Defining Innovation 1

Innovation is about helping organizations grow. Growth is often measured in terms of turnover and profit, but can also occur in knowledge, in human experience, and in efficiency and quality. Innovation is the process of making changes to something established by introducing something new. As such, it can be radical or incremental, and it can be applied to products, processes, or services and in any organization. It can happen at all levels in an organization, from management teams to departments and even to the level of the individual.

This chapter describes the main concepts behind innovation. We explore the different types of innovation that affect the growth of an organization. The difference between radical and incremental innovation is discussed, as is the special relationship between product and process innovation.

LEARNING TARGETS

When you have completed this chapter you will be able to

- Define innovation and explain the difference with related terms
- Understand the drivers of the need for innovation and change
- Explain product, process, and service innovation
- Describe the difference between radical and incremental innovation
- Define disruptive technology
- Show how product and process innovations are related
- Explain the relationship between innovation and operations

Definition of Innovation

Innovation has been and continues to be an important topic of study for a number of different disciplines, including economics, business, engineering, science, and sociology. Despite the fact that innovation has been studied in a variety of disciplines, the term is often poorly understood and can be sometimes confused with related terms such as *change, invention, design,* and *creativity.* Most people can provide examples of innovative products such as the iPod or the PC, but few can clearly define the innovative aspects of these products. Among academics there is a difference of opinion about what the term *innovation* really means. One definition of *innovation* taken from the dictionary that fits the ideas and concepts used in this book is the following (*The New Oxford Dictionary of English,* 1998, p. 942):

> *Making changes to something established by introducing something new.*

This definition does not suggest that innovation must be radical or that it occurs exclusively to products. Nor does it suggest that innovation is exclusively for large organizations or single entrepreneurs. Nor does it suggest that it is exclusively for profit-making businesses; innovation is as relevant for a hospital or local government as it is for a business. In the organizational context innovation can occur to products, processes, or services. It can be incremental or radical, and it can occur at various levels in an organization, from management groups and departments to project teams and even individuals.

This is the general concept of innovation as discussed in this book. We will see later that the fundamental concepts of innovation as they are derived from this definition are universally relevant for all organizations, from private companies such as Nokia down to public organizations such as hospitals. Innovation is a process that transforms ideas into outputs, which increase customer value. The process can be fed by both good and bad ideas. In management of the innovation process, destroying poor ideas often is as important as nurturing good ones; in this way, scarce resources can be released and good ideas spotlighted. Every good idea usually replaces an older established one. The goal of every organization is the successful development of good ideas. To express this development of good ideas in innovation, we need to add an addendum to our definition:

> *Innovation is the process of making changes to something established by introducing something new that adds value to customers.*

This addendum is important. By describing an innovation as adding value to customers, we assume naturally that customers who experience the added value will continue to use the product, process, or service or at

least have an improved experience. This in turn will lead to growth for the organization. Innovation management is the process of managing innovation within an organization. This includes activities such as managing ideas, defining goals, prioritizing projects, improving communications, and motivating teams. As we will see later, innovations have particular life cycles; today's innovation will become obsolete in the future. For organizations to sustain their mission, they must continuously innovate and replace existing products, processes, and services with more effective ones. Focusing on innovation as a continuous process acknowledges the effect that learning has on knowledge creation within the organization. Learning how to innovate effectively entails managing knowledge within the organization and offers the potential to enhance the way the organization innovates. This element adds a further extension to our definition:

> *Innovation is the process of making changes to something established by introducing something new that adds value to customers and contributes to the knowledge store of the organization.*

The concept of an organization's knowledge store is partially synonymous with the concept of organizational learning. An organization that can continuously learn and adapt its behavior to external stimuli does so by continuously adding to its collective knowledge store. The emerging perspective by specialists in the field of innovation is to define innovation in the broadest context possible. One reason for this is that if it is defined too narrowly, it may limit creativity by excluding certain avenues of investigation. Innovation is linked to the concepts of novelty and originality. However, novelty is highly subjective. What may be a trivial change for one organization may be a significant innovation for another. Based on this perspective, we can further extend the definition of innovation as follows:

> *Innovation is the process of making changes, large and small, radical and incremental, to products, processes, and services that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization.*

This latter definition, although general, is specific enough to illustrate a number of core concepts of innovation as applied in any organization. Applying innovation, which is the main focus of this book, can be defined by adding a number of key words to the preceding definition.

> *Applying innovation is the application of practical tools and techniques that make changes, large and small, to products, processes, and services that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization.*

Related Concepts

Innovation is often used in conjunction with terms such as *creativity, design, invention,* and *exploitation.* It is also closely associated with terms such as *growth* and *change.* Let's explore these relationships in more detail in order to get a deeper understanding of what we mean by *innovation.* Related concepts include invention, growth, creativity, design, exploitation, change, failure, entrepreneurship, customers, knowledge, and society.

INNOVATION AND INVENTION

Invention is a term often used in the context of innovation. *Invention* has its own separate entry in the dictionary and is defined as follows (*The New Oxford Dictionary of English,* 1998, p. 960):

> *Creating something new that has never existed before.*

Invention need not fulfill any useful customer need and need not include the exploitation of the concept in the marketplace. Innovation differs from invention in that it is more than the creation of something novel; it also includes the exploitation for benefit by adding value to customers. Invention is often measured as the ability to patent an idea. If this can be achieved, then it is an invention. The success or failure of an invention depends not only on the ideas chosen by the organization but also on how well their implementation is managed. Invention is often about creating something that has yet to be desired by a customer. Numerous inventions never lead to innovation because they are never brought to the marketplace. If an invention can be exploited and transformed into change that adds value to a customer, then it becomes an innovation. On the other hand, there are many innovations that do not require invention in terms of originality. Process and service innovations often involve applying well-established techniques and technology. Although it can be argued that this does not encompass invention because it already exists, it is still a legitimate form of innovation because it is novel to the organization applying it.

INNOVATION AND GROWTH

Innovation is about developing growth. According to Drucker (1988), innovation can be viewed as a purposeful and focused effort to achieve change in (an organization's) economic or social potential. Bottom-line growth can occur in a number of ways, such as better service quality and shorter lead times in nonprofit organizations and cost reduction, cost avoidance, and increased turnover in profit-focused organizations.

