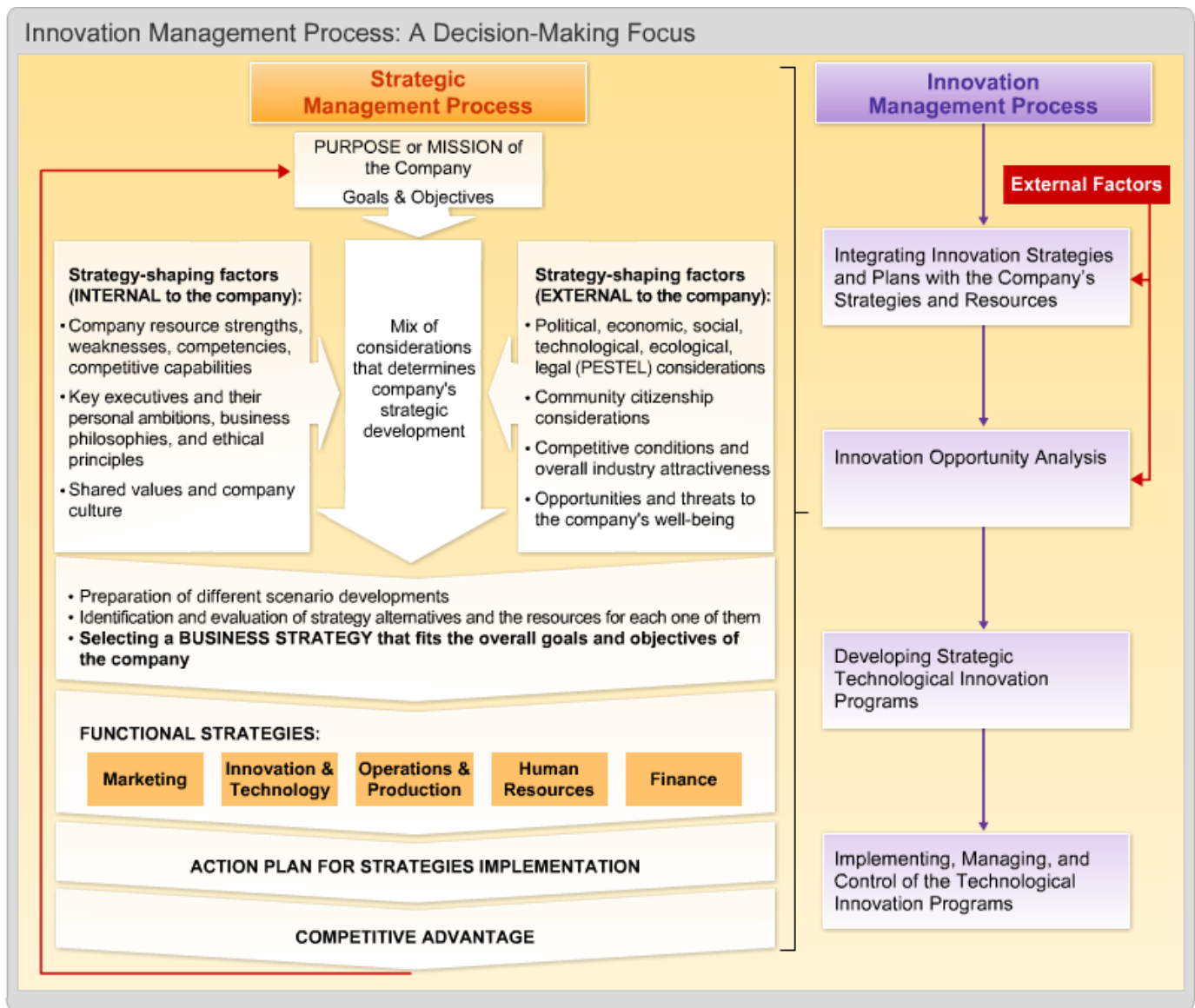
Standardization

In addition to product life cycles, product designers must also decide whether to consider **standardization** in their initial design work decision making. Consumers have a level of expectation for certain products that are used on a regular basis. These products are expected to be the same in terms of aesthetics and quality. It is also expected that, since these products are the same and are manufactured in volume, the savings in cost of production will result in a lower price than would be expected for a more customized product. Consumers also believe that needs are unique and there is a choice from among a variety of products to fulfill that unique need. Product designers consider the first scenario as standardization, designing low-cost and low-priced products that will be manufactured in volume. The second scenario describes a need for mass customization-producing products that have the benefits (cost, price, volume manufacture) and yet present the consumer with enough variety to meet their perceived uniqueness.

Among the best examples of these two design considerations are the standardized product design of the "Over 99 Billion Served" McDonald's Burgers compared to the design of Burger King's "Have it your way" continuing campaign for mass customization.

