CHAPTER 3

REQUIREMENTS DETERMINATION

One of the first activities of an analyst is to determine the business requirements for a new system. This chapter begins by presenting the requirements definition, a document that lists the new system's capabilities. It then describes how to analyze requirements using business process automation, business process improvement, and business process reengineering techniques and how to gather requirements using interviews, JAD sessions, questionnaires, document analysis, and observation. The chapter also describes a set of alternative requirements-documentation techniques and describes the system proposal document that pulls everything together.

OBJECTIVES

- Understand how to create a requirements definition
- Become familiar with requirements-analysis techniques
- Understand when to use each requirements-analysis technique
- Understand how to gather requirements using interviews, JAD sessions, questionnaires, document analysis, and observation
- Understand the use of concept maps, story cards, and task lists as requirements-documentation techniques
- Understand when to use each requirements-gathering technique
- Be able to begin creating a system proposal

CHAPTER OUTLINE

INTRODUCTION

The systems development process aids an organization in moving from the current system (often called the *as-is system*) to the new system (often called the *to-be system*). The output of planning, discussed in **Chapter 2**, is the system request, which provides general ideas for the to-be system, defines the project's scope, and provides the initial workplan. Analysis takes the general ideas in the system request and refines them into a detailed requirements definition (this chapter), functional models (**Chapter 4**), structural models (**Chapter 5**), and behavioral models (**Chapter 6**) that together form the *system proposal*. The system proposal also includes revised project management deliverables, such as the feasibility analysis and the workplan (**Chapter 2**).

The system proposal is presented to the approval committee, who decides if the project is to continue. This usually happens at a system *walk-through*, a meeting at which the concept for the new system is presented to the users, managers, and key decision makers. The goal of the walk-through is to explain the system in moderate detail so that the users, managers, and key decision makers clearly understand it, can identify needed improvements, and can make a decision about whether the project should continue. If approved, the system proposal moves into design, and its elements (requirements definition and functional, structural, and behavioral models) are used as inputs to the steps in design. This further refines them and defines in much more detail how the system will be built.

The line between analysis and design is very blurry. This is because the deliverables created during analysis are really the first step in the design of the new system. Many of the major design decisions for the new system are found in the analysis deliverables. In fact, a better name for analysis is really analysis and initial design, but because this is a rather long name and because most organizations simply call it analysis, we do

too. Nonetheless, it is important to remember that the deliverables from analysis are really the first step in the design of the new system.

In many ways, because it is here that the major elements of the system first emerge, the requirements-determination step is the single most critical step of the entire system development process. During requirements determination, the system is easy to change because little work has been done yet. As the system moves through the system development process, it becomes harder and harder to return to requirements determination and to make major changes because of all of the rework that is involved. Several studies have shown that more than half of all system failures are due to problems with the requirements.[1] This is why the iterative approaches of many object-oriented methodologies are so effective—small batches of requirements can be identified and implemented in incremental stages, allowing the overall system to evolve over time. In this chapter, we focus on the requirements workflow of the Unified Process. We begin by explaining what a requirement is and the overall process of requirements gathering and requirements analysis. We then present a set of techniques that can be used to analyze and gather requirements.

REQUIREMENTS DETERMINATION

The purpose of *requirements determination* is to turn the very high-level explanation of the business requirements stated in the system request into a more precise list of requirements that can be used as inputs to the rest of analysis (creating functional, structural, and behavioral models). This expansion of the requirements ultimately leads to the design of the system. However, the most difficult aspect of determining the actual requirements is analogous to the story of the blind men and the elephant (see **Figure 3-1**). In this story, depending on which part of the elephant each blind man touches, each "sees" the elephant differently. In many ways, the analyst is like one of the blind men. Depending on which part of the proverbial elephant the analyst touches, the analyst sees the requirements differently. Also, like the blind men, the analyst may only be able to perceive the individual part in a biased manner. Therefore, the analyst must be on guard to prevent the poor elephant (requirements) from being misrepresented.

