Appendix 1

Succeeding as a Systems Analyst

LEARNING OBJECTIVES

After studying this appendix, you should be able to:

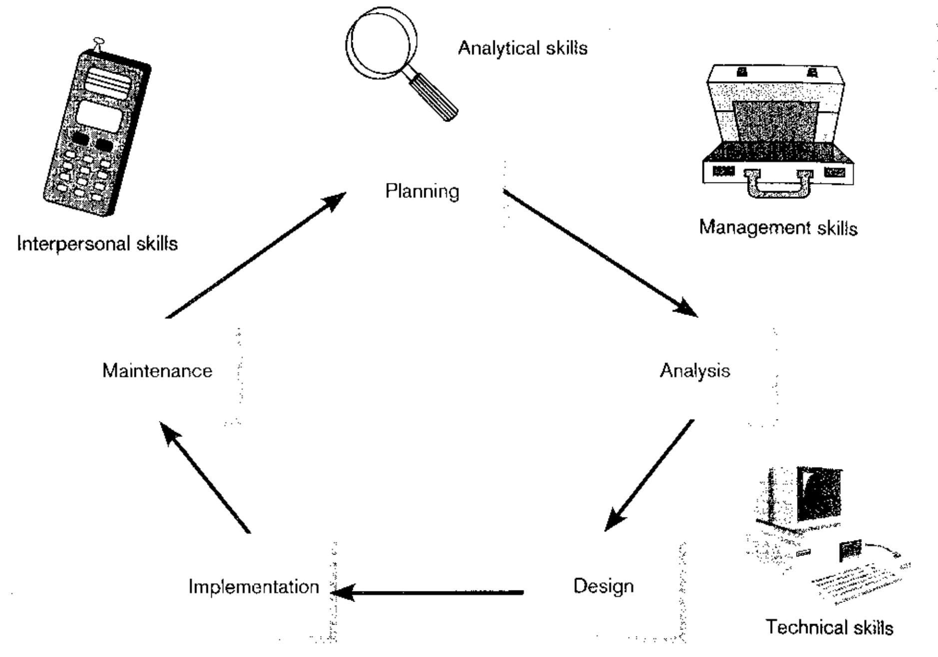
- Describe the organizational roles, including that of the systems analyst, that are involved in information systems development.
- Discuss the analytical skills, including systems thinking, needed for a systems analyst to be successful.
- Describe the technical skills required of a systems analyst.
- Discuss the management skills required of a systems analyst.
- Identify the interpersonal skills required of a systems analyst.
- Describe the systems analysis profession.

INTRODUCTION

In Chapter 1, you learned about the different types of information systems developed in organizations and the project environment in which systems are developed. In this appendix, we will examine the skills needed to succeed as a systems analyst. You will first read about the many different people in an organization who are involved in systems development. You will then examine the analytical skills a systems analyst needs and discuss the technical, management, and interpersonal skills required of a good analyst. One of the key analytical skills you will study is systems thinking, or the ability to see things as systems. You probably learned about systems and systems thinking in your introductory information systems class, so we will review here the highlights of systems and systems thinking that directly affect the design of information systems and how a systems analyst develops systems.

As illustrated in Figure A1-1, an analyst works throughout all phases of the systems development life cycle. The life cycle model represents the process of developing information systems, the same process you read about in Chapter 1. The skills the analyst needs to be successful are represented by the objects placed in the diagram.

Figure A1-1
The relationship between a system analyst's skills and the SDLC



The laptop computer represents technical skills; the briefcase represents management skills; the magnifying glass represents analytical skills; and the telephone represents interpersonal skills. As you can see, to follow the guidelines established by any development methodology, an analyst needs to rely on many skills. Our goal is to sensitize you to abilities that you need to develop from other courses and materials in order to become a successful systems analyst. The appendix ends by stepping back from these specific skills to examine systems analysis as a profession with its own standards of practice, ethics, and career paths.

YOUR ROLE AND OTHER ORGANIZATIONAL RESPONSIBILITIES IN SYSTEMS DEVELOPMENT

In an organization that develops its own information systems internally, several types of jobs are involved. In medium to large organizations, there is usually a separate Information Systems (IS) department. Depending on how the organization is set up, the IS department may be a relatively independent unit, reporting to the organization's top manager. Alternatively, the IS department may be part of another functional department, such as Finance, or there may even be an IS department in several major business units. In any of these cases, the manager of an IS department will be involved in systems development. If the department is large enough, there will be a separate division for systems development, which would be home base for systems analysts, and another division for programming, where programmers would be based (see Figure A1-2). The people for whom the systems are designed are located in the functional departments and are referred to as users or end users.

Some organizations use a different structure for their IS departments. Following this model, analysts are assigned and may report to functional departments. In this way, analysts learn more about the business they support. This approach is supposed to result in better systems, because the analyst becomes an expert in both systems development and the business area.

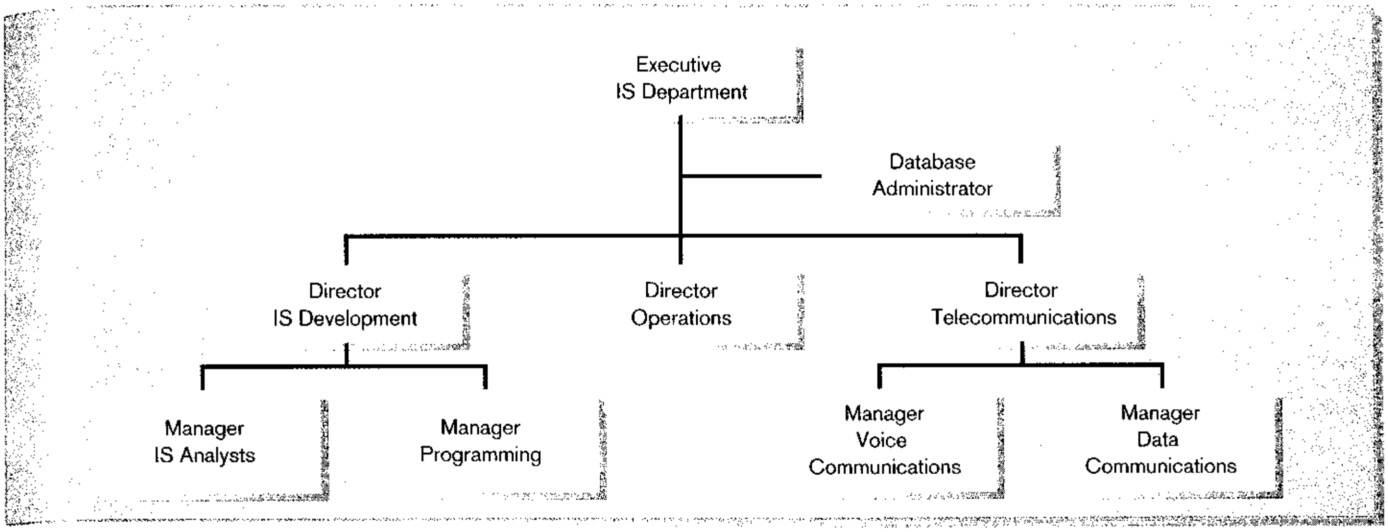


Figure A1-2
Organization chart for typical IS department

Regardless of how an organization structures its IS department, systems development is a team effort. Systems analysts work together in a team, usually organized on a project basis. Team membership can be expanded to include IS managers, programmers, users, and other specialists who may be involved (throughout or at specific points) in the system development project. It is rare to find an organizational information system project that involves only one person. Thus, learning how to work with others in teams is an important skill for any IS professional, and we have stressed team skills throughout this book.

A good team has certain characteristics, some that are a result of how the group is assembled and others that must be acquired through effort on the part of team members (see Table A1-1). A good team is diverse and tolerant of diversity:

- A diverse team has representation from all the different groups interested in a system, and the representation of these groups on the team increases the likelihood of acceptance of the changes a new system will cause.
- Diversity exposes team members to new and different ideas—ideas they might never think of were all team members from the same background, with the same skills and goals.
- New and different ideas can help a team generate better solutions to its problems and defend the course of action it chooses.
- Team members must be able to entertain new ideas without being overly critical or dismissing new ideas out of hand simply because they are new.
- Team members must be able to deal with ambiguous information as well as with complexity and must learn to play a role on a team (and different roles on different teams) so that the talents of all team members can best be utilized.

In order to work well together, a good team must strive to communicate clearly and completely with its members. Team members will communicate more effectively if they trust each other. Trust, in turn, is built on mutual respect and an ability to place one's own goals and views second to the goals and views of the group. To help ensure that a team will work well together, management needs to develop a reward structure that promotes shared responsibility and accountability within the team. In addition to rewards for individual efforts, team members must be rewarded by IS managers for their work as members of an effective work unit.

Team success depends not only on how a team is assembled or the efforts of the group, but also on the management of the team. Reward systems are one part of

TABLE A1-1 Characteristics of Successful Teams

- Diversity in backgrounds, skills, and goals
- Tolerance of diversity, uncertainty, ambiguity
- Clear and complete communication
- Trust
- Mutual respect and putting one's own views second to those of the team
- Reward structure that promotes shared responsibility and accountability

good team management. Effective project management is another key element of successful teams. Project management includes devising a feasible and realistic work plan and schedule, monitoring progress against this schedule, coordinating the project with its sponsors, allocating resources to the project, and sometimes even deciding whether and when a project should be terminated before completing the system.

The characteristics of each systems analysis and design project will dictate which types of individuals should be on the project team. In general, those involved in systems development include IS managers, systems analysts, programmers, end users, and business managers as well as additional IS managers, technicians, and specialists. We will now preview the role of each of these players and other **stakeholders** in systems development.

Stakeholder: A person who has an interest in an existing or new information system.

Managers in Systems Development

The manager of an IS department may have a direct role in the systems development process if the organization is small or if that is the manager's style. Typically, IS managers are more involved in allocating resources to and overseeing approved system development projects rather than in the actual development process. Thus, IS managers may attend some project review meetings and certainly will expect written status reports on project progress covering their areas of concern. IS managers may prescribe what methodologies, techniques, and tools are to be used and the procedure for reporting the status of projects. As department leaders, IS managers are also responsible for career planning and development for systems analysts and other employees and for solving problems that arise in the course of development projects.

There are, of course, several IS managers in any medium to large IS department (see Figure A1-2). The manager of an entire IS department may have the title Chief Information Officer and may report to the president or chairman of the firm. Each division of the IS department will also have a manager. Typical titles for these managers are Director of IS Development, IS Operations Manager, and IS Programming Director. The Director of IS Development may be responsible for several development projects at any given time, each of which has a project manager. The responsibilities and focus of any particular IS manager depend on his or her level in the department and on how the organization manages and supports the systems development process.