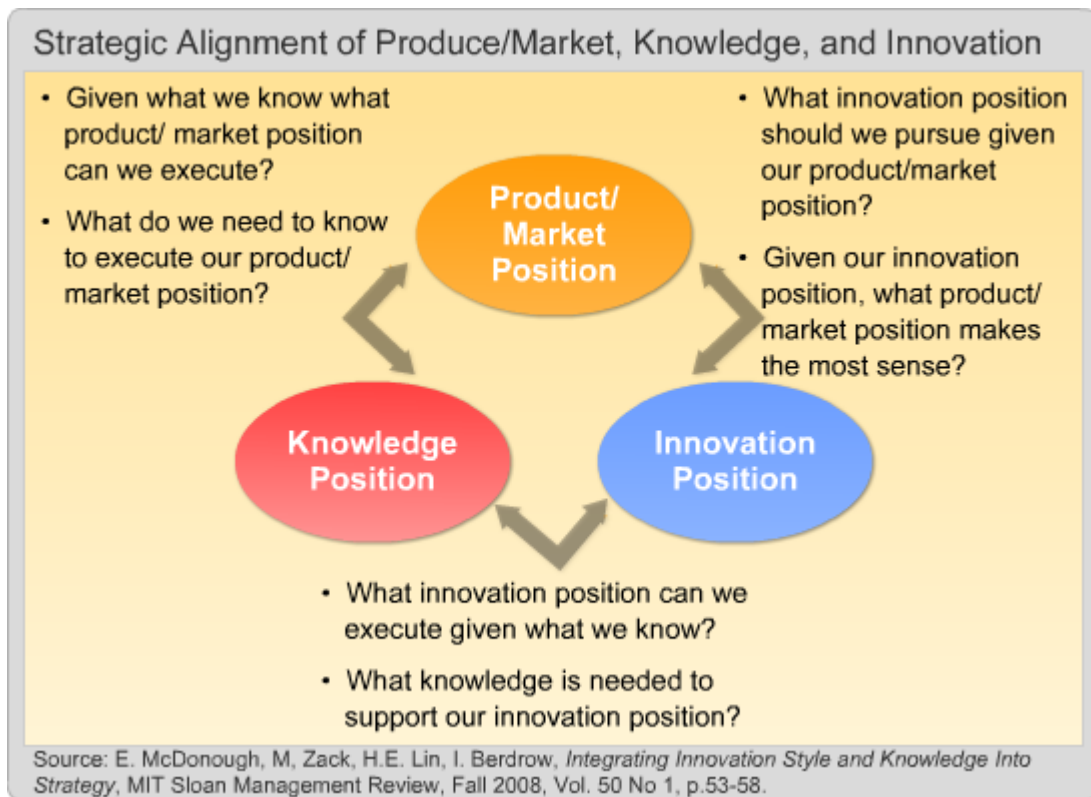
Innovation Management Process: A Decision-Making Focus

Please review the diagram below before moving on in this topic:



Integrating Innovation Strategies and Plans with the Company's Strategies and Resources

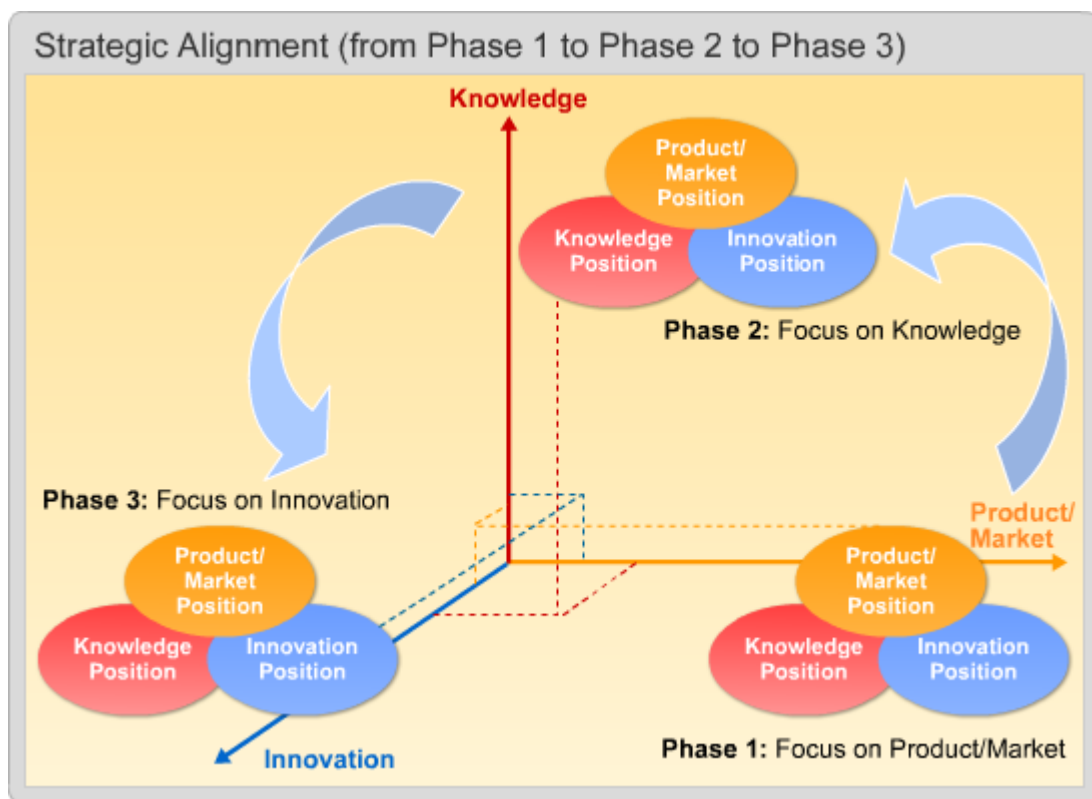
The distinguish identification for the efficiency of the management body of a company is the way how the company makes money. One way to describe the role of decision making and the business model of the company is to analyze the ability of the corporate management to integrate innovation style and knowledge into strategy⁴. In the core of this model is the strategic alignment and mutually reinforcement of three aspects of the overall strategy of the company: product/market, knowledge, and innovation. The graph below shows the main characteristics of the strategic alignment of all three positions.



The next step is to see how the strategic alignment works in the time, where the strategic transitions are described as a three dimensional model (see the graph below) – the three coordinates are symbolizing the focus of the decision making process on one of initially selected strategic characteristics: product/market, knowledge, and innovation.