It was six men of Indostan
To learning much inclined,
Who went to see the Elephant
(Though all of them were blind),
That each by observation
Might satisfy his mind

The First approached the Elephant,
And happening to fall
Against his broad and sturdy side,
At once began to bawl:
God bless me! but the Elephant
Is very like a wall!

The Second, feeling of the tusk,
Cried, Ho! what have we here
So very round and smooth and sharp?
To me tis mighty clear
This wonder of an Elephant
Is very like a spear!

The Third approached the animal,
And happening to take
The squirming trunk within his hands,
Thus boldly up and spake:

The Fourth reached out an eager hand,
And felt about the knee.
What most this wondrous beast is like
Is mighty plain, quoth he;
'Tis clear enough the Elephant
Is very like a tree!

The Fifth, who chanced to touch the ear,
Said: Even the blindest man
Can tell what this resembles most;
Deny the fact who can
This marvel of an Elephant
Is very like a fan!?

The Sixth no sooner had begun
About the beast to grope,
Than, seizing on the swinging tail
That fell within his scope,
I see, quoth he, the Elephant
Is very like a rope!

And so these men of Indostan
Disputed loud and long,
Each in his own opinion
Exceeding stiff and strong

So oft in theologic wars,
The disputants, I ween,
Rail on in utter ignorance
Of what each other mean,
And prate about an Elephant
Not one of them has seen!

– John Godfrey Saxe

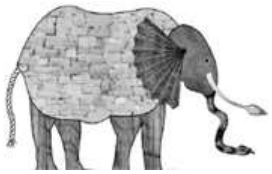


FIGURE 3-1 The Blind Men and the Elephant

Defining a Requirement

A *requirement* is simply a statement of what the system must do or what characteristic it must have. During analysis, requirements are written from the perspective of the businessperson, and they focus on the "what" of the system. Because they focus on the needs of the business user, they are usually called *business requirements* (and sometimes user requirements). Later in design, business requirements evolve to become more technical, and they describe how the system will be implemented. Requirements in design are written from the developer's perspective, and they are usually called *system requirements*.

Before we continue, we want to stress that there is no black-and-white line dividing a business requirement and a system requirement—and some companies use the terms interchangeably. The important thing to remember is that a requirement is a statement of what the system must do, and requirements will change over time as the project moves from inception to elaboration to construction. Requirements evolve from detailed statements of the business capabilities that a system should have to detailed statements of the technical way the capabilities will be implemented in the new system.

Requirements can be either functional or nonfunctional in nature. A *functional requirement* relates directly to a process a system has to perform or information it needs to contain. For example, requirements that state that a system must have the ability to search for available inventory or to report actual and budgeted expenses are functional requirements. Functional requirements flow directly into the creation of functional, structural, and behavioral models that represent the functionality of the evolving system.

Nonfunctional requirements refer to behavioral properties that the system must have, such as performance and usability. The ability to access the system using a Web browser is considered a nonfunctional requirement. Nonfunctional requirements can influence the rest of analysis (functional, structural, and behavioral models) but often do so only indirectly; nonfunctional requirements are used primarily in design when decisions are made about the user interface, the hardware and software, and the system's underlying physical architecture.

Figure 3-2 lists different kinds of nonfunctional requirements and examples of each kind. Notice that the nonfunctional requirements describe a variety of characteristics regarding the system: operational, performance, security, and cultural and political. For example, the project team needs to know if a system must be highly secure, requires sub-second response time, or has to reach a multicultural customer base.

These characteristics do not describe business processes or information, but they are very important in understanding what the final system should be like. Nonfunctional requirements primarily affect decisions that will be made during the design of a system. We will return to this topic later in the book when we discuss design. The goal in this chapter is to identify any major issues.