Systems Analysts in Systems Development

Systems analysts are the key individuals in the systems development process. To succeed as a systems analyst, you will need to develop four types of skills: analytical, technical, managerial, and interpersonal. Analytical skills enable you to understand the organization and its functions, to identify opportunities and problems, and to analyze and solve problems. One of the most important analytical skills you can develop is systems thinking, or the ability to see organizations and information systems as systems. Systems thinking provides a framework from which to see the important relationships among information systems, the organizations they exist in, and the environment in which the organizations themselves exist. Technical skills help you understand the potential and the limitations of information technology. As an analyst, you must be able to envision an information system that will help users solve problems and that will guide the system's design and development. You must also be able to work with programming languages, various operating systems, and computer hardware platforms. Management skills help you manage projects, resources, risk, and change. Interpersonal skills help you work with end users as well as with other analysts and programmers. As a systems analyst, you will play a major role as a liaison among users, programmers, and other systems professionals. Effective written and oral communication, including competence in leading meetings, interviewing, and listening,

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Figure A1-3
Typical advertisement for a systems analyst position

is a key skill analysts must master. Effective analysts successfully combine these four skills, as Figure A1-3, a typical advertisement for a systems analyst position, illustrates.

As with any profession, becoming a good systems analyst takes years of study and experience. Once hired by an organization, you will generally be trained in the development methodology used by the organization. There is usually a career path for systems analysts that allows them to gain experience and advance into project management and further IS or business management positions. Many academic IS departments train their undergraduate students to be systems analysts. As your career progresses, you may get the chance to become a manager inside or outside the IS area. In some organizations, you can opt to follow a technical career advancement ladder. As an analyst, you will become aware of a consistent set of professional practices, many of which are governed by a professional code of ethics, similar to other professions.

Programmers in Systems Development

Programmers convert the system specifications given to them by the analysts into instructions the computer can understand. Writing a computer program is sometimes called writing code, or coding. Programmers also write program documentation and programs for testing systems. For many years, programming was considered an art. However, computer scientists found that code could be improved if it was structured, so they introduced what is now called structured programming (Bohm and Jacopini, 1966). In structured programming, all computing instructions can be represented through the use of three simple structures: sequence, repetition, and selection. Becoming a skilled programmer takes years of training and experience. Many computer information systems undergraduates begin work as programmers or programmer/analysts.

Programming is very labor intensive; therefore, special-purpose computing tools called code generators have been developed to generate reasonably good code from specifications, saving an organization time and money. Code generators do not put programmers out of work; rather, these tools change the nature of programming. When code generators are used, programmers take the generated code and fix problems with it, optimize it, and integrate it with other parts of the system. The goal of some computer-aided software engineering (CASE) tools is to provide a variety of code generators that can automatically produce 90 percent or more of code directly from the system specifications normally given to a programmer. When this goal is achieved, the role of programmers on systems development teams will be changed further.

Business Managers in Systems Development

Another group important to systems development efforts is business managers, such as functional department heads and corporate executives. These managers are important to systems development because they have the power to fund development projects and to allocate the resources necessary for the projects' success. Because of their decision-making authority and knowledge of the firm's lines of business, department heads and executives are also able to set general requirements and constraints for development projects. In larger companies where the relative importance of systems projects is determined by a steering committee, these executives have additional power because they are usually members of the steering committees or systems planning groups. Business managers, therefore, have the power to set the direction for systems development, to propose and approve projects, and to determine the relative importance of projects that have already been approved and assigned to other people in the organization.

Other IS Managers/Technicians in Systems Development

In larger organizations where IS roles are more differentiated, there may be several additional IS professionals involved in the systems development effort. A firm with an existing set of databases will most likely have a database administrator who is usually involved in any systems project affecting the firm's databases. Network and telecommunications experts help develop systems involving data and/or voice communication, either internal or external to the organization. Some organizations have human factors departments that are concerned with system interfaces and ease-of-use issues, training users, and writing user documentation and manuals. Overseeing much of the development effort, especially for large or sensitive systems, are an organization's internal auditors who ensure that required controls are built into the system. In many organizations, auditors also have responsibility for keeping track of changes in the system's design. The necessary interaction of all these individuals makes systems development very much a team effort.

ANALYTICAL SKILLS FOR SYSTEMS ANALYSTS

Given the title systems analyst, you might think that analytical skills are the most important. While there is no question that analytical skills are essential, other skills are equally required. First, however, we will focus on the four sets of analytical skills: systems thinking, organizational knowledge, problem identification, and problem analyzing and solving.

Systems Thinking: A Review

If you counted the number of times each key term is used in this book, the most frequently used key term would undoubtedly be *system*. Let's take the time now to examine systems in general and information systems in particular. (For a more thorough treatment of system concepts, see Martin et al. [2002]). Let's start by examining what we mean by a system and identify the characteristics that define a system.

Definitions of a System and Its Parts A **system** is an interrelated set of components with an identifiable boundary working together for some purpose. A system has nine characteristics (see Figure A1-4):

System: An interrelated set of components with an identifiable boundary working together for some purpose.

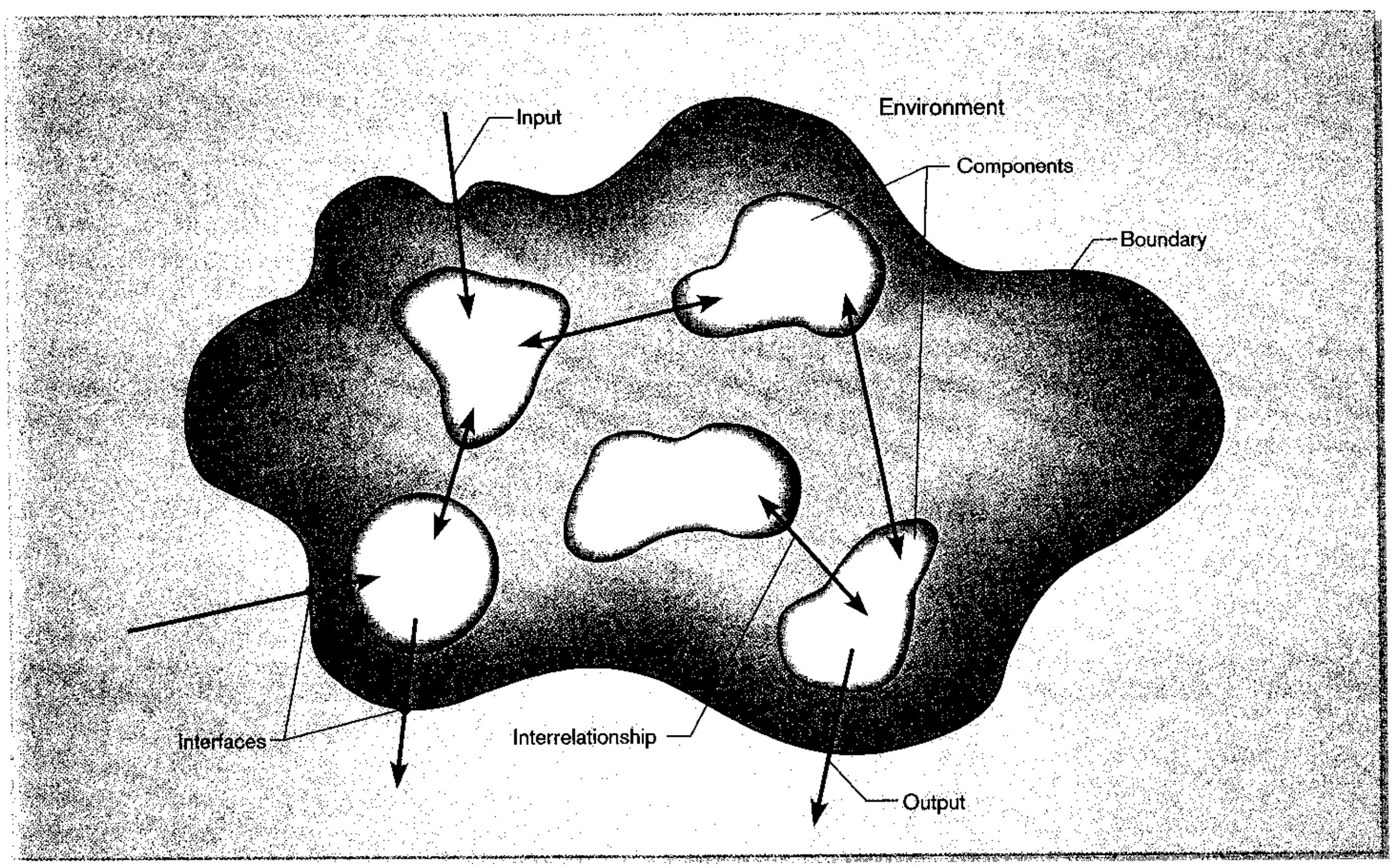
1. Components
2. Interrelated components
3. A boundary
4. A purpose
5. An environment
6. Interfaces
7. Input
8. Output
9. Constraints

A system is made up of components. A **component** is either an irreducible part or an aggregate of parts, also called a subsystem. The simple concept of a component is very powerful. For example, just as with an automobile or a stereo system with proper design, we can repair or upgrade the system by changing individual components without having to make changes throughout the entire system. The components are **interrelated**; that is, the function of one is somehow tied to the functions of the others. For example, the work of one component, such as producing a daily report of customer orders received, may not progress successfully until the work of another

Component: An irreducible part or aggregation of parts that make up a system, also called a subsystem.

Interrelated components: Dependence of one subsystem on one or more subsystems.

Figure A1-4
A general depiction of a system



Boundary: The line that marks the inside and outside of a system and that sets off the system from its environment.

Purpose: The overall goal or function of a system.

Environment: Everything external to a system that interacts with the system.

Interface: Point of contact where a system meets its environment or where subsystems meet each other.

Constraint: A limit to what a system can accomplish.

Input: Whatever a system takes from its environment in order to fulfill its purpose.

Output: Whatever a system returns to its environment in order to fulfill its purpose.

component is finished, such as sorting customer orders by date of receipt. A system has a **boundary** within which all of its components are contained and that establishes the limits of a system, separating the system from other systems. Components within the boundary can be changed, whereas things outside the boundary cannot be changed. All of the components work together to achieve some overall **purpose** for the larger system: the system's reason for existing.

A system exists within an **environment**—everything outside the system's boundary. For example, we might consider the environment of a state university to include the legislature, prospective students, foundations and funding agencies, and the news media. Usually the system interacts with its environment, exchanging, in the case of an information system, data and information. The points at which the system meets its environment are called **interfaces**, and there are also interfaces between subsystems (Figure A1-5 provides a list of functions performed by interfaces). An example of a subsystem interface is the clutch subsystem, which acts as the point of interaction between the engine and transmission subsystems of a car. As can be seen from Figure A1-5, interfaces may include much functionality. You will spend a considerable portion of time in systems development dealing with interfaces, especially interfaces between an automated system and its users (manual systems) and interfaces between different information systems. It is the design of good interfaces that permits different systems to work together without being too dependent on each other.

A system must face **constraints** in its functioning because there are limits (in terms of capacity, speed, or capabilities) to what it can do and how it can achieve its purpose within its environment. Some of these constraints are imposed inside the system (e.g., a limited number of staff available), whereas others are imposed by the environment (e.g., due dates or regulations). A system takes **input** from its environment in order to function. Mammals, for example, take in food, oxygen, and water from the environment as input. Finally, a system returns **output** to its environment as a result of its functioning and thus achieves its purpose.

Now that you know the definition of a system and its nine important characteristics, let's take an example of a system and use it to illustrate the definition and each system characteristic. Consider a system that is familiar to you: a fast-food restaurant (see Figure A1-6).