- During **Phase 1** the company is competing on product leadership. In the process of strengthening of its competence to manufacture and sell better products, the company is establishing an effective alignment among its product/market, knowledge, and innovation positions. If the products are generally superior to those of the competition and the markets are relatively unsaturated, this strategy can be successful.
- As the industry is becoming more competitive, the product leadership position is evolving to a less competitive one. One possible (and successful) outcome for the leadership is to shift its strategic focus from a product-oriented position to a knowledge-based position, which is **Phase 2** of its strategic transformation. Based on unique knowledge the company can not only offer leading-edge products, but also can start selling value-added services by showing customers how to make the most effective use of its products. By narrowing the products and services to selected market segments, the company can focus the knowledge and the innovation required to support the new products & services/market position. The new knowledge how to shift from products to applications logically provides a way to compete on more strategic and difficult to copy combination of products and services. The benefits of this focus are supported by the new dimension of corporate innovation – from internal product-centered innovation to external, customer-driven knowledge-sharing service innovation.

- **Phase 3** can be characterized as 'continues innovation'. The company still focuses on problem-solving skills and application expertise, but in addition is adding customer relations and communication skills, the ability to learn and innovate with the customer, and a deep understanding of customer's strategy, operations, economics and manufacturing processes and systems. In this context the new innovation position is based on continues, collaborative, custom-specific, problem-focused innovation. By establishing such a closed relationship, the company can maintain and defend its unique access to the customer-specific learning that is fueling the next round of innovation for that customer. In addition to products and services related innovation the company innovates also its organizational structure and processes and is aligned its innovation focus with the other two strategic positions. In the center of the new approach is the ability of the company to support communication and knowledge sharing across its operations. In this context the role of business intelligence and business analytics is becoming a centerpiece of the continuous innovation of the company.

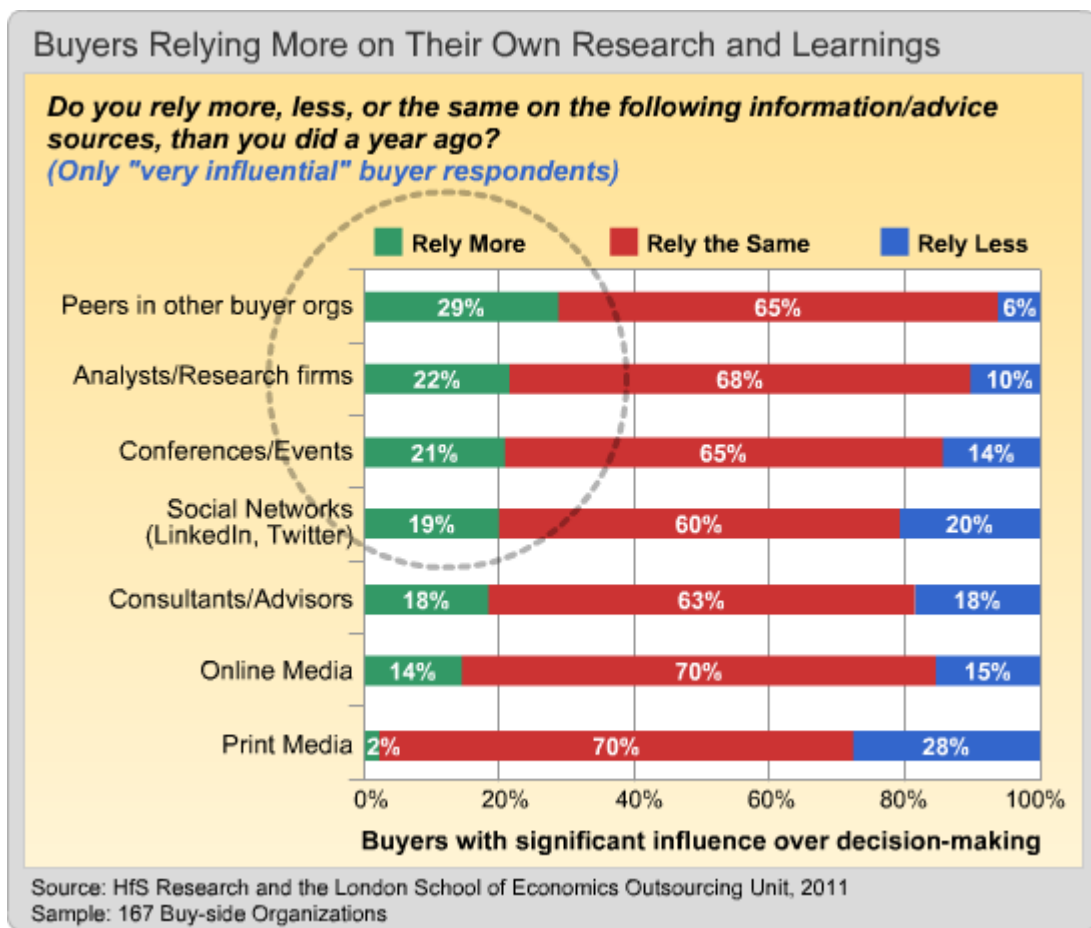


⁴ E. McDonough, M, Zack, H.E Lin, I. Berdrow, *Integrating Innovation Style and Knowledge Into Strategy*, MIT Sloan Management Review, Fall 2008, Vol.50 No 1, pp. 53 - 58

Innovation Opportunity Analysis

Strategic transition to continuous innovation is possible only if the company can capitalize on technology advances to pioneer a whole new innovation paradigm, based on the ways they measure, experiment wit, share, and replicate

information⁵. In addition, companies are following the general trend to rely more on their own research and learning – see the graph below.