INNOVATION AND CREATIVITY

Creativity is regarded as a key building block for innovation (Rosenfeld & Servo, 1991) and is an inherent capability in all human beings. Creativity is a mental process that results in the production of novel ideas and concepts that are appropriate, useful, and actionable. The creative process can be said to consist of four distinct phases: preparation, incubation, illumination, and verification (Wallas, 1926). Later revisions of this process have added a final phase, elaboration (Kao, 1989), in which the idea is structured and finalized in a form that can be readily communicated to others. Creativity entails a level of originality and novelty that is essential for innovation. Although creativity is a fundamental part of innovation, it is wrong to interchange the terms. Innovation encourages the further processing of the output of the creative process (the idea) so as to allow the exploitation of its potential value through development.

INNOVATION AND DESIGN

The term *design* in the context of innovation is defined as "the conscious decision-making process by which information (an idea) is transformed into an outcome be it tangible (product) or intangible (service)" (von Stamm, 2003, p. 11). The design activity draws heavily on creativity to resolve issues such as the aesthetics, form, and functionality of the eventual outcome. In this way, during the exploitation phase of the innovation process, organizations engage in design activities that will produce an output that provides the optimum fit with market requirements. Although design is an integral part of the exploitation phase of an innovation, it is only one aspect. Exploitation can include other elements, such as process development and market preparation.

INNOVATION AND EXPLOITATION

There are numerous alternative definitions of *innovation*. One popular alternative is to present innovation as an invention that has been exploited commercially (Martin, 1994). In this alternative definition, the term *invention* has the same meaning as mentioned earlier, that is, something new that has never existed before. This creation of something new derives from the creative capability of the organization and provides opportunities to be exploited. This alternative definition of innovation has been expressed as follows (Roberts, 1988):

$$\text{Innovation} = \text{Invention} + \text{Exploitation}$$

Therefore, innovation can be viewed as the systematic approach to creating an environment based on creative discovery, invention, and commercial

exploitation of ideas that meet unmet needs (Bacon & Butler, 1998). This definition fits in very well with many high-profile examples of innovation, such as the invention of the transistor used in computers or radio-frequency identity (RFID) tags used on ID cards. However, it also masks the millions of innovations that are often much smaller in scale, do not involve an invention, or are not necessarily exploited in the same commercial sense. Not included in this definition are innovations such as changing customer expectations regarding the purchase of airline tickets or dramatically improving waiting times at accident and emergency departments through improvements in patient screening. This alternative definition also has a strong technology focus because many inventions are technology based. Replacing the term *invention* with *creativity* makes the definition more applicable to organizations not actively engaged in product innovation. Therefore, a more encompassing restating of this alternative definition might be this one:

Innovation = Creativity + Exploitation

EXAMPLE: In 1923, John Logie Baird invented the television. Before its existence there had been no desire for it, but once the invention happened it established something new that never existed before. The exploitation of this invention was not instantaneous; it took decades for the TV to invade the domestic market. Broadcasting and production companies had to be set up to provide the necessary content for viewing. In hindsight, although the television did take time to exploit, it became an innovation that not only changed how we entertain ourselves but also influenced the way we live. The new flat-screen television, on the other hand, is an innovation that has been more direct in its exploitation. It meets existing customer demand for slimmer large-screen television sets. This came about because small-apartment living could not accommodate the traditional cathode ray tube (CRT) TVs. The desire for large-screen TVs led to the development of plasma and liquid crystal display televisions. The innovation has been so successful that it has resulted in a disruption in the industry, with CRT-based TVs becoming obsolete. When Philips invented the interactive TV in the 1980s, some analysts viewed it as another innovation by a company renowned for its innovation processes. They argued that it could destroy the traditional CRT television market. However, customers found the interactive TV too expensive and too cumbersome to use, and it failed to make the transition from being an invention to an innovation.

INNOVATION AND CHANGE

Although we view innovation as resulting in change, it is incorrect to equate innovation with all forms of change. In order for change to qualify

as innovation, it must have some degree of desirability and intentionality (West & Farr, 1990). When we examine the output of innovation and change, another difference becomes apparent. This is that change can have a positive or negative impact on the organization, whereas innovation by definition must be positive because it must add value to the customer. Therefore, we may conclude that although all innovation can be viewed as change, not all change can be viewed as innovation.

INNOVATION AND FAILURE

One of the first writers to emphasize the importance of innovation was Schumpeter (1942), who described innovation as "creative destruction" that is essential for economic growth. Innovation is essential for helping organizations grow. Growth is often measured in terms of turnover and profit, but growth can also occur in knowledge, human experience, and the efficiency and quality of products, processes, and services. The innovation process will naturally involve unsuccessful ideas. These are seen as a natural byproduct of the innovation process. In order for some ideas to succeed, many more must fail. Organizations can learn from these failures and bring new knowledge (and sometimes technology) to use in future innovative actions that may benefit the organization. Organizations that can successfully sift out the good ideas from the bad will be more adaptable than those that cannot do so. In managing the innovation process, destroying poor ideas is often as important as nurturing good ones. Destroying poor ideas early on allows scarce resources to be released and refocused on new ideas.

EXAMPLE: Merck's product Mectizan, used to treat river blindness in developing countries, has been of huge benefit to patients: It literally allows the blind to see. However, in economic terms the product innovation has cost Merck money because the company has distributed the drug for free as part of its corporate social responsibility policy (because people with the disease usually cannot afford to pay for the drug). This example highlights the difficulty of defining innovation based on narrow metrics such as profit.

INNOVATION AND ENTREPRENEURSHIP

The terms *entrepreneurship* and *innovation* are often used interchangeably, but this is misleading. Innovation is often the basis on which an entrepreneurial business is built because of the competitive advantage it provides. On the other hand, the act of entrepreneurship is only one way of bringing an innovation to the marketplace. Technology entrepreneurs

often choose to build a startup company around a technological innovation. This will provide financial and skill-based resources that will exploit the opportunity to develop and commercialize the innovation. Once the entrepreneur has established an organization, the focus shifts toward its sustainability, and the best way that this can be achieved is through organizational innovation. However, innovation can be brought to market by means other than entrepreneurial startups; it can also be exploited through established organizations and strategic alliances between organizations.

INNOVATION AND CUSTOMERS

An innovation must add value to customers to make them purchase or consume the product or service or perceive an improvement. An important part of the exploitation process is ensuring that the innovation adequately fulfills prospective customers' needs. The better the innovation fulfills customer needs, the more likely customers are to adopt it. A common mistake technology companies make is to focus on the technological capability of their offering rather than on how that technology can satisfy customer needs. It is important to emphasize that a customer is anyone who purchases or uses a product or service. Customers can include students who purchase a book in the university bookstore, patients who use services in a hospital, or members of the public who use the services of a local library. Customers can also be internal to an organization. University lecturers who offer a service to students are in turn customers of the library, for example. Doctors who deliver a service to patients are also customers of support laboratories, and librarians are customers of the library's computer service department. When we use the term *organization* in this book, we refer to the organization around which innovation is focused. This can be an entire company, a department within a company, or a team of individuals.