How is a fast-food restaurant a system? Let's take a look at the fictional Hoosier Burger restaurant in Bloomington, Indiana. First, Hoosier Burger has components, or subsystems. We can figure out what the subsystems are in many ways but, for the sake of illustration, let's focus on Hoosier Burger's physical subsystems as follows: kitchen, dining room, counter, storage, and office. As you might expect, the subsystems are interrelated and work together to prepare food and deliver it to customers, one purpose for the restaurant's existence. Food is delivered to Hoosier

Figure A1-5
Special characteristics of interfaces

INTERFACE FUNCTIONS

Because an interface exists at the point where a system meets its environment, the interface has several special, important functions. An interface provides

- **Security,** protecting the system from undesirable elements that may want to infiltrate it
- **Filtering** unwanted data, both for elements leaving the system and entering it
- **Coding and decoding** incoming and outgoing messages
- **Detecting and correcting errors** in its interaction with the environment
- **Buffering,** providing a layer of slack between the system and its environment, so that the system and its environment can work on different cycles and at different speeds
- **Summarizing** raw data and transforming them into the level of detail and format needed throughout the system (for an input interface) or in the environment (for an output interface)

Because interface functions are critical in communication between system components or a system and its environment, interfaces receive much attention in the design of information systems (see Chapters 11 and 12).

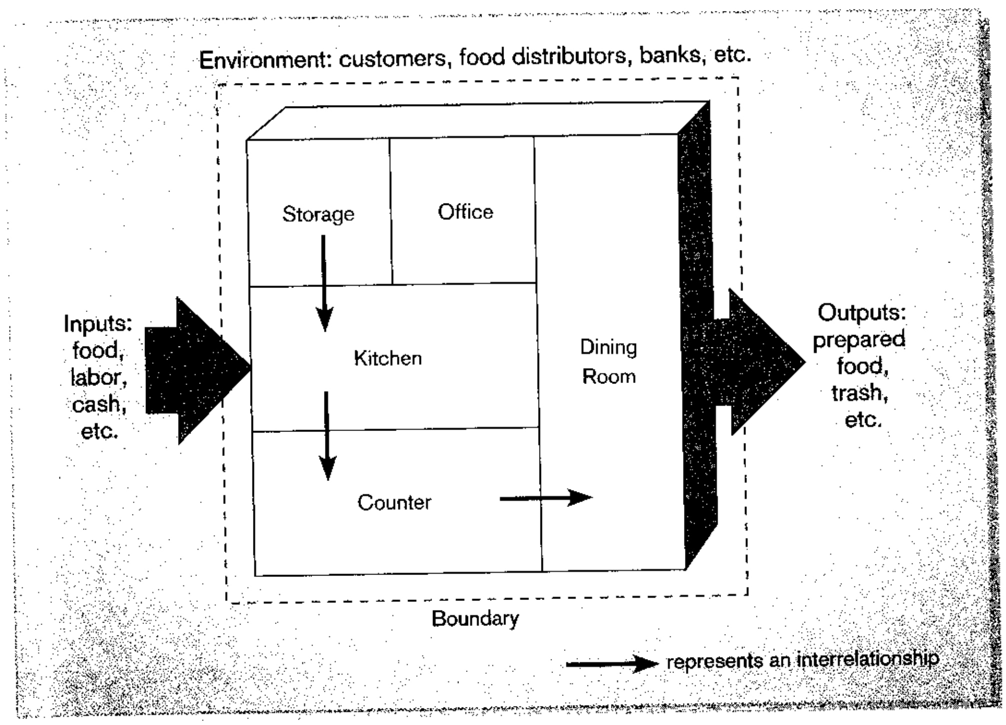


Figure A1-6
A fast-food restaurant as a system

Burger early in the morning, kept in storage, prepared in the kitchen, sold at the counter, and often eaten in the dining room. The boundary of Hoosier Burger is represented by its physical walls, and the primary purpose for the restaurant's existence is to make a profit for its owners, Bob and Thelma Mellankamp.

Hoosier Burger's environment consists of those external elements that interact with the restaurant, such as customers (many of whom come from nearby Indiana University), the local labor supply, food distributors (much of the produce is grown locally), banks, and neighborhood fast-food competitors. Hoosier Burger has one interface at the counter, where customers place orders, and another at the back door, where food and supplies are delivered. Still another interface is the telephone managers use regularly to talk with bankers and food distributors. The restaurant faces several constraints. It is designed for the easy and cost-effective preparation of certain popular foods, such as hamburgers and milk shakes, which constrains the restaurant in the foods it may offer for sale. Hoosier Burger's size and its location in the university neighborhood constrain how much money it can make on any given day. The Monroe County Health Department also imposes constraints, such as rules governing food storage. Inputs include, but are not limited to, ingredients for the burgers and other food as well as cash and labor. Outputs include, but are not limited to, prepared food, bank deposits, and trash.

Important System Concepts Once we have recognized something as a system and identified the system's characteristics, how do we understand the system? Further, what principles or concepts about systems guide the design of information systems? A key aspect of a system is the system's relationship with its environment. Some systems, called **open systems**, interact freely with their environments, taking in input and returning output. As the environment changes, an open system must adapt to the changes or suffer the consequences. A **closed system** does not interact with the environment; changes in the environment and adaptability are not issues for a closed system. However, all business information systems are open, and in order to understand a system and its relationships to other information systems, to the organization, and to the larger environment, you must always think of information systems as open and constantly interacting with the environment.

Open system: A system that interacts freely with its environment, taking input and returning output.

Closed system: A system that is cut off from its environment and does not interact with it.

Figure A1-7
Purpose of decomposition

DECOMPOSITION FUNCTIONS
Decomposition aids a systems analyst and other systems development project team members by • Breaking a system into smaller, more manageable, and understandable subsystems • Facilitating the focusing of attention on one area (subsystem) at a time without interference from other parts • Allowing attention to concentrate on the part of the system pertinent to a particular audience, without confusing people with details irrelevant to their interests • Permitting different parts of the system to be built at independent times and/or by different people

There are several other important systems concepts with which systems analysts need to become familiar:

- Decomposition
- Modularity
- Coupling
- Cohesion

Decomposition: The process of breaking down a system into smaller and less complex pieces that are easier to understand.

Decomposition deals with being able to break down a system into its components. These components may themselves be systems (subsystems) and can be broken down into their components as well. How does decomposition aid understanding of a system? Decomposition results in smaller and less complex pieces that are easier to understand than larger, complex pieces. Decomposing a system also allows us to focus on one particular part of a system, making it easier to think of how to modify that one part independently of the entire system (Figure A1-7). Figure A1-8 shows the decomposition of a portable compact disc (CD) player. At the highest level of abstraction, this system simply accepts CDs and settings of the volume and tone controls as input and produces music as output. Decomposing the system into subsystems reveals the system's inner workings: There are separate systems for reading the digital signals from the CDs, for amplifying the signals, for turning the signals into sound waves, and for controlling the volume and tone of the sound. Breaking the subsystems down into their components would reveal even more about the inner workings of the system and greatly enhance our understanding of how the overall system works.

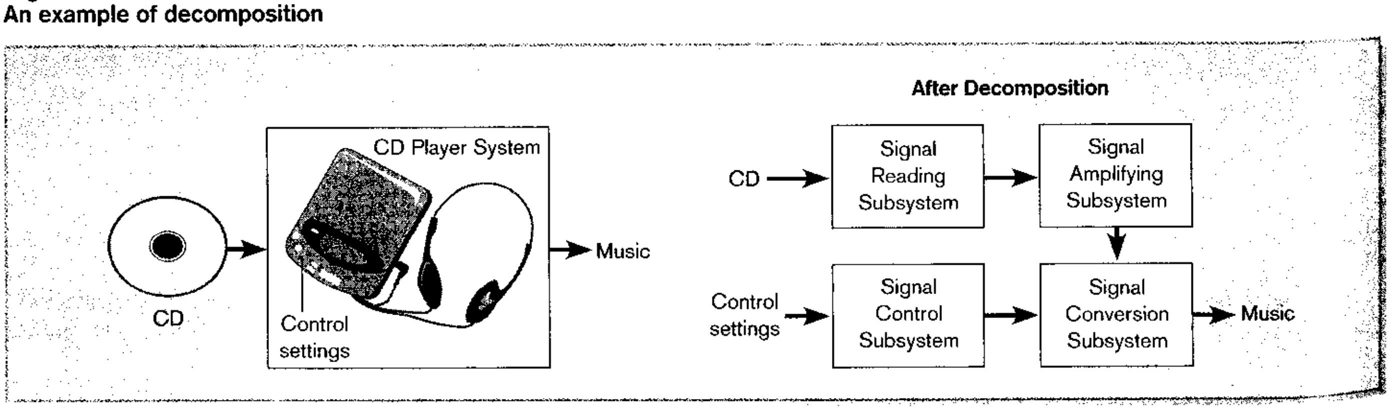
Modularity: Dividing a system up into chunks or modules of a relatively uniform size.

Modularity, a direct result of decomposition, refers to dividing a system up into chunks or modules of a relatively uniform size. Modules can represent a system simply, making it not only easier to understand, but also easier to redesign and rebuild.

Coupling: The extent to which subsystems depend on each other.

Coupling is the extent to which subsystems are dependent on each other. Subsystems should be as independent as possible. If one subsystem fails and other

Figure A1-8
An example of decomposition



subsystems are highly dependent on it, the others will either fail themselves or have problems functioning. Looking at Figure A1-8, we would say the components of a portable CD player are tightly coupled. The amplifier and the unit that reads the CD signals are wired together in the same container, and the boundaries between these two subsystems may be difficult to draw clearly. If one subsystem fails, the entire CD player must be sent off for repair. In a home stereo system, the components are loosely coupled because the subsystems, such as the speakers, the amplifier, the receiver, and the CD player, are all physically separate and function independently. For example, if the amplifier in a home stereo system fails, only the amplifier needs to be repaired.

Finally, **cohesion** is the extent to which a subsystem performs a single function. In biological systems, subsystems tend to be well differentiated, and thus very cohesive. In human made systems, subsystems are not always as cohesive as they should be.

Cohesion: The extent to which a system or a subsystem performs a single function.

One final key systems concept with which you should be familiar is the difference between logical and physical systems. Any description of a system is abstract because the definition is not the system itself. When we talk about logical and physical systems, we are actually talking about logical and physical system descriptions.

A **logical system description** portrays the purpose and function of the system without tying the description to any specific physical implementation. For example, in developing a logical description of the portable CD player, we describe the basic components of the player (signal reader, amplifier, speakers, controls) and their relations to each other, focusing on the function of playing CDs using a self-contained, portable unit. We do not specify whether the earphone jack contains aluminum or gold, where we could buy the laser that reads the CDs, or how much the jack or the laser cost to produce.

Logical system description: Description of a system that focuses on the system's function and purpose without regard to how the system will be physically implemented.

In contrast, the **physical system description** is a material depiction of the system, a central concern of which is building the system. A physical description of the portable CD player would provide details on the construction of each subunit, such as the design of the laser, the composition of the earphones, and whether the controls feature digital readouts. A systems analyst should deal with function (logical system description) before form (physical system description), just as an architect does for the analysis and design of buildings.

Physical system description: Description of a system that focuses on how the system will be materially constructed.

