Management of Technology and Innovation

1. MTI—Its Importance Now and In the Future 1. What do we mean by management of technology and innovation (MTI), and why is it crucial? Management of technology and innovation is critical to the organization. Because of innovations and new technologies, we have historically seen the emergence of innovative organizational structures and new ways of performing work. For example, the Industrial Revolution ushered in the functional structure of organizations. As businesses moved from small craft businesses like blacksmiths to railroads, there was a need to introduce a more complex business structure. Today, we see the innovations in information technology changing structures to more network-based with people being able to work remotely. The changes in structure are innovations in the technology of how work is accomplished; the innovations brought on by the invention of new products influence the technology we use and how we use it.

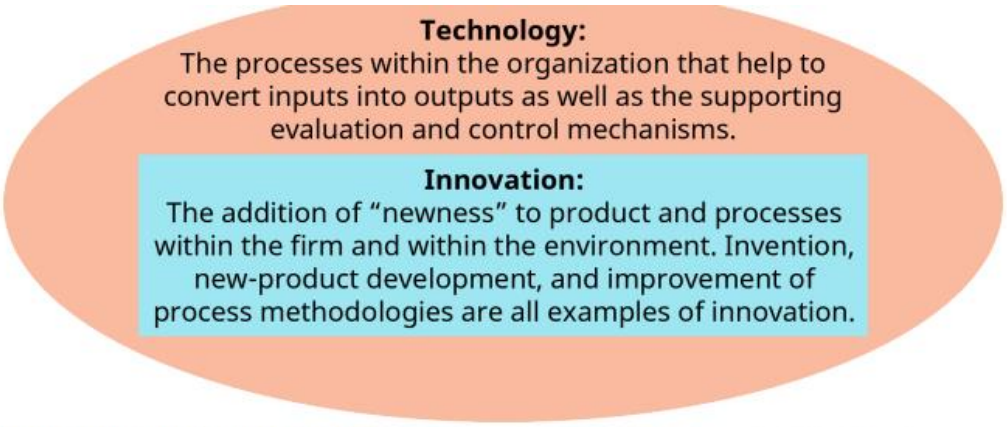

Exhibit 18.2 Technology and Innovation Defined (Attribution: Copyright Rice University, OpenStax, under CC-BY 4.0 license)

Technology can be defined in a number of ways. The basic purpose of a system (such as an organization) is to convert inputs into outputs. Therefore, we will define organizational technology as the processes within the organization that help to convert inputs into outputs as well as the supporting evaluation and control mechanisms. The **management of technology** involves the planning, implementation, evaluation, and control of the organization's resources and capabilities in order to create value and competitive advantage. This involves managing:

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1. Technology strategy—the logic of how technology will be used and what role technology will have in the organization. For example, will innovation (first-to-market strategies dominate) be the focus, or will the firm want to do things better to obtain market share and value (let others take the initial risks)? 2. Technology forecasting—the use of tools to study the environment for potential technological changes that can both positively and negatively affect the firm's value proposition. Digitization of a variety of products such as watches and cameras provided great opportunities for some firms and caused others to go bankrupt. Forecasting (or at least keeping an eye on the changes in technology) is very important in the management of technology. 3. Technology road mapping—the process of taking an innovation or technology and trying to build more value by looking for ways to use the technology in different markets and places. 4. Technology project portfolio—the use of portfolio techniques in the development and use of technology enhances the potential value of technologies being developed and the technologies that are currently part of a firm's portfolio. Disney was a leading producer of animated films. However, Disney did not stop there—the portfolio of characters in the films is now marketed as products and displayed in Disney theme parks, and Disney very carefully manages the availability of the animated films. Innovation activities are an important subset of technology activities. Innovation includes "newness" in the development and use of products and/or processes within a firm and an industry. The invention, new product development, and process improvement methods are all examples of innovation. Management of innovation includes both change management and managing organizational processes that encourage innovation. The management of innovation is more than just planning new products, services, brand extensions, or technology inventions—it is about imagining, mobilizing, and competing in new ways. For the organization, innovation management involves setting up systems and processes that allow newness that adds value to emerge. Some firms, like Google and 3M, give some employees time during the workweek to work on their ideas with the hope of sparking new ideas that will add value. Google News and 3M Post-it Notes are products that emerged from this practice. To manage innovation processes successfully, the firm must undertake several activities (these can involve the study of technologies currently in use).