EXAMPLE: The development of the blockbuster drug Viagra transformed its creator, Pfizer, into one of the world's leading pharmaceutical companies. However, if an alternative use other than the original focus on heart conditions such as angina and hypertension had not been found, then the company would have written off millions of dollars of R&D investment. It is not only the innovative idea but also how an organization manages the exploitation of that idea and its fit with market need that determine success.

INNOVATION AND KNOWLEDGE

Innovation is built on a foundation of creativity and sometimes on invention, resulting in the creation of new knowledge and learning within

the organization. Even when failures occur, the learning gained can be a valuable asset for the organization. The scope of innovation exists primarily within the realm of the individual and the collective knowledge of the organization. This has become increasingly evident as the complexity of technology and markets has increased. Therefore, the knowledge reservoir of the organization determines the type and level of innovation possible. If an organization's culture and routine are capable of capturing knowledge from past failures, then future innovative efforts will not repeat the mistakes of the past. Organizations that develop such knowledge systems are in a better position to store and share this knowledge so that it will improve the innovation process through enhanced idea generation, better decision making, and more effective exploitation. In this way, all ideas, whether successful or not, can contribute to the organization's long-term success.

INNOVATION AND SOCIETY

Innovation is an attribute that is beneficial to a large society such as a nation or region. Not only can innovation introduce new products and services that enrich the lives of individuals both nationally and internationally; it can also contribute significantly to economic growth. Process innovation also increases the amount of economic growth by providing cost competitiveness within a nation and attracting investment by organizations that establish bases there. National economies develop through the innovation and manufacturing abilities of their organizations and from selling the resulting innovative products on the global market. These activities not only bring increased revenue streams into the economy, increasing the gross domestic product, but also provide employment opportunities. On the other hand, innovation can have a negative impact on society by wiping out traditional industries or having other unintended side effects. For example, although a certain chemical innovation may allow farmers to grow more crops per acre, it may also pollute the environment, kill wildlife, and even cause human health problems by working its way up the food chain. In order to balance the advantages and disadvantages of particular innovations, specific regulatory bodies such as the Food and Drug Administration have been established; if side effects are deemed to be too dangerous, the product can be blocked from reaching the market. Many national governments have established agencies to promote and foster a more innovative culture in order to increase wealth and reduce costs for the nation. In this respect, performance indicators such as gross national product, export sales, direct foreign investment, R&D expenditure, employment levels, and new business startups suggest the innovative potential of a large society.

Drivers of Innovation

Various factors encourage an organization to innovate. Each of these drivers demands continuous innovation and learning so that the process can be repeated continuously. These drivers also help to create a sense of urgency around the need to create new organizational goals and generate new ideas for meeting these goals. These drivers can be summarized as follows:

- Emerging technologies
- Competitor actions
- New ideas from customers, strategic partners, and employees
- Emerging changes in the external environment

EMERGING TECHNOLOGIES

These have the potential for significant innovation across the organization and can be the basis for innovative products, processes, and services that can revolutionize the fortunes of an organization. In the past, organizations developed technologies in large R&D laboratories; however, in today's environment the sources of emerging technology are often far too prolific for any one organization to develop internally. Consequently, organizations expend more resources scanning the environment for potential technological opportunities. Sources of emerging technology can include universities, high-technology startups, and competing organizations.

COMPETITOR ACTIONS

The innovative actions of competitors and other organizations can be another driver of innovation. Competitors can provide a benchmark regarding which projects and initiatives to pursue. Copying competitor innovations reduces risk because the products may have already been adopted by the market. Although such behavior is unlikely to increase market share, it can be effective in maintaining the status quo by counteracting the advantage to the competitor.

NEW IDEAS

In the past, innovations were developed from the insights of a small number of designers and engineers. Now, however, with greater technological complexity and market segmentation, modern organizations

are engaging as many stakeholders as possible in the innovation process. This can result in increased scanning capabilities and better information about market needs. Engaging employees, suppliers, customers, and other lead users can reveal new opportunities that otherwise might have gone undiscovered.

EXTERNAL ENVIRONMENT

All organizations are affected by changes in their external environment; these changes can be another driver of innovation. Environmental changes can occur because of competitor actions that have revolutionized the business environment or can happen through macro shifts in the political, economic, cultural, or technological environment. As organizations struggle to realign with their new business environment, they must innovate their products, processes, and services accordingly.

EXAMPLE: After the terrorist attacks of 2001 in the United States, governments across the globe imposed greater security requirements on the airline industry. The initial impact of this new environment was chaos at airports, long queues, and customer confusion. Airlines and airport authorities had to innovate their processes to meet these new customer requirements to remain competitive.

Categories of Innovation

The term *innovation* is often associated with products. When we think about innovation we think about a physical product: a television, car, or digital music player. However, innovation can also occur in processes that make products, services that deliver products, and services that provide intangible products. Many services don't involve physical products at all. For example, a hospital or government department offers a range of services without producing products. In this book we focus on innovation in the organizational context, and although product innovation is an important part of this, it is still only a part. We can say that innovation relates to products, processes, and services.

Product innovation is about making beneficial changes to physical products. Examples include

- Introducing a new screen size for TVs
- Changing from a CRT TV to a flat screen
- Adding functionality such as Internet access to TVs

Process innovation is about making beneficial changes to the processes that produce products or services, as for example,

- Building new systems that assemble a TV set faster and cheaper

- Redesigning the assembly line so that TVs can be manufactured more reliably

- Outsourcing the production of the plastic covers on TVs so costs can be reduced and quality improved

Service innovation is about making beneficial changes to services that customers use. Examples include

- Changing the way dealers sell new TVs in order to cut costs

- Changing the way customers get rid of their old TVs by introducing a take-back policy

- Offering credit finance options to allow customers to purchase TVs

Each of the innovations just listed adds value; if customers recognize this, they will return to purchase or use similar products or services in the future. A key characteristic of a product, process, or service is the degree of tangibility of the product and the degree of interaction with the end customer or consumer. For example, product innovation involves innovating tangible products. This is an activity in which most consumers have little involvement. The first time a customer experiences the product is when it is brought into the market and the customer purchases it. On the other hand, services typically involve intangible products such as banking and serving fast food. Unlike with products, the customer has a high degree of contact and interaction with services.

Other differences between products and services include the following:

- Inventory: Products can be stored; services cannot.

- Response time: Products have a longer lead time; services have a shorter lead time.