Benefiting from Systems Thinking The first step in systems thinking is to be able to identify something as a system. This identification also involves recognizing each of the system's characteristics, for example, identifying where the boundary lies and all of the relevant inputs. But once you have identified a system, what is the value of thinking of something as a system? Visualizing a set of things and their interrelationships as a system allows you to translate a specific physical situation into more general, abstract terms. From this abstraction, you can think about the essential characteristics of a specific situation. This in turn allows you to gain insights you might never get from focusing too much on the details of the specific situation. Also, you can question assumptions, provide documentation, and manipulate the abstract system without disrupting the real situation.

Let's look again at Hoosier Burger. How can visualizing a fast-food restaurant as a system help us gain insights about the restaurant that we might not get otherwise? Let's imagine that Hoosier Burger is facing more demand for its food than it can handle. Some people are convinced that its hamburgers are the best in Bloomington, maybe even in southern Indiana. Many people, especially Indiana University students and faculty, frequently eat at Hoosier Burger, and the staff is having a difficult time keeping up with the demand. For the owner-managers, Bob and Thelma Mellankamp, the high level of demand is both a problem and an opportunity. The problem is that if the restaurant can't keep up with demand, people will stop coming to eat there, and the owners will lose money. The opportunity is to capitalize on Hoosier Burger's popularity and serve even more customers every day, making larger profits for the owners (which is the purpose of their system).

How does looking at Hoosier Burger as a system help? By decomposing the restaurant into subsystems, we can analyze each subsystem separately and discover if one or more subsystems are at capacity. Capacity is a general problem common to many systems. Let's say, after careful study, that we discover that the kitchen, storage, and dining room subsystems have plenty of available capacity. However, the counter is unable to handle the rush of people. Customers have to wait in line for several minutes to place and receive their orders. The counter is the restaurant's bottleneck; thus, the capacity of the counter needs to be increased. If we redesign the counter area or the procedures for taking customer orders, then we can increase the counter's capacity and better match it to the kitchen's capacity. Customers will have to wait in line less time to place their orders and they will get their food faster. Fewer customers will turn away because of long lines, which should translate into more food sold and higher profits.

There are other aspects of the system we could have examined, such as outputs, inputs, or environmental conditions, but to make the example more clear and concise, we looked only at subsystems. For this particular problem, decomposing Hoosier Burger into its subsystems enabled us to determine its problem with demand. Other problems may have required an examination of all aspects of the restaurant system.

Applying Systems Thinking to Information Systems None of the examples of systems we have examined so far in this appendix have been information systems, even though information systems are the focus of this book. There are two reasons why we have looked at other types of systems first. One is so that you will become accustomed to thinking of some of the many different things you encounter daily as systems and realize how useful systems thinking can be. The second is that thinking of organizations as systems is a useful perspective from which to begin developing information systems. Information systems can be seen as subsystems in larger organizational systems, taking input from and returning output to their organizational environments.

NET SEARCH
The concept of "system" is central to systems analysis and design. Visit www.prenhall.com/hoffer to complete an exercise on this topic.

Let's examine a simplified version of an information system as a special kind of system. In our fast-food restaurant example, Hoosier Burger uses an information system to take customer orders, send the orders to the kitchen, monitor goods sold and inventory, and generate reports for management. The information system is depicted as a data flow diagram in Figure A1-9.

As the diagram illustrates, Hoosier Burger's customer order system contains four components, or subsystems: Process Customer Food Order, Update Goods Sold File, Update Inventory File, and Produce Management Reports. The arrows in the diagram show how these subsystems are interrelated. For example, the first process produces four outputs: a Kitchen Order, a Receipt, Goods Sold data, and Inventory data. The latter two outputs serve as input for other subsystems. The dotted line illustrates the boundary of the system. Notice that the Customer, the Kitchen, and the Restaurant Manager (Bob Mellankamp) are all considered to be outside the customer order system. The specific purpose of the system is to facilitate customer orders, monitor inventory, and generate reports; the system's general purpose is to improve the efficiency of the restaurant's operations.

Because this information system is smaller in scope and purpose than the Hoosier Burger system itself, its environment is also smaller. For our purposes, we can limit the environment to those entities that interact with the system: Customers, the Kitchen, and the Restaurant Manager. Constraints on the system may or may not be apparent from the diagram. For example, the diagram implicitly shows (by omission) that there is no direct data exchange between the customer order system and information systems used by the restaurant's suppliers; this prevents the system from automatically issuing an order for supplies directly to the suppliers when inventory falls below a certain level. We do not know, however, if any other Hoosier Burger system supports such direct data exchange. Another constraint may be the system's inability to provide online, real-time information on inventory levels, limiting Bob Mellankamp to receiving nightly batched reports. This is not at all clear from Figure A1-9. In contrast, system input and outputs are very clear. The only system input is the Customer

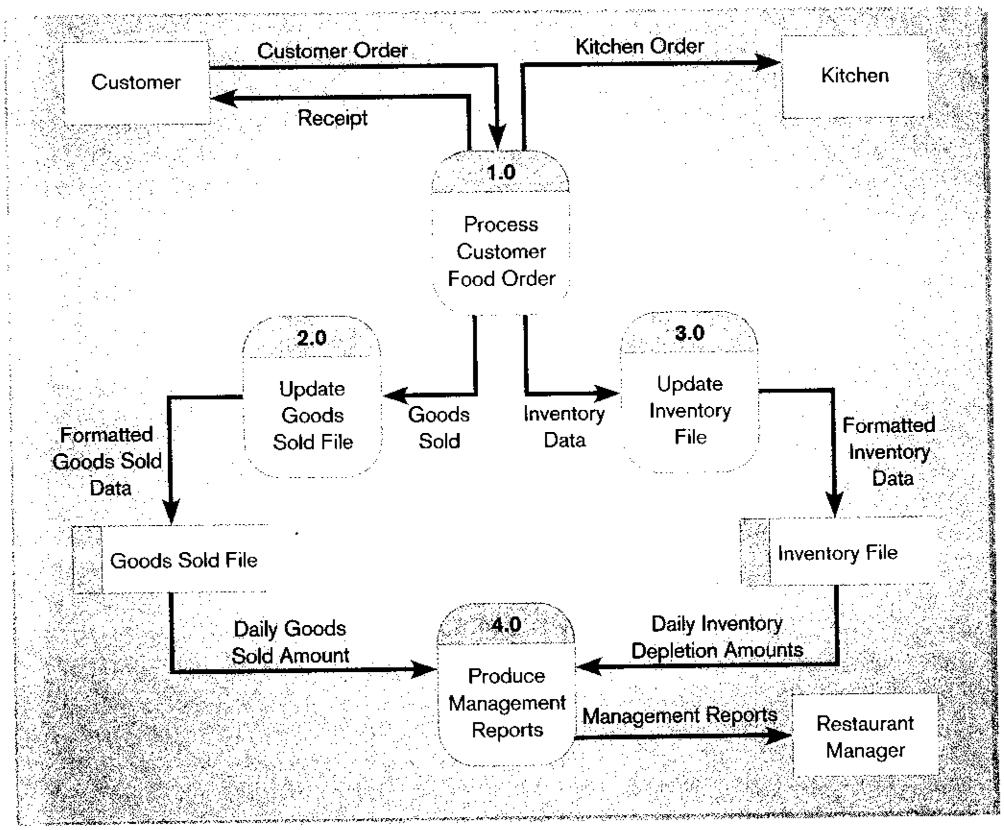


Figure A1-9
A fast-food restaurant's customer order information system depicted in a data flow diagram

Order, and there are three overall system outputs: a Receipt for the customer, a Kitchen Order, and Management Reports.

On one level of analysis and description, Hoosier Burger's customer order system is a physical system that takes input, processes data, and returns output. The physical system consists of a computerized cash register that a clerk uses to enter a customer order and return a paper receipt to the customer. Another piece of paper, the kitchen order, is generated from a printer in the restaurant's kitchen. The cash register sends data on the order about goods sold and inventory to a computer in Hoosier Burger's office, where computer files on goods sold and inventory are updated by applications software. Other application software uses data in the Goods Sold and Inventory files to generate and print reports on a laser printer in the office.

On another level of analysis and description, Hoosier Burger's customer order system can be explained using a logical description of an information system that focuses on the flow and transformation of data. The physical system is one possible implementation of the more abstract, logical information system description. For the logical information system description, it is irrelevant whether the customer's order shows up in the kitchen as a piece of paper or as lines of text on a monitor screen. What's important is the information that is sent to Hoosier Burger's kitchen. For every logical information system description, there can be several different physical implementations of it.

The way we draw information systems shows how we think of them as systems. Data flow diagrams clearly illustrate inputs, outputs, system boundaries, the environment, subsystems, and interrelationships. Purpose and constraints are much more difficult to illustrate and must therefore be documented using other notations. In total, all elements of the logical system description must address all nine characteristics of a system.

Organizational Knowledge

As a systems analyst, you will work in organizations. Whether you are an in-house analyst or a contract custom software developer, you must understand how organizations work. In addition, you must understand the functions and procedures of the particular organization (or enterprise) you are working for. Furthermore, many of the systems you will build or maintain serve one organizational department, and you must understand how that department operates, its purpose, its relationships with other departments and, if applicable, its relationships with customers and suppliers. Table A1-2 lists various kinds of organizational knowledge that a systems analyst must acquire in order to be successful.

Problem Identification

What is a problem? Pounds (1969) defines a problem as the difference between an existing situation and a desired situation. For him, the process of identifying problems is the process of defining differences, so problem solving is the process of finding a way to reduce differences. According to Pounds, a manager defines differences by comparing the current situation to the output of a model that predicts what the output should be. For example, at Hoosier Burger, a certain portion of the food ordered from local produce distributors is expected to go bad before it can be used. Comparing a current food spoilage rate of 10 percent to a desired spoilage rate of 5 percent defines a difference and therefore identifies a problem. In this case, Bob Mellankamp has used a model to determine the desired spoilage rate of 5 percent. The particular model used, showing how fast produce ripens after harvesting, typical delivery times, and how long produce will stay fresh in a refrigerator, has come from research carried out at Purdue University's College of Agriculture. Based on the research, the Mellankamps have set a standard of a 5 percent spoilage rate, with an acceptable variance of 2 percent in either direction. According to this standard, a 5 percent variance between the desired and actual is clearly out of line and merits attention. Another model might have indicated that a 10 percent spoilage rate was acceptable. You can see that understanding how managers identify problems is understanding the models they use to define differences.

In order to identify problems that need to be solved, you must be able to compare the current situation in an organization to the desired situation. You must

TABLE A1-2 Selected Areas of Organizational Knowledge for a Systems Analyst

How Work Officially Gets Done in a Particular Organization
Terminology, abbreviations, and acronyms
Policies
Standards and procedures
Standards of practice
Formal organization structure
Job descriptions
Understanding the Organization's Internal Politics
Influence and inclinations of key personnel
Who the experts are in different subject areas
Critical incidents in the organization's history
Informal organization structure
Coalition membership and power structures
Understanding the Organization's Competitive and Regulatory Environment
Government regulations
Competitors, domestic and international
Products, services, and markets
Role of technology
Understanding the Organization's Strategies and Tactics
Short- and long-term strategy and plans
Values and mission

develop a repertoire of models to define the differences between what is and what ought to be. It is also important that you appreciate the models that information systems users rely on to identify problems. Every functional area of the organization will use different models to find problems; what is helpful in accounting will not necessarily work well in manufacturing. You must be able to see problems from a broader perspective. By relying on models from their own particular functional areas, users may not see the real problem from an organizational view.