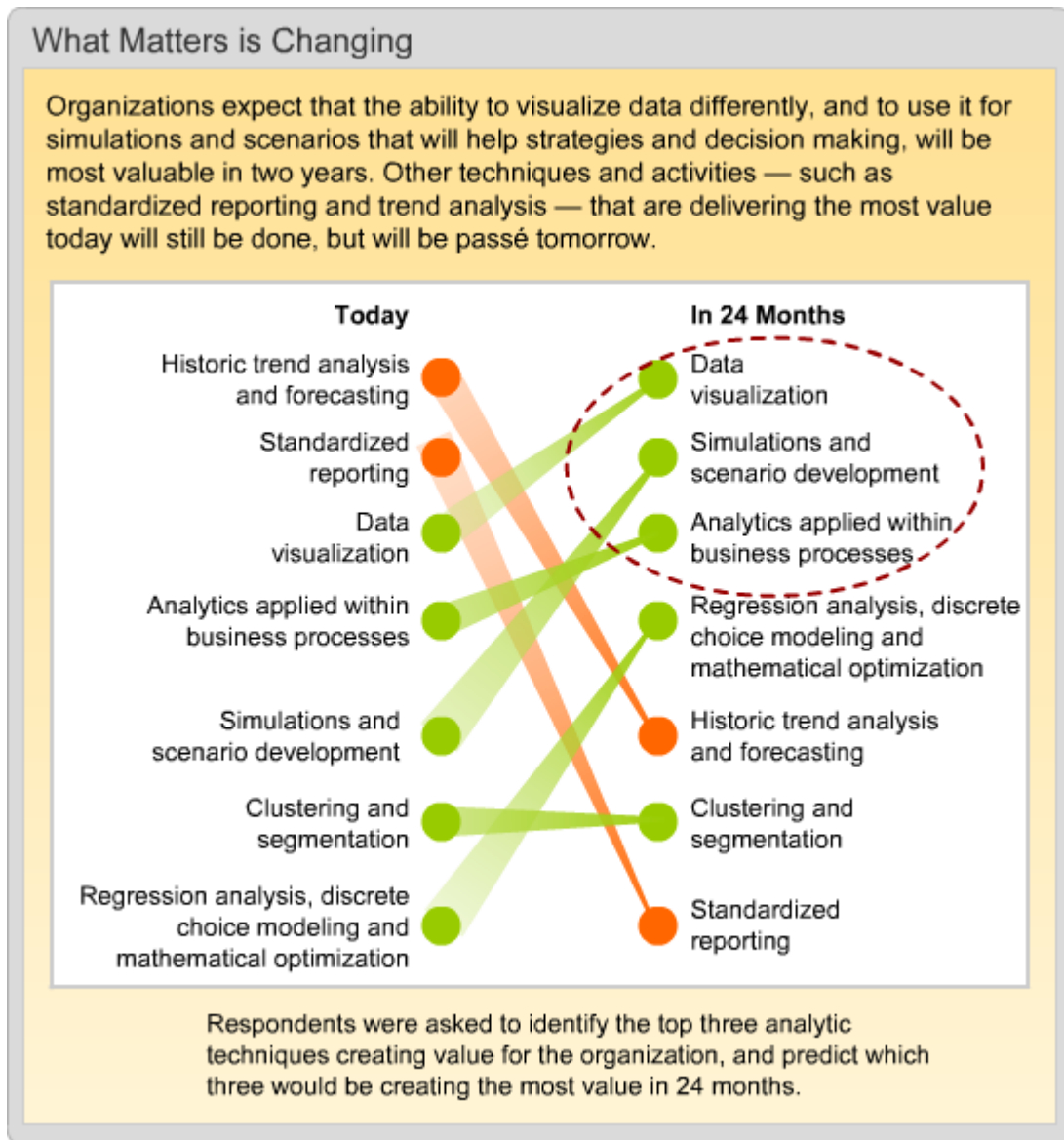


In 2009 and 2010 IBM and MIT Sloan School of Management asked over 3,000 executives from all over the world to participate in a survey called The New Intelligent Enterprise Survey. Below are 10 observations and questions about analytics-driven management⁶:

1. The big picture: make it new (or, the innovation imperative)
2. Analytics = Performance?
3. You cant graft analytics on to your business without modifying its culture, too
4. Help wonted (the analytics talent challenge)
5. Where in organizations is analytics done?
6. Were are the leaders going?
7. Seeing it believing (and understanding, using, and collaborating)
8. Strategy: plan less, experiment more
9. Analytics plays no favorites
10. Experts vs. Executives – the 'ideal state' assessment gap

One of the 10 data points of the survey is: "Sofisticates expect continued use of analytics to increase their competitive advantage". Respondents were asked to identify the top three analytic techniques creating value for the

organization, and predict which three would be creating the most value in 24 months. Below are the answers.



⁵ Interview with Erik Brynjolfsson, The Four Ways IT is Revolutionizing Innovation, MIT Sloan Management Review, Spring 2010, Vol. 51 No 3, pp. 51–65

⁶ M. Hopkins and others, 10 Insights: A first look at the New Intelligent Enterprise Survey on Winning With Data; 10 Data Points: Information and Analytics at Work, MIT Sloan Management Review, Fall 2010, Vol. 52 No 1, pp. 21–31