Four topics that have influenced information system requirements are the Sarbanes-Oxley Act, COBIT (Control OBjectives for Information and related Technology) compliance, ISO 9000 compliance, and Capability Maturity Model compliance. Depending on the system being considered, these four topics could affect the definition of a system's functional requirements, nonfunctional requirements, or both. The Sarbanes-Oxley Act, for example, mandates additional functional and nonfunctional requirements. These include additional security concerns (nonfunctional) and specific information requirements that management must now provide (functional). When developing financial information systems, information system developers should be sure to include Sarbanes-Oxley expertise in the development team. In another example, a client could insist on COBIT compliance, ISO 9000 compliance, or that a specific Capability Maturity Model level had been reached for the firm to be considered as a possible vendor to supply the system under consideration. Obviously,

these types of requirements add to the nonfunctional requirements. Further discussion of these topics is beyond the scope of this book.[2]

Nonfunctional Requirement	Description	Examples
Operational	The physical and technical environments in which the system will operate	■ The system should be able to fit in a pocket or purse. ■ The system should be able to integrate with the existing inventory system. ■ The system should be able to work on any Web browser.
Performance	The speed, capacity, and reliability of the system	■ Any interaction between the user and the system should not exceed 2 seconds. ■ The system should receive updated inventory information every 15 minutes. ■ The system should be available for use 24 hours per day, 365 days per year.
Security	Who has authorized access to the system under what circumstances	■ Only direct managers can see personnel records of staff. ■ Customers can see their order history only during business hours.
Cultural and political	Cultural, political factors and legal requirements that affect the system	■ The system should be able to distinguish between United States and European currency. ■ Company policy says that we buy computers only from Dell. ■ Country managers are permitted to authorize customer user interfaces within their units. ■ The system shall comply with insurance industry standards.

Source: The Atlantic Systems Guild, http://www.systemsguild.com/GuildSite/Robs/Template.html

FIGURE 3-2 Nonfunctional Requirements

Another recent topic that influences requirements for some systems is the whole area of globalization. The idea of having a global information supply chain brings to bear a large number of additional nonfunctional requirements. For example, if the necessary operational environments do not exist for a mobile solution to be developed, it is important to adapt the solution to the local environment. Or, it may not be reasonable to expect to deploy a high-technology-based solution in an area that does not have the necessary power and communications infrastructure. In some cases, we may need to consider some parts of the global information supply chain to be supported with manual—rather than automated—information systems.

YOUR TURN: 3-1 Identifying Requirements

One of the most common mistakes by new analysts is to confuse functional and nonfunctional requirements. Pretend that you received the following list of requirements for a sales system.

Requirements for Proposed System The system should

1. be accessible to the Web users;
2. include the company standard logo and color scheme;
3. restrict access to profitability information;
4. include actual and budgeted cost information;
5. provide management reports;
6. include sales information that is updated at least daily;
7. have two-second maximum response time for predefined queries and ten-minute maximum response time for ad hoc queries;
8. include information from all company subsidiaries;

9. print subsidiary reports in the primary language of the subsidiary;
10. provide monthly rankings of salesperson performance.

Questions

1. Which requirements are functional business requirements? Provide two additional examples.
2. Which requirements are nonfunctional business requirements? What kind of nonfunctional requirements are they? Provide two additional examples.

Manual systems have an entirely different set of requirements that create different performance expectations and additional security concerns. Furthermore, cultural and political concerns are potentially paramount. A simple example that affects the design of user interfaces is the proper use of color on forms (on a screen or paper). Different cultures interpret different colors differently. In other words, in a global, multicultural business environment, addressing cultural concerns goes well beyond simply having a multilingual user interface. We must be able to adapt the global solution to the local realities. Friedman refers to these concerns as glocalization.[3] Otherwise, we will simply create another example of a failed information system development project.

CONCEPTS IN ACTION: 3-A What Can Happen If You Ignore Nonfunctional Requirements

I once worked on a consulting project in which my manager created a requirements definition without listing nonfunctional requirements. The project was then estimated based on the requirements definition and sold to the client for $5,000. In my manager's mind, the system that we would build for the client would be a very simple stand-alone system running on current technology. It shouldn't take more than a week to analyze, design, and build.