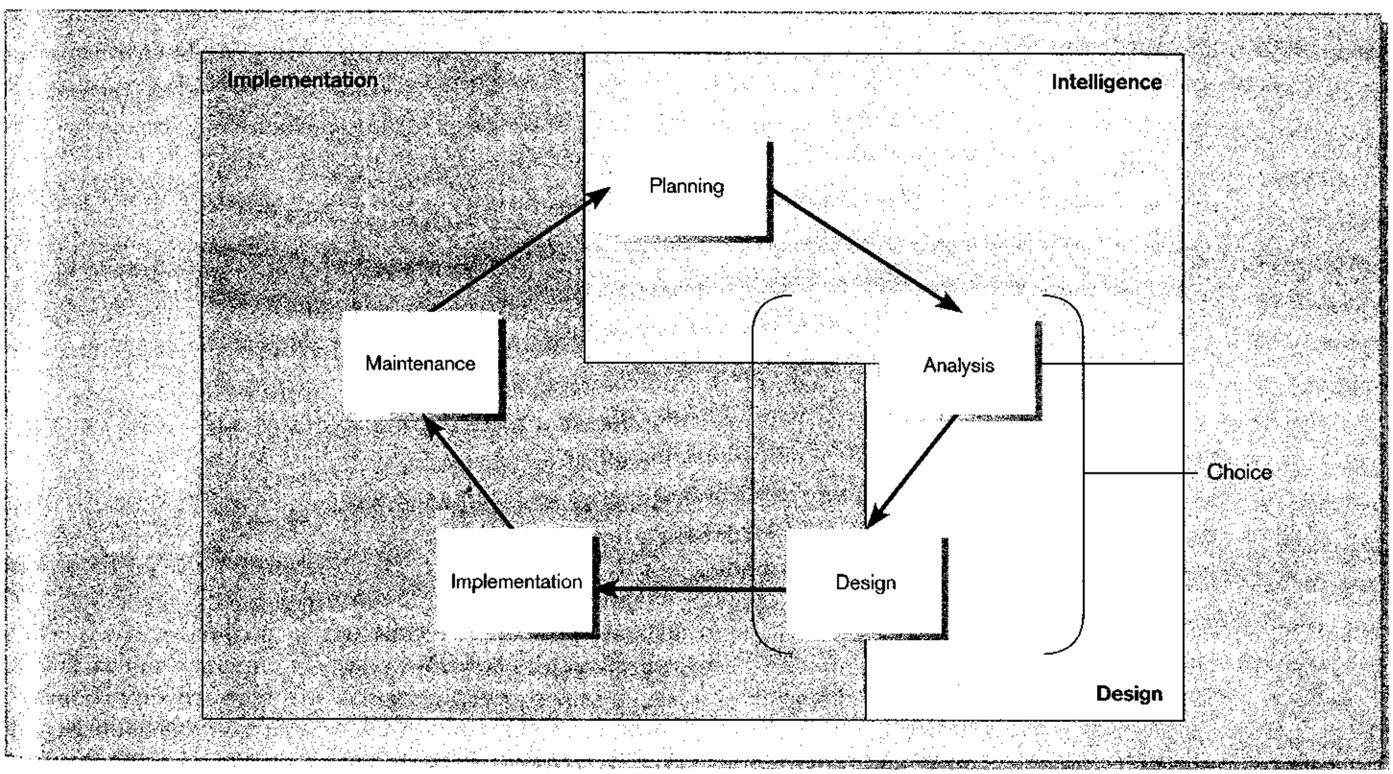
Problem Analyzing and Solving

Once a problem has been identified, you must analyze the problem and determine how to solve it. Analysis entails finding out more about the problem. Systems analysts learn through experience, with guidance from proven methods, how to get the needed information from people as well as from organizational files and documents. As you seek out additional information, you also begin to formulate alternative solutions to the problem. Devising solutions leads to a search for more information, which in turn leads to improvements in the alternatives. Obviously, such a process could continue indefinitely, but at some point, the alternatives are compared and typically one is chosen as the best solution. Once the analyst, users, and management agree on the general suitability of the solution, they devise a plan for implementing it.

The approach for analyzing and solving problems we describe was formally described by Herbert Simon (Simon, 1960). The approach has four phases: intelligence, design, choice, and implementation. During the intelligence phase, all information relevant to the problem is collected. During the design phase, alternatives are formulated, and, during choice, the best alternative solution is chosen. The solution is put into practice during the implementation phase.

This problem-analysis and problem-solving approach should be familiar to you: It is essentially the same general process as that described earlier in the systems development life cycle (see Figure A1-10). Simon's intelligence phase corresponds roughly to

Figure A1-10
The systems development life cycle and Simon's problem-solving model



the first two phases in the life cycle, planning and analysis. Simon's design phase corresponds to that part of analysis where alternative solutions are formulated. The detailed solution formulation, however, would be performed in the life cycle's design phase. In our life cycle model, activities that occur in design, implementation, and maintenance correspond to Simon's implementation phase. Choice of the best solution is made in stages, during various interactions that occur in the analysis and design phases.

Simon's problem-solving model is a useful one that lends insight into how people solve certain kinds of problems, but there are other factors in organizations that influence how problems are solved. Among these are personal interests, political considerations, and limits in time and cognitive ability that affect how much information people can gather and process.

TECHNICAL SKILLS

Many aspects of your job as a systems analyst are technically oriented. In order to develop computer-based information systems, you must understand how computers, data networks, database management and operating systems, and a host of other technologies work as well as their potential and limitations. Further, you must be technically adept with different notations for representing, or modeling, various aspects of information systems. You need these technical skills not only to perform tasks assigned to you, but also to communicate with the other people with whom you work in systems development. Rather than develop a single set of technical skills to use throughout your career, you must constantly reeducate yourself about information technology, techniques, and methodologies. Information technology, techniques, and methodologies change quickly, and you must keep up with the changes. You need to understand alternative technologies (such as Microsoft Windows, Linux, and UNIX operating environments) as organizational preferences, because choices vary across companies and over time. Versatility, based on a sound understanding of technical concepts rather than specific tools, gives you the flexibility needed for such a changing skill set.

The following activities will help you stay versatile and up-to-date:

- Read trade publications (e.g., *Computerworld* or *PCWeek*) and books.
- Join professional societies (e.g., the Association of Information Technology Professionals or the Association for Computing Machinery) or other clubs and attend their meetings.
- Attend classes or teach at a local college. Teaching is a wonderful way to force yourself to stay current and to learn from others.
- Attend any courses or training sessions offered by your organization.
- Attend professional conferences, seminars, or trade shows.
- Participate in electronic bulletin boards, news groups, or conferences on local, national, or international networks.
- Regularly browse Websites that focus on industry news, such as CNET. Many trade publications, including *Computerworld*, also have Websites.

Maybe you have seen the cartoon of the person wearing tattered clothes, looking thin, sitting on a park bench feeding the birds. The caption reads, "He was an outstanding systems analyst, but he took a 6-month vacation and fell too far behind in his field." Being a systems analyst requires continuous learning.

Because of the rapid changes that occur in technology, we do not dwell on specifics in this section. For example, when this book was being written, object-oriented database technology was considered new and experimental. It is quite possible, however, that this technology may be popular and widespread when you read this book. In general, you should be as familiar as possible with the following families of technologies:

- Microcomputers, workstations, minicomputers, and mainframe computers
- Programming languages
- Operating systems, both for single machines and networks
- Database and file management systems
- Data communication standards and software for local and wide area networks
- Systems development tools and environments (such as form and report generators and graphical interface design tools)
- Web development languages and tools such as HTML, ColdFusion, and Microsoft's FrontPage
- Decision support system generators and data analysis tools

In addition, you should also be familiar with modern methods and techniques for describing, modeling, and building systems. How technical you must be will vary by job assignment and where you are in your career. Often, you will be asked to be more technical in the early stages of your career and then assume more managerial responsibilities as you gain experience. We discuss career progression later in this appendix.

MANAGEMENT SKILLS

Systems analysts are almost always members of project teams and are frequently asked to lead teams. Management skills are very useful for anyone in a leadership role. As an analyst, you also need to know how to manage your own work and how to use organizational resources in the most productive ways possible. Self-management, then, is an important skill for an analyst. In this section, we describe four categories of management skills: resource, project, risk, and change management.

Resource Management

Any organizational worker must know how to obtain and work effectively with organizational resources. A systems analyst must know how to get the most out of a wide range of resources: system documentation, information technology, and money. For an analyst leading a team, the most important resource is people. A team leader must learn how to best use the particular talents of other team members. A team leader must also be able to delegate responsibility, empowering people to do the tasks they have been assigned.

Resource management includes the following capabilities:

- Predicting resource usage (budgeting)
- Tracking and accounting for resource consumption
- Learning how to use resources effectively
- Evaluating the quality of resources used
- Securing resources from abusive use
- Relinquishing resources when no longer needed and obsoleting resources when they can no longer be useful

Project Management

Effectively managing projects is crucial to a systems analyst's job. Information systems development projects range from one-person projects that take very little time and effort to multiperson, multiyear efforts costing millions of dollars. The goal of project management is to prevent projects from coming in late and going over budget. In addition, project management is designed to help managers keep track of the project's progress.

Even if you are not a project leader, you will be given responsibilities for parts of a project, or subprojects. In the role of project or subproject manager, you first need to decompose a (sub)project into several independent tasks. The next step is to determine how the tasks are related to each other and who will be responsible for each task. As you saw in Chapter 3, analysts use established tools and techniques to help manage projects. The most important element, however, is managing the people working on the project. Successful analysts motivate people to work together and instill a sense of trust and interdependence among them. Project management extends beyond the organization to any vendors or contractors working on the project.

In today's development environment, many aspects of a project may be farmed out to various contractors outside the organization. Using independent contractors has many advantages. A particular contractor may be more skilled than internal personnel in a technology or may be less expensive. If a project is short on time, it may also make sense to contract out some parts of a development project to help speed up the overall process. Many times, however, contractors deliver work that is late or of low quality or that does not meet requirements. If the system requirements are unstable or not well defined, the potential problems with contractors can be exaggerated. For these reasons, it is just as important to manage outside contractors as it is to manage everyone else involved in a project. Two mechanisms that help manage contractors are contracts and relationship managers. Very well-specified contracts that spell out exactly what is expected and when and that lay out explicit sanctions for nonperformance may motivate contractors to perform to expectations. In addition, very explicit contracts may scare off contractors who know that they cannot live up to such a contract's terms. Relationship managers act as liaisons between your firm and the contractors. By establishing personal relationships with the parties involved, relationship managers may be in a position to sense trouble before it happens and work with both parties toward reasonable settlements.

Risk Management

Risk management is the ability to anticipate what might go wrong in a project. Once risks to the project have been identified, you must be able to minimize the likelihood that those risks will actually occur. If minimizing risk is not possible, then you try to minimize the damage that might result. Risk management also includes knowing where to place resources (such as people) where they can do the most good and prioritizing activities to achieve the greatest gain.

Change Management

Introducing a new or improved information system into an organization is a change process. In general, people do not like change and tend to resist it; therefore, any change in how people perform their work in an organization must be carefully managed. Change management, then, is a very important skill for systems analysts, who are organizational change agents. You must know how to get people to make a smooth transition from one information system to another, giving up their old ways of doing things and accepting new ways. Change management also includes the ability to deal with technical issues related to change, such as obsolescence and reusability.