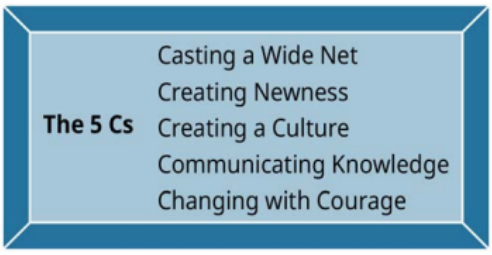

Exhibit 18.4 Innovation Management (Attribution: Copyright Rice University, OpenStax, under CC-BY 4.0 license)

1. Casting a wide net while trying to keep up with potential changes in the firm, the market, the competition, etc. is crucial. Eastman Kodak was the dominant U.S. camera manufacturer. On several occasions in their history they missed opportunities to take advantage of innovations in their product line—they did not cast their net out. Land, the founder of Polaroid, went to Kodak with his invention of instant photographs—Kodak said no. Kodak did not see the telephone as a potential competitor until it was too late. Kodak was especially vulnerable because the firm was a late entrant into the digital camera market. As a result of failure to cast a wide net in keeping up with trends and innovations, Kodak went bankrupt.
2. Creating newness with existing products can expand the portfolio of value of a product. 3M has done this with all kinds of tape and with different formats and forms of Post-it Notes. Asking "how else can the

3. Creating a culture open to newness is critical to cultivating ideas. If the leadership of the firm is open to ideas from all over the organization, then the firm will be more innovative. Some large firms such as Texas Instruments encourage employees to start new businesses if TI does not want to keep a product in house. Often, TI is the first investor and customer of these small firms.

4. Communicating knowledge throughout the firm is important. This knowledge can be positive and negative at first glance. For Post-it Notes, the glue used emerged from the laboratory efforts to create a stronger glue to compete with Elmer's Super Glue. The outcome did not meet the original goal, but the communication of the new formula's characteristics—tacky and leaves no residue—triggered another usage

5. Changing with courage is necessary if a firm is going to manage innovation and stay competitive. Too often firms get comfortable with where they are, narrow their focus on studying the environment, and focus on building strength in their current market. This leads to strategic inertia—not innovating and losing customers and market share to more innovative companies. Just as Kodak failed to change, so did IBM—famously, the CEO of IBM was quoted as saying "who wants a computer on their desk?" as IBM continued manufacturing mainframes while desktops and then laptops were emerging.

Developing Technology and Innovation

2. How do organizations develop technology and innovation? There are a number of ways that organizations can develop and manage technology and innovation. We will focus on organization-level activities and the three strategic processes in this section of the chapter. For a firm to develop a successful management of technology and innovation strategy, the organization must be readied for the effort. This requires agility because changes and adjustments to products and processes are filled with risk and uncertainty. However, agility is inherently less efficient if it is to be effective. Therefore, the management of technology and innovation must balance short-term efficiency with long-term effectiveness in the market if the firm is to add value and thrive in a changing environment. Strong dynamic capabilities are needed if the organization is going to be able to address the challenges of innovation and dynamic competition.

4 There are four things the firm should do to balance the conflicting demands of being agile in a dynamic environment.

These are

1. Design systems and processes that can identify, assess, and develop technology-based opportunities (or protect from new technology threats). The systems and processes should be able to sense what is coming.

2. Identify communication needs and efficiently turn data into information so that the right information can be available to make the best decision in a timely fashion. The current interest in big data and what it can tell firms is tied to the notion that we have a lot of bytes of data available because of computer technology that is not being used effectively or efficiently.

3. Develop employees through training and learning opportunities. This becomes more critical as the competitive environment for the organization becomes more dynamic. The management of technology and innovation requires that all levels of the organization are involved and that efforts are made to ensure that employees are allowed to enhance their skills for themselves and the organization. The more dynamic the environment, the more important skill enhancement is for the firm and the individual.

4. Use good change management processes to help the firm succeed in introducing newness into the organization. Many firms learned expensive lessons when desktop computers were introduced into the workplace. First, most managers did not type, so they did not adopt the new technology. Second, younger staff members were more likely to be comfortable with the new computers (even elated because the

computer was better than they could afford at home), so knowledge power was turned upside down from the hierarchy and seniority. Third, many firms installed desktops with little or no training (because they were "upgraded typewriters") while leaving the typewriters easily accessible. The result was that some companies deemed desktops a failure and sold the equipment at a loss. Desktop computers are now a vital tool in the workplace, but this just illustrates what happens when a good change management process that includes proper support systems, communication, and training is not implemented.

1. Designing systems and processes
2. Identifying communication needs
3. Implementing training and development to address change
4. Using excellent change management processes

Exhibit 18.6 Key Management Activities (Attribution: Copyright Rice University, OpenStax, under CC-BY 4.0 license)

There are three basic organizational processes—buying and partnering, developing newness within the firm, and entrepreneurially exploiting a space in the environment. Exhibit 18.6 delineates the three types. Buying and partnering includes mergers and acquisitions, joint ventures, contractual agreements, and other forms of acquiring technology/innovation from external sources. Internal sources of new technology/innovation for the organization include research and development of new products as well as reconfiguring or developing new processes—ways of doing things. This can be organization structure or redesigning an assembly line. Adding robotics to a manufacturing process may be an internally driven process, or a firm may buy a robotics manufacturer to acquire the capability to add robotics to the assembly process.