- Resources: Products tend to be capital-intensive (e.g., machines), whereas services tend to be labor-intensive.

Figure 1.1 illustrates these differences along the two main dimensions: the degree of tangibility and the degree of customer contact. We will now look at each of these innovation types in greater detail.
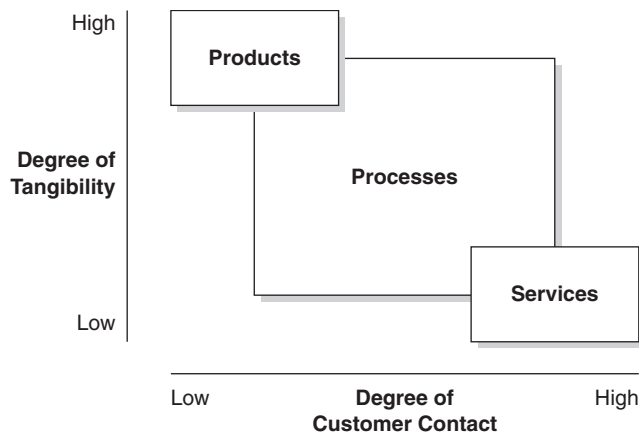
Figure 1.1   Tangibility and Customer Contact

Product Innovation

Product innovation is about making beneficial changes to physical products. Related terms that are often used interchangeably include *product design, research and development,* and *new product development* (NPD). Each of these terms offers a particular perspective on the degree of changes to products. The degree of change can include the following (Wheelwright & Clark, 1992):

- Incremental improvements

- Additions to product families

- Next-generation products

- New core products

Established organizations typically have a portfolio of products that must be incrementally improved or adjusted as problems are identified in service or as new requirements emerge. It is important that they also work on additions to the product families. One of the main activities of the product design team is the work it performs on next-generation products or new models of products. They may also work on designing radical new products or new core products that expand the portfolio significantly and often involve radically new processes to create them. These new core products ideally offer the organization the possibility of major increases in revenue and growth, which can also create the potential of a temporary monopoly in the market. The product development process for

next-generation and new core products follows a familiar cycle in most organizations (Cooper, 2000):

1. Ideation

2. Preliminary investigation

3. Detailed investigation

4. Development

5. Testing and validation

6. Market launch and full production

Each of these steps involves interaction with customers, who may participate in idea generation and feature recognition. Key performance criteria in the design process revolve around the following (Smith & Reinertsen, 1995):

- Time to market
- Product cost
- Customer benefit delivery
- Development costs

These criteria can be traded off against one another. For example, development costs can be traded against time to market, customer benefits can be traded against product costs, and so on. Three design methods have established themselves as providing a management system for effective product innovation: phase review, stage gate, and product and cycle time excellence (PACE).

PHASE REVIEW

This method divides the product development life cycle into a series of distinct phases. Each phase comprises a body of work that, once completed and reviewed, is handed over to the next phase. No attention is paid to what may or may not happen in the subsequent phases, mainly because of a lack of expertise or exclusive focus on the tasks in the current phase. The phase review method is a sequential rather than concurrent product design process; that is, each phase is executed and completed before the next phase can begin. Phases typically are carried by different functions or departments within the organization. All tasks, decisions, and tradeoffs are made solely in the context of the phase being executed. A significant criticism of this approach is the poor coordination between phases, which can result in significant delays and rework.

STAGE GATE

The stage gate method is a concurrent product design process that follows a predetermined life cycle from concept generation to market launch (Cooper, 2000). The stages in this method are primarily cross-functional. Stage gates appear at the end of each stage, where a design review takes place. Each stage gate reviews the agreed deliverables for completion at the end of the stage, a checklist of the criteria agreed for each stage, and a decision about how to proceed from a particular stage. This method identifies a number of roles for people involved in the process, including gatekeepers, who are typically senior managers. Other features of the stage gate process include "fuzzy front-end" stages of customer opportunity identification, which incorporate gates that are contingent on future events.

PACE

The PACE method is concerned primarily with developing product development strategies (McGrath, 1996). The method links product strategy with the overall strategy and vision of the organization. A key feature is deploying the voice of the customer throughout the product design process. Strategies are divided into six product strategic thrusts: expansion, innovation, strategic balance, platform strategy, product line strategy, and competitive strategy.

Product innovation methods and processes are one element in an organization's mission to create value for customers. Too often functional groups within organizations have focused exclusively on the NPD process in their department as an end in itself rather than taking a broader business perspective. Interaction with functions such as marketing, warranty, manufacturing, and senior management offer design teams a more holistic perspective in the design process. This also ensures that the goals of the design process form strong relationships with the goals of the organization as a whole. Taking this broader perspective can encourage design teams to engage in new core product development, that is, to develop products that are radically different from what already exists in the organization.

As customer needs change and as markets adapt to a changing competitive environment, design teams often fail to recognize changes or disruptions to existing product requirements (Christensen, 1997). Successful organizations are capable of taking a broader perspective, recognizing the potential of disruptive technologies and then creating new products that meet the unforeseen needs of customers.

Process Innovation

Process innovation can be viewed as the introduction of a new or significantly improved method for the production or delivery of output that

adds value to the organization. The term *process* refers to an interrelated set of activities designed to transform inputs into a specified output for the customer. It implies a strong emphasis on how work is done within an organization rather than what an organization does (Davenport, 1992). Processes relate to all operational activities by which value is offered to the end customer, such as the acquisition of raw materials, manufacturing, logistics, and after-sales service.

In the 1970s and 1980s process innovation gave Japanese industry a competitive advantage that allowed them to dominate some global markets with cars and electronic goods. Similarly, process innovation has allowed organizations such as Dell and Zara to gain competitive advantage by providing higher-quality products, delivered faster and more efficiently to the market than by the competition. By concentrating on the means by which they transform inputs such as raw materials into outputs such as products, organizations have gained efficiencies and have added value to their outputs. Process innovation allows some organizations to compete by having a more efficient value chain than their competitors have.

Process innovation has resulted in organizational improvements such as lower stock levels, faster, more agile manufacturing processes, and more responsive logistics. Organizations can improve the efficiency and value of their processes with a vast array of different enablers. Although the use of these enablers is contingent on the organizational context, many offer the potential for enhanced process performance. The application of technology such as robotics, enterprise resource planning systems, and sensor technologies can change the process by reducing the cost or variation of its output, improving safety, or reducing the throughput time of the process. The application of certain human resource practices can improve the quality of the process, enhance motivation, and allow increased complexity through greater flexibility. Similarly, as the raw material input to the process is altered, costs can be reduced or performance parameters improved.