INTERPERSONAL SKILLS

Although, as a systems analyst, you will be working in the technical area of designing and building computer-based information systems, you will also work extensively with all types of people. Perhaps the most important skills you will need to master are interpersonal ones. In this part of the appendix, we will discuss the various interpersonal skills necessary for successful systems analysis work: communication skills, working alone and with a team, facilitating groups, and managing expectations of users and managers.

Communication Skills

The single most important interpersonal skill for an analyst, as well as for any professional, is the ability to communicate clearly and effectively with others. Analysts should be able to successfully communicate with users, other information systems professionals, and management. Analysts must establish a good, open working relationship with clients early in the project and maintain it throughout by communicating effectively.

Communication takes many forms, from written (memos, reports) to verbal (phone calls, face-to-face conversations) to visual (presentation slides, diagrams). The analyst must be able to master as many forms of communication as possible. Oral communication and listening skills are considered by many information system professionals as the most important communication skills analysts need to succeed. Interviewing skills are not far behind. All types of communication, however, have one thing in common: They improve with experience. The more you practice, the better you get. Some of the specific types of communication we will mention are interviewing and listening, and written and oral presentations.

Interviewing and Listening Interviewing is one of the primary ways analysts gather information about an information systems project. Early in a project, you may spend a large amount of time interviewing users about their work and the information they use. There are many ways to effectively interview someone, and becoming a good interviewer takes practice. It is important to point out that asking questions is only one part of interviewing. Listening to the answers is just as important, if not more so. Careful listening, helps you understand the problem you're investigating and, many times, the answers to your questions will lead to additional questions that may be even more revealing and probing than the questions you prepared before your interview.

Written and Oral Presentations At many points during the systems development process, you must document the progress of the project and communicate that progress to others. This communication takes the following forms:

- Meeting agenda
- Meeting minutes
- Interview summaries
- Project schedules and descriptions
- Memoranda requesting information, an interview, participation in a project activity, or the status of a project
- Requests for proposal from contractors and vendors

A variety of other documents are also possible. This documentation is essential to provide a written, not just an oral, history for the project, to convey information clearly, to provide details needed by those who will maintain the system after you are off the project team, and to obtain commitments and approvals at key project milestones.

The larger the organization and the more complicated the systems development project are, the more writing you will have to do. You and your team members will have to complete and file a report at the end of each stage of the systems development life cycle. The first report will be the business case for getting approval to start the project. The last report may be an audit of the entire development process. And at each phase, the analysis team will have to document the system as it evolves. To be effective, you need to write both clearly and persuasively.

Because many different parties often are involved in the development of a system, there are many opportunities to inform people of the project's status. Periodic written status reports are one way to keep people informed, but there will also be unscheduled calls for ad hoc reports. Many projects will also involve scheduled and unscheduled oral presentations. Part of oral presentations involves preparing slides, overhead transparencies, or multimedia presentations, including system demonstrations. Another part involves being able to field and answer questions from the audience.

How can you improve your communication skills? We have four simple yet powerful suggestions:

1. Take every opportunity to practice. Speak to a civic organization about trends in computing. Such groups often look for local speakers to present talks on topics of general interest. Conduct a training class on some topic on which you have special expertise. Some people have found participation in Toastmasters, an international organization with local chapters, a very helpful way to improve oral communication skills.
2. Videotape your presentations and do a critical self-appraisal of your skills. You can view videotapes of other speakers and share your assessments with each other.
3. Make use of writing centers located at many colleges as a way to critique your writing.
4. Take classes on business and technical writing from colleges and professional organizations.

Working Alone and with a Team

As a systems analyst, you must often work alone on certain aspects of any systems development project. To this end, you must be able to organize and manage your own schedule, commitments, and deadlines. Many people in the organization will depend on your individual performance, yet you are almost always a member of a team and must work with the team toward achieving project goals. As we saw earlier in the appendix, working with a team entails a certain amount of give and take. You need to know when to trust the judgment of other team members as well as when to question it. For example, when team members are speaking or acting from their base of experience and expertise, you are more likely to trust their judgment than when they are talking about something beyond their knowledge. For this reason, the analyst leading the team must understand the strengths and weaknesses of the other team members. To work together effectively and to ensure the quality of the group product, the team must establish standards of cooperation and coordination that guide their work (review Table A1-3 for the characteristics of a successful team).

Several dimensions of cooperation and coordination influence teamwork. Table A1-3 lists the twelve characteristics of a high-performance team (McConnell, 1996). The first characteristic is a shared vision, which allows each team member to have a clear understanding of the project's objectives. A shared vision helps team members keep their priorities straight and not allow small items of little significance to become overwhelming and distracting. To provide motivation, the vision also needs to present a challenge to team members. The second characteristic, team identity, emerges as team members work together closely and begin to share a common language and sense of humor. Team identity can lead to the synergy of effort only possible when groups work together well.

Shared vision and team identity are important, but they alone may not be enough for a team to actually accomplish something. The third characteristic of high-performance teams is how the teams are organized. A result-driven structure is

TABLE A1-3 Characteristics of a High-Performance Team (McConnell, 1996)

1. Shared, elevated vision or goal
2. Sense of team identity
3. Result-driven structure
4. Competent team members
5. Commitment to the team
6. Mutual trust
7. Interdependence among team members
8. Effective communication
9. Sense of autonomy
10. Sense of empowerment
11. Small team size
12. High level of enjoyment

(*Source:* Adapted with the permission of The Microsoft Press. All rights reserved.)

one that depends on clear roles, effective communication systems, means of monitoring individual performance, and decision making based on facts rather than emotions. Choosing the right people for the team is the fourth characteristic. McConnell (1996) reports that team performance may differ by as much as a factor of five, depending only on the skills and attitudes of a team's members. Although the skills of each team member are important determinants of how well the team will perform, all members must be committed to the team, the fifth characteristic of high-performance teams. A group of the best and brightest individuals, committed only to their own self-interests, cannot outperform a true team of lesser talents who are genuinely committed to each other and to their joint effort.

The next five characteristics of high-performance teams all have to do with how the team members interact with each other. It is very important that team members develop genuine trust for each other. The need for trust is why you see so many team-building exercises; for example, an individual falls backwards into the arms of a fellow team member, not knowing if the other person is really there but trusting that he or she will be. Similarly, members of high-performance teams work interdependently, relying on each others' strengths; develop effective means of communication; give each team member the autonomy to do whatever he or she believes is best for the team and for the project; and empower each team member.

All of these high-performance characteristics seem to work best, according to McConnell (1996), in small teams no larger than eight to ten people. Finally, it is important that teams have fun. When team members enjoy working together, team cohesiveness is increased, which has been shown to be a key ingredient of team productivity (Lakhanpal, 1993).

Facilitating Groups

Sometimes you need to interact with a group in order to communicate and receive information. In Chapter 1, we introduced you to the Joint Application Design (JAD) process in which analysts actively work with groups during systems development. Analysts use JAD sessions to gather systems requirements and to conduct design reviews. The assembled group is the most important resource the analyst has access to during a JAD, and you must get the most out of that resource. Successful group facilitation is one way to do that. In a typical JAD, there is a trained session leader running the show. He or she has been specially trained to facilitate groups, to help them work together, and to help them achieve their common goals. Facilitation necessarily involves a certain amount of neutrality on the part of the facilitator. The facilitator must guide the group without being part of the group and must work to keep the effort on track by ferreting out disagreements and helping the group resolve differences.

Figure A1-11
Some guidelines for running effective meetings (Adapted from Option Technologies, Inc. (1992)
(Source: Option Technologies, Inc. (1992). Just-in-Time Knowledge for Teams. *Mendotta Heights, MN.)*

- Become comfortable with your role as facilitator by gaining confidence in your ability, being clear about your purpose, and finding a style that is right for you.
- At the beginning of the meeting, make sure the group understands what is expected of them and of you.
- Use physical movement to focus on yourself or on the group, depending on which is called for at the time.
- Reward group member participation with thanks and respect.
- Ask questions instead of making statements.
- Be willing to wait patiently for group members to answer the questions you ask them.
- Be a good listener.
- Keep the group focused.
- Encourage group members to feel ownership of the group's goals and of their attempts to reach those goals.

Obviously, group facilitation requires training. Many organizations that rely on group facilitation train their own facilitators. Figure A1-11 lists some guidelines for running an effective meeting, a task that is fundamental to facilitating groups.

Managing Expectations

Systems development is a change process, and any organizational change is greeted with anticipation and uncertainty by organization members. Organization members will have certain ideas, perhaps based on their hopes and wishes, about what a new information system will be able to do for them; these expectations about the new system can easily run out of control. Ginzberg (1981) found that successfully managing user expectations is related to successful systems implementation. For you to successfully manage expectations, you need to understand the technology and what it can do. You must understand the work flows that the technology will support and how the new system will affect them. More important than understanding, however, is your ability to communicate a realistic picture of the new system and what it will do for users and managers. Managing expectations begins with the development of the business case for the system and extends all the way through training people to use the finished system. You need to educate those who have few expectations as well as temper the optimism of those who expect the new system to perform miracles.

SYSTEMS ANALYSIS AS A PROFESSION

Even though systems analysis is a relatively new field, those in the field have established standards for education, training, certification, and practice. Such standards are required for any profession.

Whether or not systems analysis is a profession is open to debate. Some feel that systems analysis is not a profession because it simply has not been around long enough to have established the rigorous standards that define a profession. Others feel that at least some standards are already in place. There are guidelines for college curricula, and there are standard ways of analyzing, designing, and implementing systems. Professional societies that systems analysts may join include the Society for Information Management, the Association of Information Technology Professionals, and the Association for Computing Machinery (ACM). There is a Certified Computing Professional (CCP) exam, much like the Certified Public Accountant (CPA) exam, that you can take to prove your competency in the field, although, unlike the CPA certificate, very few jobs and employers in the IS field require you to have the CCP certificate. Codes of ethics to govern behavior also exist. In this section, we will discuss several aspects of a systems analyst's job:

standards of practice, the ACM code of ethics, and career paths for those choosing to become systems analysts.

Standards of Practice

Standard methods or practices of performing systems development are emerging that are making systems development less of an art and more of a science. Standards are developed through education and practice and spread as systems analysts move from one organization to another. We will focus here on four standards of practice: an endorsed development methodology, approved development platforms, well-defined roles for people in the development process, and a common language.

Several different development methodologies are now in use in organizations. Although no single, standard methodology is in use across all organizations, a few prominent methodologies are in common use. An *endorsed development methodology* lays out specific procedures and techniques to be used during the development process. These standards are central to promoting consistency and reliability in methods across all of an organization's development projects. Some methodologies are spread through the work of well-known consultants; others are spread by major consulting firms.

Closely associated with endorsed methodologies are *approved development platforms*. Some methodologies are closely tied to platforms, whereas others are more adaptable and can work in close accordance with development platforms that exist in the organization, such as database management systems and fourth-generation languages (4GLs). The point is that organizations, and hence the analysts who work for them, are standardizing around specific platforms, and standards for development emerge from this standardization.