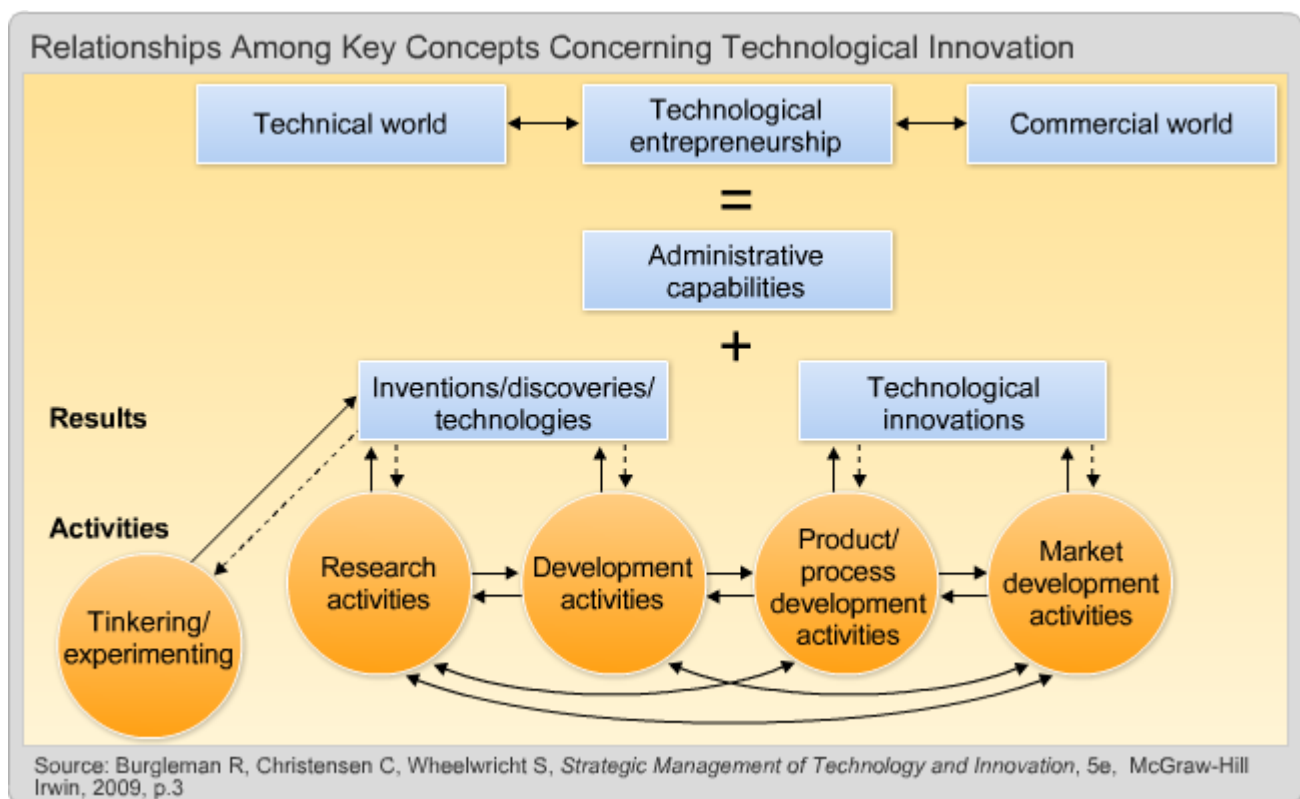
Developing Strategic Technological Innovation Programs

The main focus in this course is on managerial decision making. We should assume that managers don't have solid backgrounds in science and engineering but

- are ready to invest significant effort in learning to understand the technologies important in their business;
- know how to identify reliable and trustworthy sources of technical advice;
- must be able to frame the key strategic questions in relation to technology.

The remainder of this section focuses on these questions and discusses the tools necessary to examine how a firm's technology and business strategy can be integrated most effectively⁷.

The diagram below shows the relationships among key concepts in the technological innovation process. It highlights the activities constituting the process and the outcome produced. Inventions, discoveries, and technologies (outcomes) are the result of thinking and experimenting, research and development activities. Technological innovations (outcomes) are the result of product, process, and market development activities. The process starts with market deployment but in reality it is always iterative and concurrent rather than unidirectional and sequential.



Connecting Technology and Strategy

In early 1980s Porter created his fundamental concepts of "five forces", "generic strategies", and "value chains" which are still widely used frameworks for

- explaining why some industries are inherently more attractive than others,
- understanding a firm's strategic position relative to that of its rivals, and
- devising strategic actions that can affect the overall industry attractiveness and the strategic position of individual firms.

Porter is classifying competitive strategies as (i) industry-wide differentiation, (ii) focused differentiation, (iii) industry-wide cost leadership, and (iv) focused cost leadership. In addition he is explaining how each one of the generic strategies is linked to a different technological strategy. As shown on the diagram, below, strategic decisions about both product and process (manufacturing) technology can serve the purposes of both the differentiation and cost leadership strategies. Process related technology may be key to product performance and hence differentiation. On the other hand, product-related technology may be the basis for lower cost.