A number of common approaches to process innovation have emerged through the work of operations and quality management movements over the past 20 years. Although these may not be applicable to all organizations, they can stimulate the innovation process. The more common approaches include just-in-time, total quality management, lean manufacturing, supply chain management, and enterprise resource planning.

JUST-IN-TIME

This approach originated in Japan and was originally designed to improve high-volume production by reducing setup times and other forms of inefficiency such as high inventory. Improvement is achieved through coordination of the flows of materials through a process so that the right material arrives in the correct location just as it is needed.

TOTAL QUALITY MANAGEMENT

This seeks to improve the quality of an organization's output by eliminating defects, that is, by introducing systems that prevent defects from occurring in the first place. It also engages all employees in the effort toward continuous improvement. It focuses on all aspects of organizational quality rather than just manufacturing quality and encompasses the entire organization. The approach is also characterized by the development of standards such as ISO 9000 and accreditation of organizations to these standards by accreditation bodies.

LEAN MANUFACTURING

This approach seeks to reduce all forms of waste across the total organizational system in order to increase value. It identifies seven forms of waste: transportation, inventory, motion, waiting time, overproduction, unnecessary processing, and defective products. The approach encourages organizations to identify and remove waste that reduces value within their processes by using techniques such as continuous improvement, pull systems, total quality, flexibility, waste minimization, and an integrated supply chain.

SUPPLY CHAIN MANAGEMENT

This approach focuses on managing the flow of materials and information across the entire value chain, from supplier to customer. This encourages organizations to enhance integration with suppliers and customers and establish longer-term relations. It also enhances processes by reducing overall cost and increasing value added and responsiveness to the end customer.

ENTERPRISE RESOURCE PLANNING

This approach integrates all information and processes of an organization into one holistic system. This usually relies on large software systems that facilitate the identification and planning of all necessary resources and activities across the organization in order to deliver the product or service to the customer. Such systems help identify the bottle-necks and waste within the organization's processes and support the work of other approaches such as supply chain management, just-in-time, and lean manufacturing.

Service Innovation

Service innovation is about making changes to products that cannot be touched or seen (i.e., intangible products). Services are often associated with work, play, and recreation. Examples of this type of service include banking, recreation, hospitals, government, entertainment, retail stores, and education. In the past decade a vast number of knowledge-based services have been offered through Web sites. These services involve intangible products, have a high degree of customer interaction, and are usually activated on demand by the customer. Defining a service can be somewhat problematic. Some define service as a sequence of overlapping value-creating activities. Others define service in terms of performance, where client and provider co-produce value. There are three types of services operations:

- Quasi-manufacturing (e.g., warehouses, testing labs, recycling)

- Mixed services (e.g., banks, insurance, realtors)

- Pure services (e.g., hospitals, schools, retail)

Services can clearly involve products that form an extended part of the product life cycle, from initial sales to end-of-life recycling and disposal. Service industries in areas such as finance, food, education, transportation, health, and government make up most organizations in any economy. These organizations also need to innovate continuously so they can increase levels of service to their customers.

A key attribute of a service is a very high level of interaction with the end consumer or customer. The customer is often unable to separate the service from the person delivering the service (sometimes called inhomogeneity) and so will make quality assumptions based on impressions of the service, the people delivering the service, and any product delivered as part of the service. Another characteristic of some service organizations is that their output may be perishable; therefore, the product must be consumed as soon as possible after purchase. Therefore, the timing of the delivery and customer perception of quality are crucial to success.

The concept of service quality is of particular relevance. The unique characteristics of services, such as intangibility, customer contact, inhomogeneity, and perishable production, also offer significant scope for innovation. Another major driver of service innovation comes from the possibilities afforded by new information technology platforms, particularly the Internet. The Internet is a valuable resource on which new service relationships between organizations and their customers are being developed every day.

Example: Dell Computer Corporation uses many of the same design and manufacturing systems as their competitors, but they differ significantly in terms of how they serve their customers' needs. What originally set Dell apart from its competitors and arguably helped build its significant market share was its strategy of skipping the middleman (i.e., the sales agent) and allowing customers to configure their computers to their own requirements. This was coupled with a manufacturing system that could produce the goods very quickly and provide an all-important service and distribution process. Dell's service was also significantly boosted by use of the Internet and the availability of the Internet to potential customers.

Product and Process Innovation

Process innovation often is viewed as less important than product innovation. Whereas new product development has been the focus of much attention, process innovation has come under the headings of operations management and quality management in the literature. As highlighted by Utterback (1996), process innovation becomes of increasing importance relative to product innovation for organizations once the dominant design of the product has been established. Therefore, over the life of an industry, process innovation is of equal importance to product innovation when organizations seek competitive advantage. Process innovation can even affect product innovation when it results in improvements to the process that can inspire further product innovation. All organizations are constantly trying to develop their processes to reduce cost, improve output quality, reduce lead time, or increase value for the customer. Only certain organizations engage in product innovation, and this occurs only periodically as they develop a new product or engage in product enhancement. The greater attention paid to product innovation may result from the following:

- Individual product innovation projects are often of longer duration and greater investment than those of process innovation.
- Product innovations are more visible to the external market than process innovations.
- Product innovations are viewed as the domain of the R&D and design departments; alternatively, process innovation is viewed as the domain of the operations and quality departments.

Irrespective of the reasons behind this mindset, organizations must realize the potential offered by both product and process innovation. Every new product must be produced before it reaches the customer. If the production process cannot produce a product at the right level of cost,

quality, and reliability, then the product innovation can be rendered useless. Most product innovation takes place at the early stages of the industry life cycle when numerous designs are tried and tested before the product becomes established in the product portfolio. After a certain time period, the product reaches a stage of dominant design (Utterback, 1996). After this point, the rate of product innovation decreases as mindsets are constrained by the dominant design, and the relative importance of process innovation increases across the sector as companies try to find better and more cost-effective ways to produce a marketable product. Over the life cycle of the product, the scope of process innovation decreases as the optimum configuration of production process is achieved (Figure 1.2). The end of the life cycle typically is characterized by a disruptive shift that makes existing products and processes obsolete and resets the innovation cycle back to focus on product design.

EXAMPLE: Disposable baby diapers were first invented in the 1950s; they achieved only 1% market penetration because of high costs and poor performance (they leaked). The performance problem was solved after a year with more absorbent materials, but for another 10 years the product remained too costly for most consumers. Eventually a new and very complex process was developed that could produce diapers at a cost that most customers were prepared to accept. The product became a success only after the optimum process had been developed.