Roles for the various people involved in the development process are also becoming standardized. End users, managers, and analysts are each assigned certain responsibilities for development projects. The training that analysts receive in college, on their first jobs, and during their interactions with other analysts combine to create the gestalt of the analyst's job. For example, as you study this book and talk about systems development in your class, you are forming certain ideas about what systems analysts do and how systems are developed in organizations. Your ideas are also shaped and reinforced by the other IS courses you take in college. Once you get your first job, you will receive additional training, and you will adjust your understanding of systems analysis accordingly. As you gain experience working on projects and interacting with other analysts, who may have been trained at other universities and in other organizations, your ideas will continue to change and grow, but the basic core of what systems analysis means to you will have been established. Many of the experiences you have on the job will reinforce much of what you have already learned about systems analysis. When you leave an organization and go to work elsewhere, you will carry your understanding of systems analysis with you. Over time, as you and other analysts change jobs and move from one organization to another, what it means to be an analyst becomes standardized across organizations, and the standards of practice in the field help define what it means to be an analyst.

Another factor moving the job of the systems analyst toward professionalism is the development of a common language analysts use to talk to each other. Analysts communicate on the job, at meetings of professional societies, and through publications. As analysts develop a special language for communication amongst themselves, their language becomes standardized. One example is the Unified Modeling Language (UML), which has emerged as a common way to specify and design information systems based on the object-oriented approach (see Chapter 1 and Appendix C). Other examples of standardized communication include the widespread use of common programming languages such as Java and C and the spread of SQL as the language of choice for data definition and manipulation for relational databases. As their common language develops, analysts become more cohesive as a group—a characteristic of professions.

Ethics

The ACM is a large professional society made up of information system professionals and academics. It has over 85,000 members. Founded in 1947, the ACM is dedicated to promoting information processing as an academic discipline and to encouraging the responsible use of computers in a wide range of applications. Because of its size and membership, it has much influence in the information systems community. The ACM has developed a code of ethics for its members called the "ACM Code of Ethics and Professional Conduct." The full statement is reproduced in Figure A1-12. The code applies to all ACM members and directly applies to systems analysts.

Note the emphasis of the code on personal responsibility, honesty, and respect for relevant laws. Notice also that compliance with a code of ethics such as this one is voluntary, although article 4.2 calls for, at a minimum, peer pressure for compliance. No one can force an information systems professional to follow these guidelines. However, it is voluntary compliance with the guidelines that makes someone a professional in the first place. Notice that for leaders there is the burden of educating non-IS professionals about computing—about what computing can and cannot do. The code also expresses concern for the quality of work life and for protecting the dignity and privacy of others when performing professional work, such as developing information systems.

Though not written specifically for systems analysts, the ACM Code of Ethics can easily be adapted to the systems analysis job. Many systems development projects deal directly with many of the issues addressed in the code: privacy, quality of work life, user participation, and managing expectations. When an analyst must confront one or more of these issues, the code can be used as a guide for professional conduct.

It is also important to remember that systems analysts work within organizations. Codes of ethics, such as that approved by the ACM, may not provide all of the guidance analysts need for dealing with ethically questionable situations in business organizations. The study of ethics, however, is a complex and sometimes bewildering exercise, so simplified and targeted approaches can be very helpful. One such approach has been developed by Smith and Hasnas (1999) for business managers, but it can be usefully applied by information systems professionals as well.

Smith and Hasnas describe three different ways to view business problems with ethical considerations. The first is the stockholder approach, which holds that any action taken by a business is ethically acceptable as long as it is legal, not deceptive, and maximizes profits for stockholders.

The second view is the stakeholder approach. A stakeholder is not the same as a stockholder. A stakeholder, like a stockholder, may own part of the firm, but a stakeholder typically has a greater involvement with the firm than does a stockholder. A stakeholder is either vital to the ongoing operation of the firm or is vitally affected by the actions of the firm. According to the stakeholder approach, you first have to determine who your stakeholders are. Then every action you are considering that violates the rights of any one of these stakeholders must be rejected. Only actions that best balance the rights of the different stakeholder groups can be taken by the firm.

The third approach is called the social contract approach. The focus of this approach is much broader than the other two, as it extends beyond stockholders and stakeholders to members of society at large. Any actions potentially taken by the firm that are deceptive, that could dehumanize employees, or that could discriminate must be rejected outright. Further, any potential actions that could reduce the welfare of the members of society must also be eliminated. Only then can actions that would enhance the financial liability of the firm be considered. Table A1-4 lists the key ethical obligations of anyone employing one of these three approaches.

Association for Computing Machinery Professional Code of Ethics

Preamble

Commitment to ethical professional conduct is expected of every member (voting members, associate members, and student members) of the Association for Computing Machinery (ACM).

This Code, consisting of 24 imperatives formulated as statements of personal responsibility, identifies the elements of such a commitment. It contains many, but not all, issues professionals are likely to face. Section1 outlines fundamental ethical considerations, while Section 2 addresses additional, more specific considerations of professional conduct. Statements in Section 3 pertain more specifically to individuals who have a leadership role, whether in the workplace or in a volunteer capacity such as with organizations like ACM. Principles involving compliance with this Code are given in Section 4.

(1.0) General Moral Imperatives

(As an ACM member I will . . .)

(1.1) Contribute to society and human well-being.
(1.2) Avoid harm to others.
(1.3) Be honest and trustworthy.
(1.4) Be fair and take action not to discriminate.
(1.5) Honor property rights including copyrights and patents.
(1.6) Give proper credit for intellectual property.
(1.7) Respect the privacy of others.
(1.8) Honor confidentiality.

(2.0) More Specific Professional Responsibilities

(As an ACM computing professional I will . . .)

(2.1) Strive to achieve the highest quality, effectiveness, and dignity in both the process and products of professional work.
(2.2) Acquire and maintain professional competence.
(2.3) Know and respect existing laws pertaining to professional work.
(2.4) Accept and provide appropriate professional review.
(2.5) Give comprehensive and thorough evaluations of computer systems and their impacts, including analysis of possible risks.
(2.6) Honor contracts, agreements, and assigned responsibilities.
(2.7) Improve public understanding of computing and its consequences.
(2.8) Access computing and communication resources only when authorized to do so.

(3.0) Organizational Leadership Imperatives

(As an ACM member and an organizational leader I will . . .)

(3.1) Articulate social responsibilities of members of an organizational unit and encourage full acceptance of those responsibilities.
(3.2) Manage personnel and resources to design and build information systems that enhance the quality of working life.
(3.3) Acknowledge and support proper and authorized uses of an organization's computing and communication resources.
(3.4) Ensure that users and those who will be affected by a system have their needs clearly articulated during the assessment and design of requirements; later the system must be validated to meet requirements.
(3.5) Articulate and support policies that protect the dignity of users and others affected by a computing system.
(3.6) Create opportunities for members of the organization to learn the principles and limitations of computer systems.

(4.0) Compliance with the Code

(As an ACM member I will . . .)

(4.1) Uphold and promote the principles of this Code.
(4.2) Treat violations of this code as inconsistent with membership in the ACM.

Figure A1-12
ACM Code of Ethics and Professional Conduct

(Source: ACM Code of Ethics and Professional Conduct. Revision Draft No. 19 (9/19/91). Copyright © 1972, 1992, used by permission.)

TABLE A1-4 Comparison of Ethical Obligations for Three Different Approaches to Business Ethics (from Smith and Hasnas, 1999)

Stockholder	*Stakeholder*	*Social Contract*
• Conform to laws and regulations • Avoid fraud and deception • Maximize profits	• Determine who are relevant stakeholders • Determine rights of each; reject options that violate these • Accept remaining option that best balances interests of stakeholders	• Reject actions that are fraudulent/deceptive, dehumanize employees, or involve discrimination • Eliminate options that reduce welfare of society's members • Choose remaining option that maximizes probability of financial success

(*Source:* Adapted with permission of *MIS Quarterly.*)

The best way to compare these three approaches is to look at how they could be applied to a business situation. Smith and Hasnas (1999) supply just such an example. In December 1990, Blockbuster Entertainment Corporation announced a plan to sell the rental history of its customers to direct marketers. (Federal law prohibits the disclosure of the titles of videos that people rent, but it is legal to disclose the categories of videos that one rents.) Blockbuster scuttled the plan in response to public outcry. However, the Blockbuster case provides a good example for comparing the three approaches to business ethics.

Under the stockholder approach, Smith and Hasnas say the Blockbuster plan would have been ethically acceptable. It was legal and not deceptive, and the income from selling rental histories would have added to Blockbuster's profits. Under the stakeholder approach, the different stakeholder groups would have to be identified first, and then the effects of the plan on each group would have to be determined and compared to the effects on other groups. If, for example, the plan resulted in limited income and severely inconvenienced customers, say, for example, in terms of all the junk mail they would receive from the direct marketers who purchased their rental histories, then the plan would probably not be ethically acceptable. However, if the plan generated lots of new revenue and customers were only slightly inconvenienced, then the plan might well be ethically acceptable. Finally, using the social contract approach, the plan to sell rental histories would probably not be ethically acceptable. The primary reason for this determination, according to Smith and Hasnas (1999), is that neither Blockbuster employees nor customers would benefit in any material way from the implementation of the plan.

Although this example is greatly simplified, it does illustrate well the types of ethical dilemmas confronting information technology professionals. It also does a very good job in showing how the ethics of a situation depends greatly on the ethical approach taken to examine the issue in the first place.

Career Paths

Currently, there are many different opportunities for a recent college graduate with a degree in management information systems (MIS). Traditionally, most recent graduates took jobs as systems analysts or programmer/analysts with large consulting firms. Many still do. But the traditional path has changed in the past few years. We explore below some of the many alternatives available to information technology specialists, but first we discuss the consulting option, which remains viable and attractive.

The information systems business at consulting firms has been growing at double-digit levels over the past decade, creating a need for hundreds, if not thousands, of MIS graduates. Typically, if you are hired by a consulting firm, the first thing you do is report for extensive and intensive training in the tools and technologies the firm uses. Most of these firms have their own campuses where they train new recruits. After training, you would be assigned to a project. The project may or may not be close to the city you have chosen as your base.

As a junior consultant, your job would involve lots of travel, and you would be involved in many projects over the years. You would be exposed to many different organizations, technologies, industries, and systems. One type of system consulting firms have been heavily involved with lately has been ERP systems. These systems are so large and complex that organizations seeking to implement them need the expert help only experienced consulting firms can provide. Once you had been working for the firm for a while, if you were successful, you would have to decide if you wanted to compete for a partner position. Unlike corporations, where stockholders own the company, most consulting firms are organized as partnerships, where the partners own the company. As you might imagine, there are not many partnerships available, and competition for them is fierce. Many consulting firm employees decide not to compete for a partner position. Instead, many go to work for client firms or start their own small consulting firms.

NET SEARCH
Most professional societies and some organizations have codes of ethics for their members. Visit www.prenhall.com/hoffer to complete an exercise on this topic.

Another opportunity available to you is to work in the information systems shop of a corporation. The work is very similar to what you would do as an analyst for a consulting firm, except that your clients all work for the same corporation as you do. This does not mean you won't have to travel. Large corporations have plants and offices all over the world, so you might have to travel to these distant locations as part of your job. You would not be exposed to as many different types of systems and technologies as would be the case if you worked for a consulting firm, but instead, you would have the chance to gain deep expertise in the technologies the corporation has chosen to use. You would also have the opportunity, if you chose, to become a division or department manager in the information systems shop. You might also decide you wanted to become the corporation's Chief Information Officer, or CIO. Until very recently, most corporations chose not to hire new graduates right out of school for their information systems shops, but that is no longer the case for many organizations.