Technological Policies and Generic Competitive Strategies⁹

Technological Policies and Generic Competitive Strategies

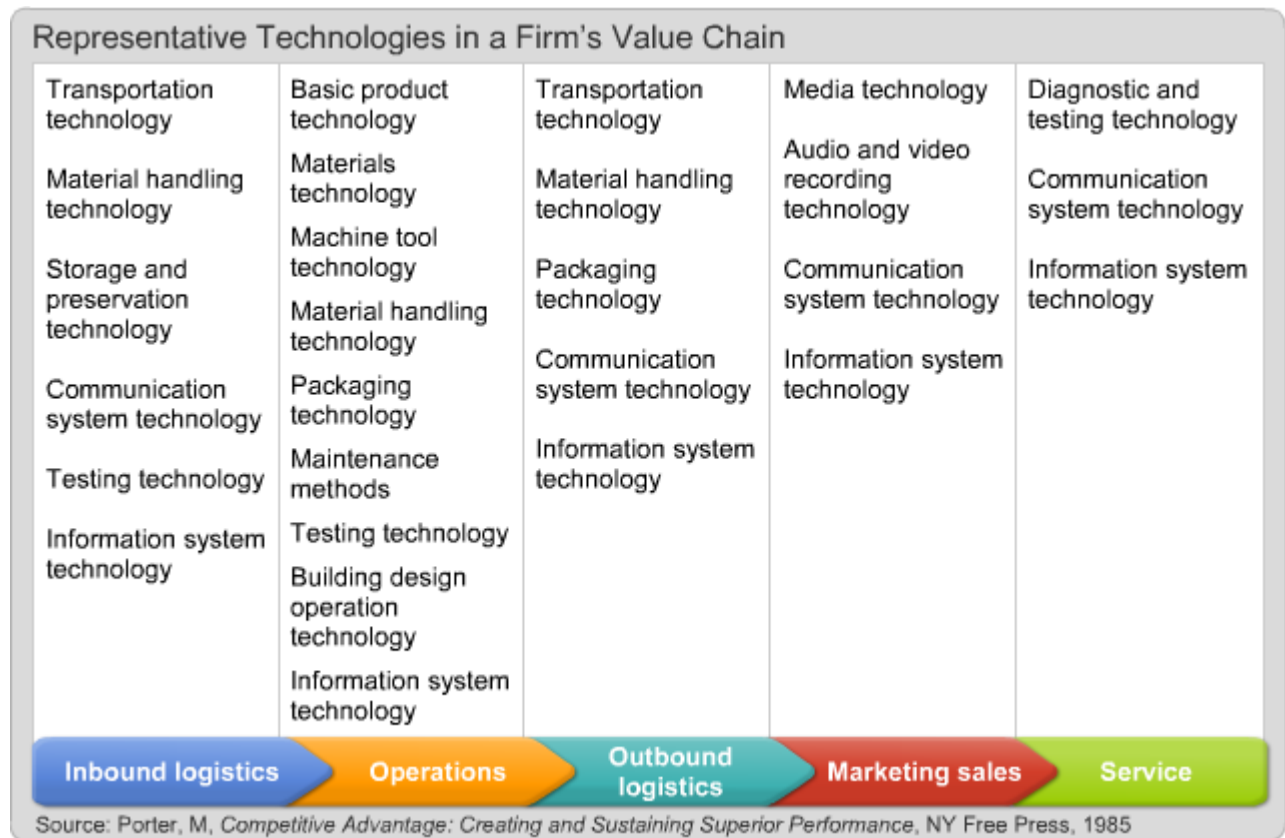
	Generic strategy			
	Overall cost leadership	Overall differentiation	Focus-segment cost leadership	Focus-segment differentiation
Technological policies				
Product technological change	Product development to reduce product cost by lowering materials content, facilitating ease of manufacture, simplifying logistical requirements, etc.	Product development to enhance product quality, features, deliverability, or switching costs	Product development to design only enough performance for the segment's needs	Product design to meet exactly the needs of the particular business segment application
Process technological change	Learning curve process improvement Process development to enhance economies of scale	Product development to support high tolerances, greater quality control, more reliable scheduling, faster response time to orders, and other dimensions that improve the ability to perform	Process development to tune production and delivery system to segment needs in order to lower cost	Process development to tune the production and delivery system to segment need in order to improve performance

Source: Porter, M, *The Technological Dimension of Competitive Strategy*, Research and Technological Innovation, Management and Policy 1, 1983, p. 1-33

Technology and the Value Chain

The diagram below shows an example of various technologies in a firm's value chain. In his 'value chain' framework Porter points out that any of these technologies can affect the industry structure or a firm's differentiation or cost position, and therefore, its competitive advantage. Thus, it is important for the manager of the company to track the evolution of all technologies that affect the firm's value activities. More specifically, the firm's manager has to decide (i) how each technology can be used for competitive advantage, and (ii) whether a given technology should be developed in-house or procured.

Representative Technologies in a Firm's Value Chain¹⁰



Technology Evolution and Forecasting

Earlier in this lecture we discussed the linkage between the life cycles of market demand, technologies, and products. The firm management has to understand the dynamics of the life cycle of the various technologies it employs and to know how to connect different stages in the technology life cycle and the potential for competitive advantage – see the diagram, below.

The second point of reference is to the role of forecasting (discussed earlier in this lecture) and the abilities of the management of the company to interpret the results of the innovative evolution of technologies and to understand how the current situation compares to the past.

Technology Life Cycle and Competitive Advantages¹¹

Technology Life Cycle and Competitive Advantages

Stages in Technology	
Life Cycle	Importance of Technologies for Competitive Advantage
I. Emerging technologies	Have not yet demonstrated potential for changing the basis of competition.
II. Pacing technologies	Have demonstrated their potential for changing the basis of competition.
III. Key technologies	Are embedded in and enable product/process. Have major impact on value-added stream (cost, performance, quality). Allow proprietary/patented positions.
IV. Base technologies	Have minor impact on value-added stream; common to all competitors; commodity.

Source: Arthur D. Little, *The Strategic Management of Technology*, European Management Forum, 1981

⁷ This and the next section of Lecture 8 are composed based on Burgelman R, Christensen C, Wheelwright S, *Strategic Management of Technology and Innovation*, 5e, McGraw-Hill Irwin, 2009, part 1 (pp. 1–11)

⁸ Burgelman R, Christensen C, Wheelwright S, *Strategic Management of Technology and Innovation*, 5e, McGraw-Hill Irwin, 2009, p. 3

⁹ Porter, M, *The Technological Dimension of Competitive Strategy*, Research and Technological Innovation, Management and Policy 1, 1983, pp. 1–33

¹⁰ Porter, M, *Competitive Advantage: Creating and Sustaining Superior Performance*, NY Free Press, 1985

¹¹ Arthur D. Little, *The Strategic Management of Technology*, European Management Forum, 1981

Implementing, Managing, and Control of the Innovation Programs (Assessing the Innovative Capabilities of the Company)

Innovative Capabilities

Innovative Capabilities can be defined as the comprehensive set of characteristics of an organization that facilitate and support innovation strategies. They exist at the business unit level and corporate levels:

- Business unit – a unit for which a particular strategy and resource commitment posture can be defined because it has a distinct set of product markets, competitors, and resources.