Radical and Incremental Innovation

The definition of innovation does not refer to the size and scope of the change to the product, process, or service. For example, introducing color television in the mid-1960s was clearly a major or radical change to the
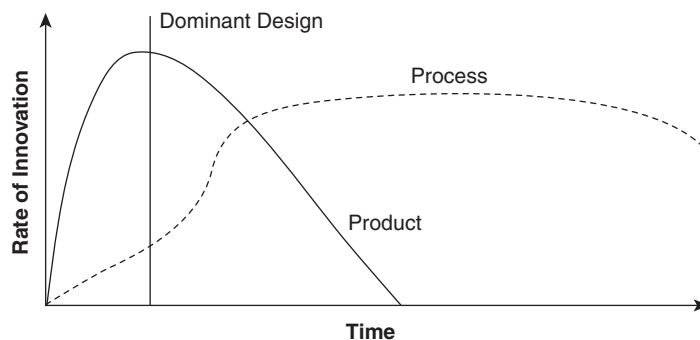
**Figure 1.2**   Product and Process Innovation

SOURCE: Adapted from Utterback (1996).

established black-and-white TV market. But what if a smaller change were made, such as changing the material of the television cabinet? Innovation can be classified as either radical innovation or incremental innovation.

RADICAL INNOVATION

Radical innovation is about making major changes in something established. Focus is significant in relation to this issue. A change can represent a radical innovation when viewed at a technological level, but the impact may be only incremental when viewed at an organizational level. When we examine innovation, it is the impact at this level that we are interested in. The term *radical* often refers to the level of contribution made to the efficiency or revenue of the organization (MacLaughlin, 1999). For example, by introducing the flat-screen television, manufacturers radically increased the demand for such products. We can visualize radical innovation as a step change in some measure of growth such as revenue or efficiency (Figure 1.3). Most organizations engage in some form of radical innovation over their lifetime.

Radical innovation can threaten to transform the industry itself by destroying the existing market and thus creating the next great wave (Christensen, 1997; Utterback, 1996). Undertaking radical innovation can bring dramatic benefits for an organization in terms of increased sales and extraordinary profits, but it is also highly resource intensive and risk laden. Companies in the pharmaceutical industry can invest more than $400 million in developing a new drug (Light & Lexchin, 2003) and have no guarantee that it will ever pass clinical trials and make it to the marketplace. Because of the turbulence of the external environment, it is difficult for any company to say that a potential innovation will result in a radical impact; they can only pursue the innovation with the knowledge that the scope exists for radical impact.
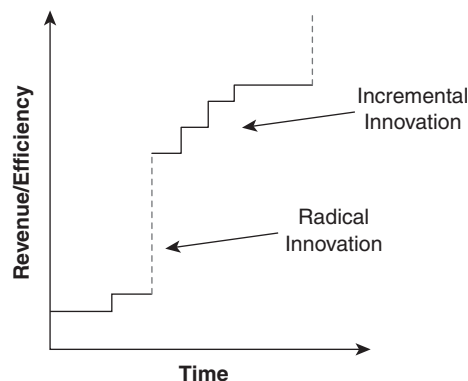
Figure 1.3   Radical and Incremental Innovation

EXAMPLE: Philips invested significant resources—time and money—in the development of its interactive TV. Customers did not purchase this product in sufficient quantities to allow Philips to reach its revenue target; in other words, the new product failed to be adopted by the market. Not only did Philips lose money, but time was lost in coming up with a better innovation. If interactive TV had succeeded at that time, Philips would have had an enormous head start over its competitors and the possibility of creating a step change in its revenues.

INCREMENTAL INNOVATION

Although radical innovations often make headlines, most organizations spread the risk associated with innovation by also looking for small or incremental innovations to their products, processes, and services. In fact, some companies shy away from radical innovations altogether, preferring instead to invest in incremental innovation. Incremental innovation is less ambitious in its scope and offers less potential for returns for the organization, but consequently the associated risks are much less. Apart from using fewer resources, incremental innovations consist of smaller endeavors, making them easier to manage than their larger counterparts. Incremental innovations such as increasing television speaker power or screen size often lead to small changes in growth. However, an organization may have to undertake more and more of these types of innovation to achieve the necessary growth to survive. If an organization successfully implements enough incremental innovations, then it can sometimes lead to the similar levels of growth driven by radical innovations. The drivers of incremental innovation initiatives can include approaches to continuous improvement such as lean manufacturing, total quality management, and world-class manufacturing.

There are advantages and disadvantages to both incremental and radical innovation. Radical innovation has the advantage of creating a step change in growth. The disadvantage is the high level of risk and high cost of failure. The advantages of incremental innovation are lower risk and the possibility of achieving small degrees of growth. However, the disadvantage compared with radical innovation is the slowness to reach growth targets before competitors, leading to a loss of competitive advantage. Most organizations adopt a dual approach to the size and scope of their innovation activities. There are usually many incremental innovations going on at the same time, yielding short-term results. They may also develop some potentially radical innovations that may yield significant results in the medium to long term. Therefore, the innovative effort of an organization consists of a portfolio of innovations rather than just one specific project. As a result, decisions involving the innovation process become much more complex, as does the attitude of the organization toward risk taking in order to fund the innovations.

OTHER CLASSIFICATIONS

Defining the scope of innovation as either radical or incremental is simplistic and can be problematic. An alternative product-oriented view of innovation views its scope as consisting of four levels (Olson, Walker, & Ruekert, 1995): products new to the world, line extensions, products new to the organization but not the market, and product modifications.

Another perspective promoted by Tidd, Bessant, and Pavitt (2005) discusses the scope of innovation using the four alternative labels *discontinuous, architectural, modular,* and *incremental.*

EXAMPLE: RFID tags are now being used as a replacement for bar codes on all types of products. The current process of purchasing goods in a supermarket is well known to most of us. We wait in line at the supermarket checkout and scan the bar code of each individual item before paying. RFID tags can be detected remotely by radio receivers. If all the items in our basket have RFID tags, then all we need to do is push the shopping basket under such a receiver. It will remotely detect every item in the basket. The value for customers is shorter lines at the checkout or even the replacement of checkouts altogether. Suppliers and supermarkets that adopt RFID tags will have the potential to attract more customers than their slower-to-innovate rivals.

Disruptive Innovation

Every now and again a radical innovation is introduced that transforms business practice and rewrites the rules of engagement. In other words, business practice across an entire industrial sector changes radically. Christensen (1997) defines these types of innovations as disruptive innovations. Disruptive innovation often occurs because new sciences and technology are introduced or applied to a new market that offers the potential to exceed the existing limits of technology. Research laboratories usually are the source of disruptive technologies. Many companies watch out for the outcome of this type of technology, and from this they choose potential winners that are quickly adopted for new products and services. Some large companies, such as Intel, have their own internal research laboratories but also work in cooperation with universities and other such organizations in order to develop the latest disruptive technologies, which can take many years to develop and exploit successfully.