Unfortunately, the clients had other ideas. They wanted the system to be used by many people in three different departments, and they wanted the ability for any number of people to work on the system concurrently. The technology they had in place was antiquated; nonetheless, they wanted the system to run effectively on the existing equipment. Because we didn't set the project scope properly by including our assumptions about nonfunctional requirements in the requirements definition, we basically had to do whatever they wanted.

The capabilities they wanted took weeks to design and program. The project ended up taking four months, and the final project cost was $250,000. Our company had to pick up the tab for everything except the agreed-upon $5,000. This was by far the most frustrating project situation I ever experienced.

Barbara Wixom

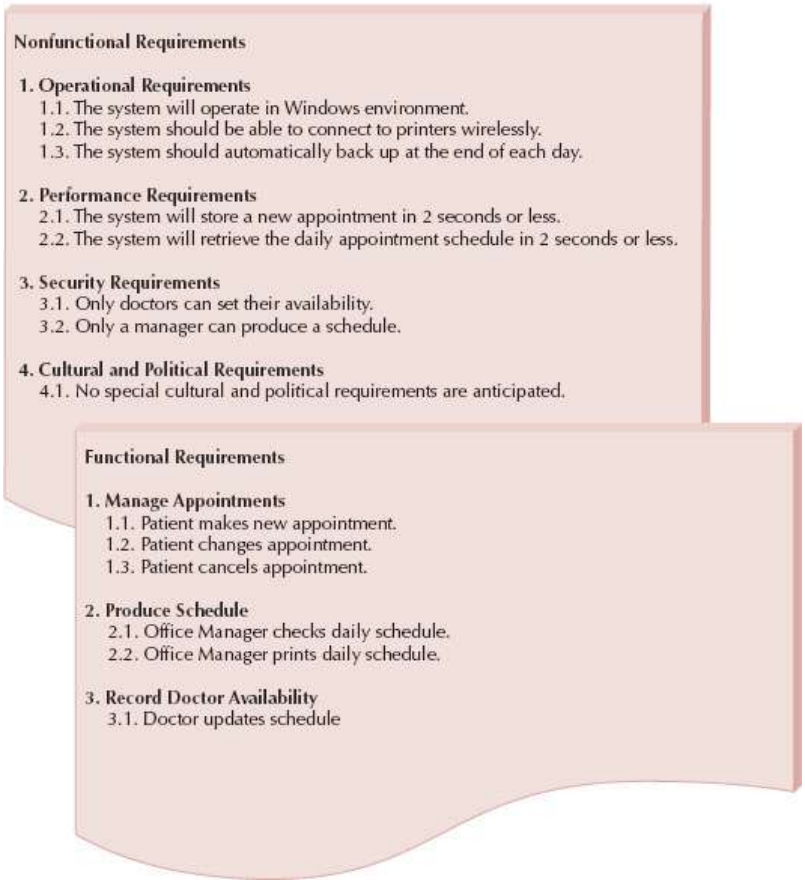


FIGURE 3-3 Sample Requirements Definition

Requirements Definition

The requirements definition report—usually just called the *requirements definition*—is a straightforward text report that simply lists the functional and nonfunctional requirements in an outline format. **Figure 3-3** shows a sample requirements definition for an appointment system for a typical doctor's office. Notice it contains both functional and nonfunctional requirements. The functional requirements include managing appointments, producing schedules, and recording the availability of the individual doctors. The nonfunctional requirements includes items such as the expected amount of time that it takes to store a new appointment, the need to support wireless printing, and which types of employees have access to the different parts of the system.

The requirements are numbered in a legal or outline format so that each requirement is clearly identified. The requirements are first grouped into functional and nonfunctional requirements; within each of those headings, they are further grouped by the type of nonfunctional requirement or by function.