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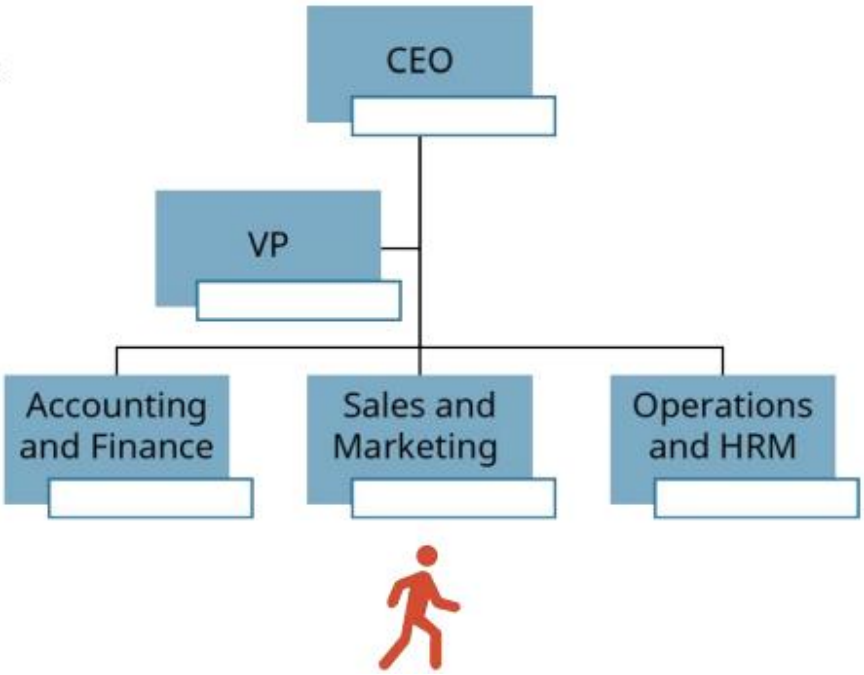
Exhibit 18.7 Three Methods of Creating New Technologies/Innovations (Attribution: Copyright Rice University, OpenStax, under CC-BY 4.0 license)

Advantages and Disadvantages of Creation Methods		
Method	Advantages	Disadvantages
External Processes: M&A, joint ventures, contractual relationships, cross-organizational projects, informal relationships	a. Quicker b. Blending rather than discovering c. Often less costly	a. Requires bringing different firm cultures together b. Often leads to perception of winners and losers c. Not-invented-here syndrome
Internal Processes: R&D	a. Clear ownership of the technology/ innovation b. Legal protections may be stronger	a. Often takes longer b. Key personnel may leave at a critical time c. Can be very costly
New Business/Entrepreneurship	a. Usually more agile and flexible in the marketplace b. Dedicated leadership—it is their "baby"	a. Highest risk factor b. Lack of skills within the firm to do things besides innovation c. Usually have very little slack

1. **Mergers/acquisitions (M&A)**, which involve ownership changes within the firms. For an acquisition, one firm buys another; for a merger, the two firms come together and form a new firm. The essence of both of these approaches is that a new, larger organizational entity is formed. The new firm should have more market power (be larger) and should gain knowledge about a technology or domain of activity. The blending of two cultures, two sets of processes, and two structures are all potential disadvantages of M&A activity.
2. **Joint ventures** are long-term alliances that involve the creation of a new entity to specifically carry out a product/process innovation. The entity is usually governed by a contractual relationship that specifies the contributions and obligations of the partners in the joint venture. There are potential culture clashes as well as the potential for **strategic drift**—losing strategic focus on the reasons for the joint venture.
3. **Franchise agreements** are usually long-term agreements that involve long payoffs for the sharing of known technology. Fast food restaurants, such as McDonald's, use franchise agreements with store owners. McDonald's provides R&D for new processes and new products. The store owners (franchisees) pay a fee for the use of the name and the marketing of the product. The contract and monitoring costs associated with franchise agreements are the big disadvantage of this type of alliance.
4. **Licensing agreements** involve technology acquisition without R&D. For example, Dolby contracts with producers of various type of sound equipment to allow them to use their technology to have better sound quality. Licensing agreements are quite common in high-tech industries. The contract costs and constraints are the disadvantages of licensing agreements.
5. **Formal and informal contracts** are used to allow firms to share technology between them. For formal contracts, the length of time the contract is enforceable is a defining characteristic. The more formal a contract, usually the longer it is, and it usually includes more details about the usage and limitations of the technology. For the informal contract, the advantage is that if the activity is no longer beneficial, it is much easier to disband.

All of the methods are of use to firms large and small. In the opening case, Acer used a number of methods to externally acquire technology.