The driving force in creating disruptive technologies is the same as for any innovation, that is, to add value for customers that will encourage them to purchase products and services over and over from the same organization. However, determining the appropriate technology trajectory

to pursue can often be difficult because there are numerous options. The task becomes even more difficult because disruptive technologies initially appear at a lower performance level than that of the existing technology (Figure 1.4). Rafii and Kampas (2002) recognize the difficulty for management of trying to distinguish signal from noise with respect to future disruptive threats. They suggest that organizations should harness their collective wisdom through a structured decision-making method to filter out the noise and identify potential disruptive threats that will inflict damage. Through their formalized decision-making approach, they believe that an organization's process of scanning for disruptive threats can become more rigorous and can increase the chances of formulating an appropriate organizational response.

Disruptive innovations can often appear in niche markets and can take time to show their real potential in dominating mainstream markets (Christensen, 1997). Organizations must take extra care to select the correct disruptive innovations to pursue. Pursuing the wrong technology can waste scarce resources and place the organization in a position of significant competitive disadvantage. Interestingly, organizations that are industry leaders of the preceding technology generation often fail to make the transition to the new industrial reality (Utterback, 1996). One can put this down to the mistake of pursuing the incorrect technology; however, one well-known commentator promotes the view that these dominant companies are overly supportive of their own business model and do not see the need to embrace the new reality (Christensen, 1997). When discussing breakthrough innovation, O'Reilly and Tushman (2004) highlight the fact that established organizations often struggle to achieve a successful balance between developing radical and disruptive innovations while still protecting their traditional business operations. They emphasize that although this dual focus is difficult, the creation of a structure of
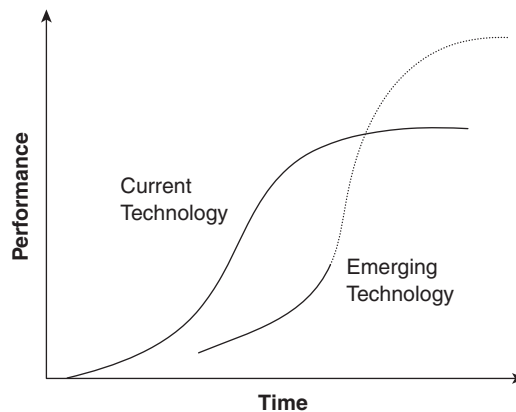
Figure 1.4   The S-Curve for Performance

organizationally distinct units that are tightly integrated at the senior management level can facilitate pursuit of this dual focus. They call this type of structure an ambidextrous organization because it provides an effective framework for organizations to pursue pioneering innovation while still achieving incremental gains in their traditional business. The ambidextrous organization is discussed further in Part IV.

There are many examples of disruptive technologies introduced in recent years, including the following:

- Data storage disks
- Digital photography
- RFID tags
- Digital media (music and video)
- The Internet and the World Wide Web
- Text messaging and the mobile phone

Arguably the largest disruptive technology to emerge has been the World Wide Web. The Web has disrupted products, processes, and services across most industrial sectors. Products such as televisions can now be Web enabled, offering customers a host of new services such as video downloads and Internet browsing. Processes such as the manufacturing of televisions regularly use the Web to source materials, receive orders from television dealers, and track sales in real time. Services such as movie rentals now use the Web to offer customers the latest movies, which can be downloaded directly to a television or computer on demand. Thus, organizations need to be aware of the threats posed by disruptive innovations in their industry and be prepared to react quickly if necessary.

EXAMPLE: The movie rental business has existed for the past 30 years or so. First, the industry had to decide which dominant design to choose: Betamax or VHS. When VHS eventually won out, organizations that had adopted the Betamax standard found their expertise obsolete and ended up lagging significantly behind the industry leaders. The next shift occurred in the early 1990s, when the DVD won out over other alternatives such as the compact video disk. Today the industry again finds itself at a crossroads: Which technology to adopt? And what will be its impact on growth? Options include broadband downloads to a personal computer, universal media disks, Blu-Ray, and other types of storage media. Like the majority of other discontinuous shifts, all these technologies are currently inferior to the DVD in certain ways, yet they address certain unfulfilled customer needs such as the nuisance of having to go out to rent a movie and remembering to return it. Where the industry will go in the future is still uncertain; the only certain thing is that in 5 years the DVD as we currently know it will be as obsolete as the VHS tape.

Innovation and Operations

Simplified to its most basic level, an organization can be said to consist of two core activities: operations and innovation. Operations are all the activities that provide an existing service or product to a customer, including manufacturing, human resources, and material planning. Operations usually form the mainstream activities of any organization and are focused on the here-and-now needs facing the organization. Innovation, on the other hand, consists of all activities that change operations and are focused on the future needs that the organization will face. Activities such as product design, process engineering, and system analysis are processes of innovation. In many organizations, tension exists between operating the system that provides existing products and services for the customer and changing the system in order to add more value to the customer, which disrupts the established operations. Some organizations often try to maintain the status quo and resist innovative change. Innovative organizations, on the other hand, embrace the challenge of maintaining a balance between serving the needs of the existing customer and meeting the future needs of the market.

Metaphorically, operations can be seen as a rotating wheel. If no changes are made to products, processes, or services, then the wheel will continue to turn; the organization will continue to serve customers with existing products and services for a time. But changes will occur outside the organization. Customer expectations, business conditions, and competitors will change. Innovation is about oiling the wheel, making it run more smoothly and more efficiently—making enhancements to products, processes, and services that better meet the changing needs of customers.
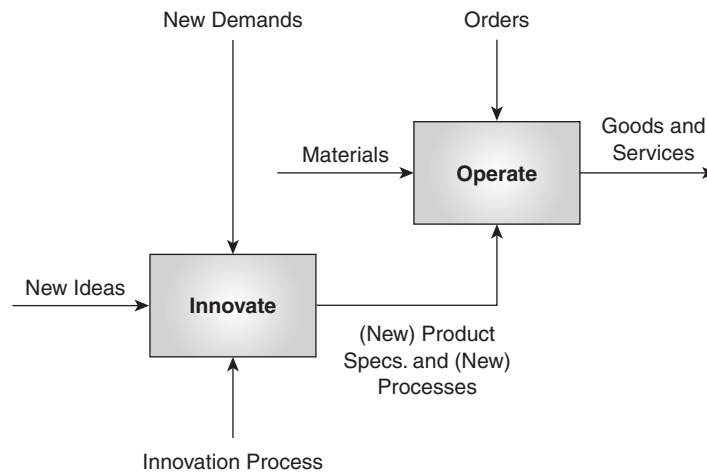
Figure 1.5   Operations and Innovation