Sometimes business requirements are prioritized on the requirements definition. They can be ranked as having high, medium, or low importance in the new system, or they can be labeled with the version of the

system that will address the requirement (e.g., release 1, release 2, release 3). This practice is particularly important when using object-oriented methodologies because they deliver requirements in batches by developing incremental versions of the system.

The most obvious purpose of the requirements definition is to provide the information needed by the other deliverables in analysis, which include functional, structural, and behavioral models, and to support activities in design. The most important purpose of the requirements definition, however, is to define the scope of the system. The document describes to the analysts exactly what the system needs to end up doing. When discrepancies arise, the document serves as the place to go for clarification.

Determining Requirements

Determining requirements for the requirements definition is both a business task and an information technology task. In the early days of computing, there was a presumption that the systems analysts, as experts with computer systems, were in the best position to define how a computer system should operate. Many systems failed because they did not adequately address the true business needs of the users. Gradually, the presumption changed so that the users, as the business experts, were seen as being the best position to define how a computer system should operate. However, many systems failed to deliver performance benefits because users simply automated an existing inefficient system, and they failed to incorporate new opportunities offered by technology.

A good analogy is building a house or an apartment. We have all lived in a house or apartment, and most of us have some understanding of what we would like to see in one. However, if we were asked to design one from scratch, it would be a challenge because we lack appropriate design skills and technical engineering skills. Likewise, an architect acting alone would probably miss some of our unique requirements.

Therefore, the most effective approach is to have both business people and analysts working together to determine business requirements. Sometimes, however, users don't know exactly what they want, and analysts need to help them discover their needs. Three kinds of strategies have become popular to help analysts do this: *business process automation (BPA), business process improvement (BPI),* and *business process reengineering (BPR).* Analysts can use these tools when they need to guide the users in explaining what is wanted from a system.

The three kinds of strategies work similarly. They help users critically examine the current state of systems and processes (the as-is system), identify exactly what needs to change, and develop a concept for a new system (the to-be system). A different amount of change is associated with

each technique; BPA creates a small amount of change, BPI creates a moderate amount of change, and BPR creates significant change that affects much of the organization.

Although BPA, BPI, and BPR enable the analyst to help users create a vision for the new system, they are not sufficient for extracting information about the detailed business requirements that are needed to build it. Therefore, analysts use a portfolio of requirements-gathering techniques to acquire information from users. The analyst has many techniques from which to choose: interviews, questionnaires, observation, joint application development (JAD), and document analysis. The information gathered using these techniques is critically analyzed and used to craft the requirements definition report. A later section of this chapter describes each of the requirements-gathering techniques in greater depth.

Creating a Requirements Definition

Creating a requirements definition is an iterative and ongoing process whereby the analyst collects information with requirements-gathering techniques (e.g., interviews, document analysis), critically analyzes the information to identify appropriate business requirements for the system, and adds the requirements to the requirements definition report. The requirements definition is kept up to date so that the project team and business users can refer to it and get a clear understanding of the new system.

To create a requirements definition, the project team first determines the kinds of functional and nonfunctional requirements that they will collect about the system (of course, these may change over time). These become the main sections of the document. Next, the analysts use a variety of requirements-gathering techniques (e.g., interviews, observation) to collect information, and they list the business requirements that were identified from that information. Finally, the analysts work with the entire project team and the business users to verify, change, and complete the list and to help prioritize the importance of the requirements that were identified.

This process continues throughout analysis, and the requirements definition evolves over time as new requirements are identified and as the project moves into later phases of the Unified Process. Beware: The evolution of the requirements definition must be carefully managed. The project team cannot keep adding to the requirements definition, or the system will keep growing and growing and never get finished. Instead, the project team carefully identifies requirements and evaluates which ones fit within the scope of the system. When a requirement reflects a real business need but is not within the scope of the current system or current release, it is either added on a list of future requirements or given

a low priority. The management of requirements (and system scope) is one of the hardest parts of managing a project.