- Organizational
  - Knowledge management
  - Forecasting
- Individual
  - Leadership
  - Followship



Key Terms

entrepreneurial activities The implementation of new ventures and idea generation in organizations.
explicit knowledge Information codified or written down as rules or guidelines.
followship The process of seeking or accepting influence.
formal and informal contracts Used to allow firms to share technology between each other.
franchise agreements Long-term agreements that involve long payoffs for the sharing of known technology.
innovation Invention, new product development, and process-improvement methods are all examples of innovation.
joint ventures Long-term alliances that involve the creation of a new entity to specifically carry out a product/process innovation.
leadership The action of leading a group of people or an organization.
licensing agreements Involve technology acquisition without R&D.
management of innovation Includes both change management and managing organizational processes that encourage innovation.
management of technology The planning, implementation, evaluation, and control of the organization's resources and capabilities in order to create value and competitive advantage.
mergers/acquisitions (M&A) For an acquisition, one firm buys another; for a merger, the two firms come together and form a new firm.
organizational learning The acquisition of knowledge through the collection of data that is analyzed to gather information, which is then transferred and shared through communication among members of the organization.
research and development (R&D) Involves the seeking and developing of new technologies, products, and/or processes through creative efforts within the firm.
strategic drift Occurs when a joint venture loses strategic focus on the reasons for the joint venture.
strategic inertia The tendency of organizations to continue on their current trajectory.
tacit knowledge Emerges from experience of an individual.
technology The branch of knowledge that deals with the creation and use of technical means and the application of this knowledge for practical ends.
value proposition A promise by a company to a customer or market segment.

Management of Technology and Innovation

Summary of Learning Outcomes

18.1 MTI—Its Importance Now and In the Future

1. What do we mean by management of technology and innovation (MTI), and why is it crucial? Management of technology and innovation is critical to the organization. Because of innovations and new technologies, we have historically seen the emergence of innovative organizational structures and new ways of performing work. The management of technology involves the planning, implementation, evaluation, and control of the organization's resources and capabilities in order to create value and competitive advantage. Management of innovation includes both change management and managing organizational processes that encourage innovation.

18.2 Developing Technology and Innovation 2. How do organizations develop technology and innovation? 616 Chapter 18 Management of Technology and Innovation This OpenStax book is available for free at http://cnx.org/content/col28330/1.8 There are four things the firm should do to balance the conflicting demands of being agile in a dynamic environment. These are: design systems and processes, identify communication needs and efficiently turn data into information, develop employees through training and learning, and use good change management processes. There are three basic organizational processes—buying and partnering, developing newness within the firm, and entrepreneurially exploiting a space in the environment.

18.3 External Sources of Technology and Innovation

3. What are external sources of technology and innovation development, and when are they best used? The external processes for developing and acquiring technology and innovation include a variety of options. They are most successfully used under the following circumstances: 1. The product line or the processes of the firm have fallen behind those of its competitors.

2. A new entrant into the market of the industry has changed the competitive dynamics.

3. A firm believes that its product mix or way of doing things is not going to be successful in the long run. The most common types of external processes used to enhance technology and innovation in a firm include: mergers/acquisitions (M&A), joint ventures, franchise agreements, licensing agreements, and formal and informal contracts. 18.4 Internal Sources of Technology and Innovation

4. What are internal sources of technology and innovation development, and when are they best used?

The most common type of internal process for technology and innovation in the organization is research and development (R&D). R&D involves the seeking and developing of new technologies, products, and/or processes through creative efforts within the firm. The disadvantages of R&D are that it is usually slower and more costly and can be disrupted by the departure of key personnel.

18.5 Management Entrepreneurship Skills for Technology and Innovation

5. How and why do entrepreneurs develop MTI skills?

For an entrepreneurial firm, the value proposition is a key factor. New business entities (a type of entrepreneurial activity) are usually more flexible and agile in the marketplace; however, the failure rate for new entrepreneurial firms is high. Entrepreneurs, by definition, are more agile than the more-established organizations. Agility is crucial within large firms that want to continue to be entrepreneurial in their activities.

18.6 Skills Needed for MTI

6. No matter what method is used, what skills do you need to successfully manage technology and innovation?

There are two skills the organization must develop to be successful—the ability to manage learning and knowledge processes, and the ability to analyze and forecast future trends. Individual skills that are critical to the organization's success include leadership/followship and creative thinking. There are two types of knowledge that must be managed: explicit knowledge and tacit knowledge.

18.7 Managing Now for Future Technology and Innovation

7. How do you look into the future to keep pace? To keep pace with changes in technology and to keep up with needed innovation processes, individuals within the firm must keep track of what competitors are doing as well as what inventions or discoveries may usurp an industry's place in the market. This is an external process, and that involves scanning the environment