A useful way to visualize the relationship between the operations and innovation activities is presented in Figure 1.5. This figure illustrates an activity diagram with two activities labeled with active verbs: *Operate* and *Innovate*. The first activity, Operate, converts orders from customers into goods and services that fulfill customer orders. Other inputs include raw materials and resources such as product specifications and processes. All three inputs are needed to produce the output. The second activity, Innovate, is about making beneficial changes to products, processes, and services. It has an entirely different set of inputs and outputs. The major input is new demands from customers and other major stakeholders. These new demands can stimulate the generation of ideas, and new ideas can be converted into new product specifications and new processes for the Operate activity. The relationship between Innovate and Operate is symbiotic. One serves the customers; the other changes the way the customer is served. This figure is simplified and incomplete, but it illustrates the two core activities in any organization. Although the majority of innovation output is focused on improving operations, certain innovation output is focused on the innovation activity itself. Thus, the organization not only strives to change operations in terms of new products, processes, and services but also changes the means by which the innovation itself is achieved. This book is focused primarily on the innovation management process and how it can be enhanced in organizations so that it can be more effective and efficient.

EXAMPLE: Innovation is applicable to any type of organization, profit or nonprofit, and also at various levels within the organization, from management teams and departments down to large project teams and even individuals. Innovation can occur in products, processes, and services and can involve radical or incremental changes that help an organization to grow in many ways. Table 1.1 presents a list of organizations that have developed their own innovation plans. The names of the organizations have been altered to protect confidentiality, but the URLs of similar organizations are real. Notice that some organizations are entire businesses, whereas others are departments within larger organizations.

Summary

Every organization needs to innovate. Innovation is as relevant to a hospital, movie theater, or press office as it is to a manufacturing plant or product design department. Innovation is the process of making changes to something established by introducing something new that adds value to the customer. Innovation is not to be confused with invention. It can be radical or incremental, and it can apply to products, processes, and services.

Table 1.1   Innovation Plan Titles

Organization	Plan Title	Benchmark
Reflective Display Films	Innovation Plan 2003–2006	www.reflexite.com
Galway Tables	Development Plan 2009	www.blueberriespine.co.uk
Beglin Entertainment Centre	Play Development Plan 2006–2009	www.citylimits.ie
Connemara Distillery	Change Program 2006–2013	www.bushmills.com
Qualtrans Translations	Strategic Plan 2010	www.translations.com
Car Consultants	Five-Year Development Plan	www.autofindersusa.com
Dynocorp Nightclub Group	Innovation 2006–2010	www.vcgh.com
HarPer Sculpting	Innovation 2000	www.gymamerica.com
Medical Device Manufacturing, Computer Services Department	Continuous Improvement Plan	www.medtronic.com
Precision Engineering, Engineering Department	Lean Manufacturing Plan 2k10	www.bellurgan.com
Ratio Technology, Design Department	Design Plans 2006–2009	www.raleigh.com
Moneypits Bank, High Street Branch	Branch Development	www.bankofamerica.com
Children's Hospital	Development Plan 2010	www.olhsc.ie
Ambec Resorts	Hotel Development Five-Year Plan	www.bestwestern.com

There is a special relationship between process and product innovation. The term *disruptive innovation* includes radical innovations within organizations that disrupt the way business is normally conducted. In the next chapter we will examine the innovation process and how organizations can enhance their innovative capability by managing it properly. We examine some of the change techniques that can support the application of innovation and also the impact organizational culture may have on nurturing innovative capability. The chapter also looks at innovation investment and some common reasons why innovations fail.

Activities

Applying innovation is a complex and difficult task. The activities in each chapter of this book are designed to allow you to develop your own innovation plan for a fictional organization that you will define and to struggle with some of the same decisions that any innovation team encounters when managing the innovation process. These activities can be undertaken on an individual basis, but we recommend a group approach. The output of all the activities throughout the book combines to create a comprehensive innovation plan for your chosen organization, that is, your very own case. For the purpose of these activities your organization may be based on a real organization, or it may be constructed from your imagination and based on your own experience.

To help you with the many decisions you will have to make, there is a sample plan in the Appendix for you to study. SwitchIt Manufacturing is a partially completed plan that contains tasks for you to complete. You are strongly encouraged to consider completing the SwitchIt Manufacturing case before beginning your chapter activities.

In this first activity you are required to create some simple pieces of information for your organization. The organization you create can be a large organization or a department within an organization. Examples of large organizations include hospitals, manufacturing plants, cinemas, software design houses, and local government. Examples of departments include computer services, engineering, quality assurance, human resources, and logistics. The organization you establish will need to be large in size. We recommend beginning with approximately sixteen individuals made up of managers and employees. These people will participate in developing and implementing the innovation plan you will develop for your organization. As you progress through the activities in each chapter, you can revisit this activity and add new employees and functions as needed.

Search online for a real organization that is similar to the organization you are considering developing. Make a note of its homepage address. Research this real organization's innovation effort to discover the goals it pursues, the products and services it has developed for the market, who its competitors are, and what aspects give it its competitive advantage. Choose a fictitious name for your organization, such as Fast Fasteners Ltd. or Kinder Childrens Hospital. Next, choose a name for your innovation plan that also includes a planning period (typically 1–5 years), such as Fast Fasteners Innovation Plan (2007–2010). Copy Table 1.2 into a spreadsheet and complete the fields.

Table 1.2   Create an Organization

Organization			Products and Services
Name:			
Plan Title:			
Benchmark:	http://		

Name: Name of your team (e.g., ABC Corp. or ABC Corp. Quality Dept.)

Plan Title: e.g., Innovation Plan 2007–2010 or Development Portfolio 2010

Benchmark: Web site of a similar but real organization

List the main products or services offered.

STRETCH: Other elements of this activity may include visiting a real organization that you are interested in and interviewing senior managers and team leaders regarding their goals, actions, teams, and results. Revisit this organization from time to time as you complete other elements of your innovation plan.

REFLECTIONS

- Define innovation and explain the difference between it and invention.
- Give one example of each of the following types of innovation: product, process, and service.
- Give one example of a radical innovation and an incremental innovation.
- What is a disruptive technology?
- Explain how product and process innovation are related.
- Explain the relationship between innovation and operations.