- Corporate level – characterized through critical variables that influence both the relationships between corporate and business levels in terms of innovative capabilities and the formulation and implementation of an overall corporate innovation strategy.

Business Unit Level Audit and Corporate Level Audit

Business Unit Level Audit

The innovative strategies at this level, with respect to new products and services and/or new production and delivery systems, can be characterized in terms of:

- timing of market entry
- technological leadership or followership
- scope of innovativeness
- rate of innovativeness.

The categories of variables with key influence on the innovation strategies of a business are represented in the following diagram.

Corporate Level Audit

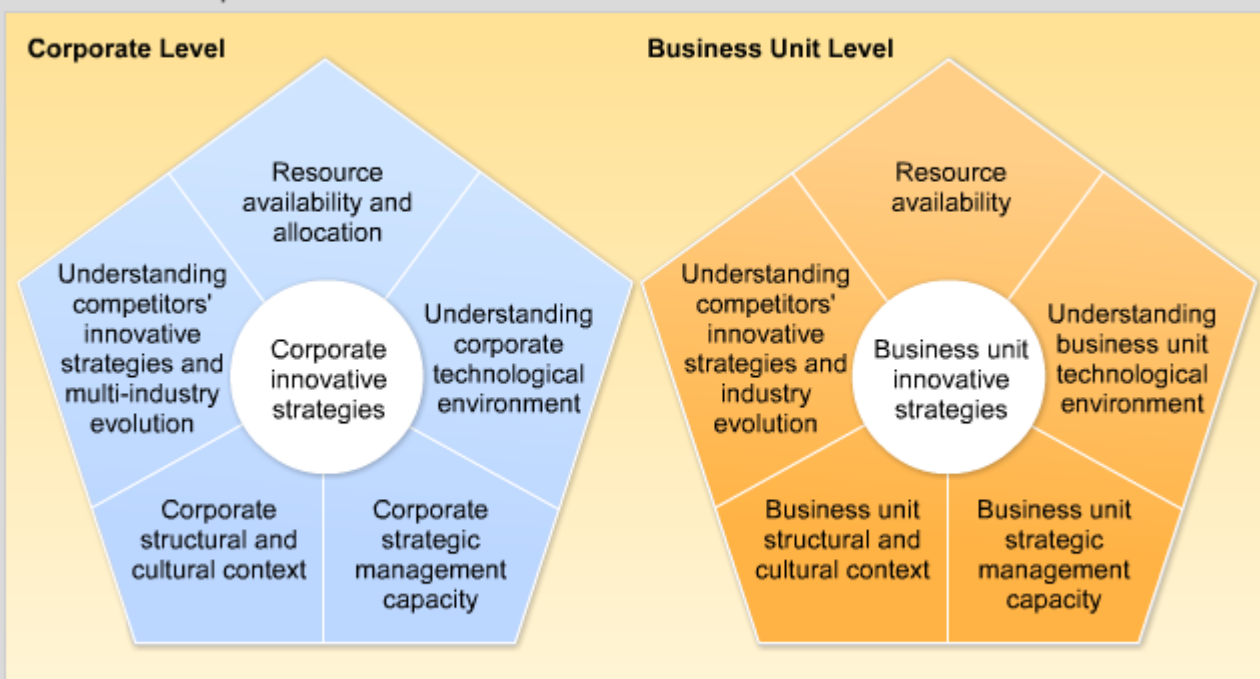
Corporate level innovative capabilities can be characterized in terms of:

- the scope and rate of development of new products and services and/or production and delivery systems that are derived from combining innovative capabilities across existing business units
- the scope and rate of new business development based on corporate Research & Development and technology development efforts, and
- the timing and entry with respect to the previous two.

The categories of variables with key influence on the innovation strategies of a corporation are represented in the following diagram.

Innovative Capabilities Audit Framework¹²

Innovative Capabilities Audit Framework



Source: Burgelman, R, Kosnik, T, Van den Poel, M, *Toward an Innovative Capabilities Audit Framework*, In Strategic Management of Technology and Innovation, Irwin, 1988

Who Should Do the Audit?

Decision makers in a company rely on others to collect much of the information necessary for the audit and for some of the information as well. They are often deciding how much to rely on help from insiders and outsiders:

- Insiders are likely to have an advantage in understanding the firm's resource availability and structural and cultural context. The major disadvantage of using insiders is the possibility of a narrow or biased perspective.
- Outsiders may provide a more realistic assessment of the firm's strategic management capacity and its ability to understand the competitive and technological environment. The disadvantage of using outsiders is the possibility of misunderstanding the internal realities and delivering of impractical recommendations.

One pragmatic way to do an audit is to setup an ad hoc audit team with representatives from different departments (planning, R&D, new product managers, key functional managers), board members, and consultants.

In the following segment of the lecture, based on a case study, we will discuss how was auditing its innovative capabilities and was building a framework for the globally integrated enterprise in the 21st century.

¹² Burgelman, R, Kosnik, T, Van den Poel, M, *Toward an Innovative Capabilities Audit Framework*, In Strategic Management of Technology and Innovation, Irwin, 1988

Innovation Management and Decision Support Tools

As part of this course, in Module 3 students have been introduced to the concept of decision analysis and decision support tools with applications in the business. For the purpose of innovation management decision makers on corporate, business, and functional levels of the company are applying the full spectrum of decision support tools – see the diagram, below.