Finally, considering that so many systems organizations use application packages developed by software vendors, there are many opportunities available for the recent MIS graduate in the software industry. The software industry is a massive, multibillion dollar a year industry, so the variety of opportunities is vast, ranging from a job with a large established firm like Microsoft to working for an Internet start-up. Working for a software vendor, you would work on developing and testing information systems, just as would be the case in a consulting firm or corporation, but unlike those jobs, you would rarely ever see or talk with the end user of the system you develop. Opportunities exist for you to move up in the company or to use what you have learned to start your own software development firm.

Not all recent MIS graduates become systems analysts, however. There are many other types of information technology jobs that make use of the skills you will acquire as part of completing an MIS degree. Among the other opportunities now available for recent MIS graduates are the following:

- Network administration, which involves installing, managing, monitoring, and upgrading the firm's internal data and communication networks
- Technical support specialist, which involves troubleshooting, customer service, hardware and/or software installation, and systems maintenance (ITAA, 2003)
- Help desk support, in which you attempt to solve user problems and answer user questions about systems they rely on
- E-business and multimedia product and service development, where you help migrate existing systems to the Internet as well as develop new applications that take advantage of trends in electronic business

- Decision support analyst, in which you design database queries and data analysis routines to support business analysis and decision making, often for one department, such as market research or investments
- Data warehouse specialist, which involves converting massive amounts of historical data to aggregated data useful for decision support
- Quality assurance specialist, in which you review and test software to make sure it is as error-free as possible

Obviously, not all of these opportunities will exist in every company that uses information technology. Not every firm will have a need for data warehouse specialists or systems analysts. At the beginning of 2003, of the 10.3 million IT workers employed in the United States, 2.1 million were programmers or software engineers, a designation that includes systems analysts (ITAA, 2003). Another million worked on enterprise systems, another million were database developers or administrators, and almost 900,000 were Web developers or administrators. The remaining 5.3 million IT workers were in technical support, network administration, digital media, technical writing, or some other related area. In short, the opportunities are widespread, regardless of which particular area of the information technology profession you decide to pursue.

NET SEARCH
MIS graduates have many career options. Visit www.prenhall.com/hoffer to complete an exercise on this topic.

Summary

In this appendix, we have surveyed the skills necessary for success as a systems analyst. The requisite skills are analytical, technical, management, and interpersonal. Analytical skills include the concept of systems thinking, which is one of the most important skills an analyst can learn. Systems thinking provides a disciplined foundation on which all other analyst skills can build. In addition, an analyst needs to understand the nature of business and of the particular enterprise he or she serves and to be able to identify, analyze, and solve problems.

Technical skills change over time as technology changes, and analysts need to keep current with changing information technology. This can be accomplished through reading trade journals, joining professional societies, attending or teaching classes, attending conferences, and participating in electronic bulletin boards and news groups. Some technology areas that play a continuing important role are programming languages, operating systems, database management systems, data communications, and systems development techniques and tools.

A useful skill is the ability to manage resources, projects, risk, and change. Interpersonal skills, especially clear communication, are also important. Analysts communicate with team members in interviews, with questionnaires, through written and oral presentations, and through facilitating groups. A key component of communicating about information systems is managing the expectations of both users and managers.

The appendix concluded with an examination of the system analyst's position, the standards of practice, the ACM Code of Ethics, and possible career paths. Systems analysis is becoming more of a science and less of an art as the systems analysis field becomes a profession.

Key Terms

1. Boundary
2. Closed system
3. Cohesion
4. Component
5. Constraints
6. Coupling
7. Decomposition
8. Environment
9. Input
10. Interface
11. Interrelated components
12. Logical system description
13. Modularity
14. Open system
15. Output
16. Physical system description
17. Purpose
18. Stakeholder
19. System

Match each of the key terms above with the definition that best fits it.

____ A system that is cut off from its environment and does not interact with it.

____ An interrelated set of components with an identifiable boundary working together for some purpose.

____ An irreducible part or aggregation of parts that make up a system, also called a subsystem.

____ A person who has an interest in an existing or new information system.

____ Dependence of one part of the system on one or more other system parts.

____ The line that marks the inside and outside of a system and that sets off the system from its environment.

____ The overall goal or function of a system.

____ Whatever a system returns to its environment in order to fulfill its purpose.

____ Everything external to a system that interacts with the system.

____ Point of contact where a system meets its environment or where subsystems meet each other.

____ A limit to what a system can accomplish.

____ Dividing a system up into chunks or modules of a relatively uniform size.

____ The extent to which subsystems depend on each other.

____ The extent to which a system or subsystem performs a single function.

____ Whatever a system takes from its environment in order to fulfill its purpose.

____ Description of a system that focuses on the system's function and purpose without regard to how the system will be physically implemented.

____ A system that interacts freely with its environment, taking input and returning output.

____ Description of a system that focuses on how the system will be materially constructed.

____ The process of breaking down a system into smaller and less complex pieces that are easier to understand.

Review Questions

1. What are the organizational roles associated with systems development? Describe the responsibilities for each role.
2. What is systems thinking? How is it useful for thinking about computer-based information systems?
3. What is decomposition? Coupling? Cohesion?
4. In what way are organizations systems?
5. What are the differences between problem identification and problem solving?
6. How can a systems analyst determine if his or her technical skills are up-to-date?
7. Explain the management skills needed by systems analysts.
8. Which communication skills are important for analysts? Why?
9. Is systems analysis a profession? Why or why not?
10. What is a code of ethics?
11. What's the difference between a logical system description and a physical system description?
12. Which areas of organizational knowledge are important for a systems analyst to know?
13. How do open and closed systems differ?
14. What kinds of tasks are included in resource management?
15. Why is an information system sometimes developed by independent contractors?
16. What are the twelve characteristics of high-performance teams? Compare Table A1-1 with Table A1-3. What differences do you see between these two tables?

Problems and Exercises

1. Describe your university or college as a system. Identify each of the following: inputs, outputs, boundary, components, component interrelationships, constraints, purpose, interfaces, and environment. Draw a diagram of this system.
2. Analyze the following systems.
   a. A car is a system with several subsystems, including the braking subsystem, the electrical subsystem, the engine, the fuel subsystem, the climate-control subsystem, and the passenger subsystem. Draw a diagram of a car as a system and label all of its system characteristics.
   b. Your personal computer is a system. Draw a diagram of a personal computer as a system and label all of its system characteristics.
3. Describe yourself in terms of your abilities at resource, project, risk, and change management. Among these categories, what are your strengths and weaknesses? Why? How can you best capitalize on your strengths and strengthen

areas in which you are weak? If you do not have managerial or supervisory experience, answer these questions as if you were generalizing from your experiences thus far to your performance later as a manager.

4. Describe yourself in terms of your abilities at each of the following interpersonal skills: working alone versus working with a team, interviewing, listening, writing, presenting, facilitating a group, and managing expectations. Where are your strengths and weaknesses? Why? What can you do to capitalize on your strengths and strengthen areas in which you are weak?
5. Use your imagination and hypothesize what a systems analyst would be like if he or she were a person with no personal or professional ethics. What types of systems would that person help to create? How might that person go about building such systems? What would the consequences of these actions be for the analyst, for his or her information systems department, for his or her users, and for the organization? Specifically, how would a code of ethics and professional conduct help curb the behavior of this person? This may seem like a silly exercise, but even your wildest guesses about the things an unethical analyst might do have probably happened in some setting.
6. You likely receive (and pay) one or more bills each month or semester (e.g., tuition, rent, utilities, or telephone). Describe one of these billing systems as an information system. Be sure to list at least one example of each of the nine characteristics of a system for your example billing system.
7. The appendix mentioned that choosing the boundary for a system is a crucial step in analyzing and studying a system. What criteria would you use to determine where to draw a system boundary? What are the ramifications of setting too broad a boundary? Too narrow a boundary?
8. Make a list of the technical skills you have developed at school, as part of any job you've held, and on your own. Using newspaper want ads, trade journals, and other sources, determine if your technical skills are up-to-date. If not, devise a plan to update your technical skills.
9. Recall a team on which you have worked in a job or course project. How well did this team follow the twelve characteristics of high-performance teams? How could you have improved the performance of this team?
10. How might the roles of systems analysts and others in systems development change if contractors are used on a project? Which of these roles might a contractor provide?
11. Figure A1-13 contains the code of ethics for the Association of Information Technology Professionals (AITP). Compare it with the ACM Code of Ethics (Figure A1-12) on a point-by-point basis. You may want to go to each group's Website to get more detailed information on their respective codes of ethics (www.acm.org and www.aitp.org).

Figure A1-13
The Code of Ethics of the AITP
(Source: AITP. Used with permission.)

Code of Ethics

I acknowledge:

That I have an obligation to management, therefore, I shall promote the understanding of information processing methods and procedures to management using every resource at my command.

That I have an obligation to my fellow members, therefore, I shall uphold the high ideals of AITP as outlined in the Association Bylaws. Further, I shall cooperate with my fellow members and shall treat them with honesty and respect at all times.

That I have an obligation to society and will participate to the best of my ability in the dissemination of knowledge pertaining to the general development and understanding of information processing. Further, I shall not use knowledge of a confidential nature to further my personal interest, nor shall I violate the privacy and confidentiality of information entrusted to me or to which I may gain access.

That I have an obligation to my College or University, therefore, I shall uphold its ethical and moral principles.

That I have an obligation to my employer whose trust I hold, therefore, I shall endeavor to discharge this obligation to the best of my ability, to guard my employer's interests, and to advise him or her wisely and honestly.

That I have an obligation to my country, therefore, in my personal, business, and social contacts, I shall uphold my nation and shall honor the chosen way of life of my fellow citizens.

I accept these obligations as a personal responsibility and as a member of this Association. I shall actively discharge these obligations and I dedicate myself to that end.

Field Exercises

1. Describe an organization of your choice as an open system. What factors lead you to believe that this system is open? Describe the organization in terms of decomposition, coupling, cohesion, and modularity. What is beneficial about thinking of the organization in this way?
2. Think about a problem you have, perhaps with a grade in a class, with a job you're not satisfied with, or with a coworker on the job. Describe the problem as a difference between "what is" and "what should be." What must happen to shift your situation from "what is" to "what should be" to bring about a situation that you are satisfied with? What specific actionable steps must you take to make this change happen? What information, if any, will you need to gather about this situation? From where and/or from whom must the information come? How can you get this information?
3. Choose a manager you know in any area and describe this person in terms of his or her abilities at resource, project, risk, and change management. Overall, is he or she successful or not? Why or why not?
4. Investigate where on your campus and in your community you could go to get help and practice with public speaking. Talk with other students, contact your instructors, look in the telephone book and directory of services at your college, and explore avenues to uncover as many sources of public speaking help as you can find.
5. Many organizations have an approved technology list from which units are free to purchase hardware and software for application development. Contact the computing services unit at your college (or other organization) and find out what hardware and software are supported on your campus for administrative computing. Given this list of supported technologies, what would you infer are the technical skills required for a systems analyst at your college (or other organization)?

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