Real-World Problems with Requirements Determination

Avison and Fitzgerald provide us with a set of problems that can arise with regard to determining the set of requirements to be dealt with.[4] First, the analyst might not have access to the correct set of users to uncover the complete set of requirements. This can lead to requirements being missed, misrepresented, and/or overspecified. This is analogous to the blind men and the elephant metaphor described earlier. Second, the specification of the requirements may be inadequate. This can be especially true with the lightweight techniques associated with agile methodologies. Third, some requirements are simply unknowable at the beginning of a development process. However, as the system is developed, the users and analysts will get a better understanding of both the domain issues and the applicable technology. This can cause new functional and nonfunctional requirements to be identified and current requirements to evolve or be canceled. Iterative and incremental-based development methodologies, such as the Unified Process and agile, can help in this case. Fourth, verifying and validating of requirements can be very difficult. We take up this topic in the chapters that deal with the creation of functional (**Chapter 4**), structural (**Chapter 5**), and behavioral (**Chapter 6**) models.

REQUIREMENTS ANALYSIS STRATEGIES

Before the project team can determine what requirements are appropriate for a given system, they need to have a clear vision of the kind of system that will be created and the level of change that it will bring to the organization. The basic process of *analysis* is divided into three steps: understanding the as-is system, identifying improvements, and developing requirements for the to-be system.

Sometimes the first step (i.e., understanding the as-is system) is skipped or is performed in a cursory manner. This happens when no current system exists, if the existing system and processes are irrelevant to the future system, or if the project team is using a RAD or agile development methodology in which the as-is system is not emphasized. Users of traditional design methods such as waterfall and parallel development (see **Chapter 1**) typically spend significant time understanding the as-is system and identifying improvements before moving to capture requirements for the to-be system. However, newer RAD, agile, and object-oriented methodologies, such as phased development, prototyping, throwaway prototyping, extreme programming, and Scrum (see **Chapter 1**) focus almost exclusively on improvements and the to-be system requirements, and they spend little time investigating the current as-is system.

Three requirements-analysis strategies—business process automation, business process improvement, and business process reengineering—help the analyst lead users through the analysis steps so that the vision of the system can be developed. Requirements analysis strategies and requirements-gathering techniques go hand in hand. Analysts need to use requirements-gathering techniques to collect information; requirements analysis strategies drive the kind of information that is gathered and how it is ultimately analyzed. Although we now focus on the analysis strategies and then discuss requirements gathering at the end of the chapter, they happen concurrently and are complementary activities.

The choice of analysis technique to be used is based on the amount of change the system is meant to create in the organization. BPA is based on small change that improves process efficiency, BPI creates process improvements that lead to better effectiveness, and BPR revamps the way things work so that the organization is transformed on some level.

To move the users from here to there, an analyst needs strong *critical thinking skills*. Critical thinking is the ability to recognize strengths and weaknesses and recast an idea in an improved form, and critical thinking skills are needed to really understand issues and develop new business processes. These skills are also needed to thoroughly examine the results of requirements gathering, to identify business requirements, and to translate those requirements into a concept for the new system.

Business Process Automation (BPA)

BPA leaves the basic way the organization operates unchanged and uses computer technology to do some of the work. BPA can make the organization more efficient but has the least impact on the business. Planners in BPA projects spend a significant time understanding the current as-is system before moving on to improvements and to-be system requirements. Problem analysis and root cause analysis are two popular BPA techniques.

Problem Analysis The most straightforward (and probably the most commonly used) requirements-analysis technique is *problem analysis*. Problem analysis means asking the users and managers to identify problems with the as-is system and to describe how to solve them in the to-be system. Most users have a very good idea of the changes they would like to see, and most are quite vocal about suggesting them. Most changes tend to solve problems rather than capitalize on opportunities, but the latter is possible as well. Improvements from problem analysis tend to be small and incremental (e.g., provide more space in which to type the customer's address; provide a new report that currently does not exist).

This type of improvement often is very effective at improving a system's efficiency or ease of use. However, it often provides only minor improvements in business value—the new system is better than the old, but it may be hard to identify significant monetary benefits from the new system.