In this lecture we will discuss only some of them (other decision support tools will be discussed in Lectures 9, 10, and 11) and will demonstrate possible applications with the help of the running case and the business simulation package, specifically developed for this course (see the next section of the lecture).

Also, to avoid unnecessary repetitions, we will discuss only decision support tools not mentioned in Lecture 7.

PESTEL Analysis $\implies$ ([Click here](#) to download the PESTEL template)

Decision Trees Analysis $\implies$ ([Click here](#) to see the Tutorial for AD715: Decision Trees in TreePlan)

Sensitivity Analysis $\implies$ ([Click here](#) to see the Tutorial for AD715: Sensitivity Analysis in SensIt)

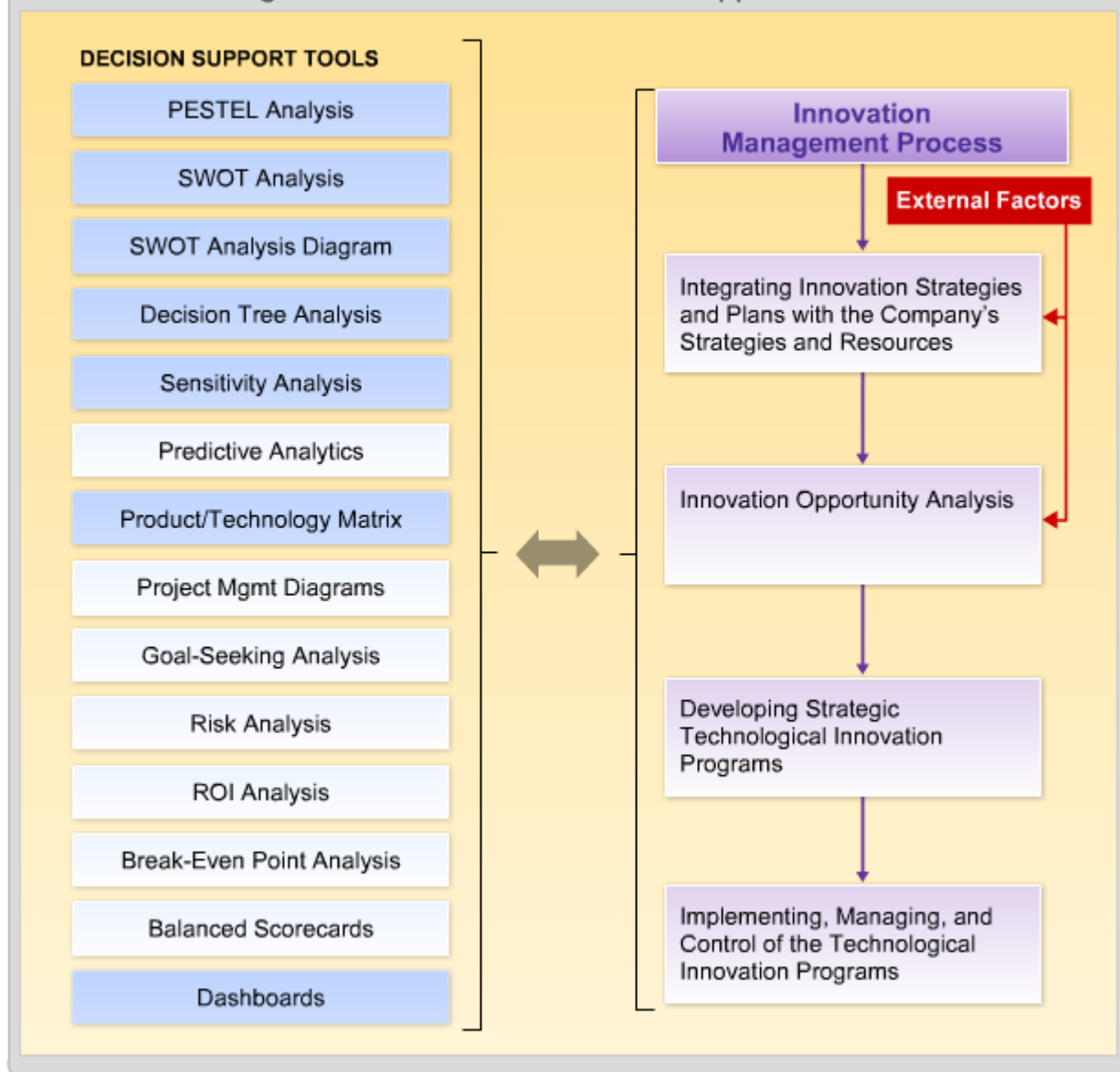
SWOT Analysis $\implies$ ([Click here](#) to download the SWOT template)

Project/Technology Matrix

A firm's strategy is expressed in the products and services it brings to market. One way to get at the integration of a firm's technology and product-market strategy is to decompose each product or service into its constituting technologies and assess the relative strength (the degree of distinctive competence) the firm has with respect to that technology¹⁹. This approach is called Product/Technology Matrix and was first introduced by Fusfeld²⁰.

One possible way to prepare a Product/Technology Matrix is to use a template $\implies$ ([Click here](#) to download the Product/Technology Matrix template)

Innovation Management Process and Decision Support Tools – An Overview



¹⁹ Burgelman R, Christensen C, Wheelwright S, *Strategic Management of Technology and Innovation*, 5e, McGraw-Hill Irwin, 2009, p. 6

²⁰ Fusfeld A, *How to Put Technology into Corporate Planning*, Technology Review, MIT, 1978

Demo Exercise

- [Part 1](#)
- [Part 2](#)
- [Part 3](#)