Root Cause Analysis The ideas produced by problem analysis tend to be solutions to problems. All solutions make assumptions about the nature of the problem, assumptions that might or might not be valid. In our experience, users (and most people in general) tend to quickly jump to solutions without fully considering the nature of the problem. Sometimes the solutions are appropriate, but many times they address a *symptom* of the problem, not the true problem or *root cause* itself.[5]

For example, suppose a firm notices that its users report that inventory stock-outs are common. The cost of inventory stock-outs can be quite significant. For example, in this case, because they happen frequently, customers could find another source for the items that they are purchasing from the firm. It is in the firm's interest to determine the underlying cause and not simply provide a knee-jerk reaction such as arbitrarily increasing the amount of inventory kept on hand. In the business world, the challenge lies in identifying the root cause—few real-world problems are simple. The users typically propose a set of causes for the problem under consideration. The solutions that users propose can address either symptoms or root causes, but without a careful analysis, it is difficult to tell which one is addressed. The analyst must keep in mind the parable of the blind men and the elephant, where the blind men, in this case, are the users.

Root cause analysis, therefore, focuses on problems, not solutions. The analyst starts by having the users generate a list of problems with the current system and then prioritize the problems in order of importance. Starting with the most important, the users and/or the analysts then generate all the possible root causes for the problems. Each possible root cause is investigated (starting with the most likely or easiest to check) until the true root causes are identified. If any possible root causes are identified for several problems, those should be investigated first, because there is a good chance they are the real root causes influencing the symptom problems. In our example, there are several possible root causes:

- The firm's supplier might not be delivering orders to the firm in a timely manner.
- There could be a problem with the firm's inventory controls.
- The reorder level and quantities could be set wrong.

Sometimes, using a hierarchical chart to represent the causal relationships helps with the analysis. As **Figure 3-4** shows, there are many possi-

ble root causes that underlie the higher-level causes identified. The key point in root cause analysis is always to challenge the obvious.

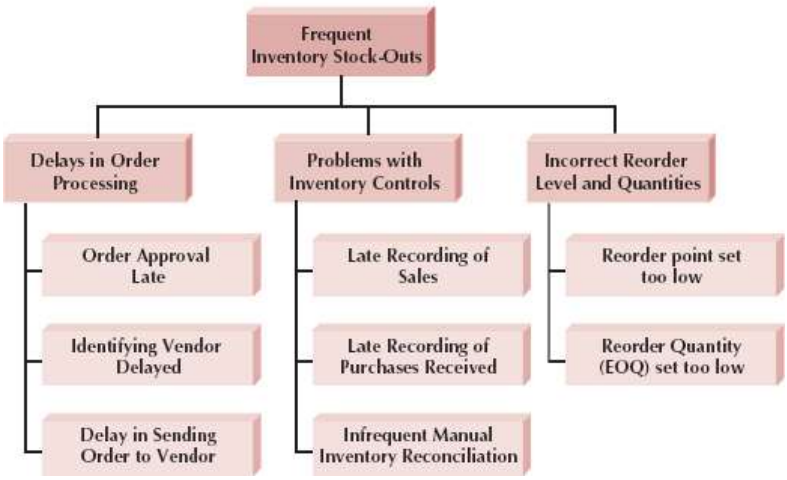


FIGURE 3-4 Root-Cause Analysis for Inventory Stock-Outs

CONCEPTS IN ACTION: 3-B Success from Failure

*I*n the gold rush days of the late 1990s, getting on the Internet was a hot topic. Many companies (many of which no longer exist) created computers for the home Internet market, many with built-in dial-up connectivity and contracts for that connectivity. The AtHome company made such an Internet appliance. Taken out of the box, connected to a phone line, and provided with initial start-up, it "phoned home" (made the connection to an Internet service provider).

But, the days of the Internet appliance were short lived. Consumers wanted more than just Internet access—they wanted to be able to have and share files, photos, and materials with others. The basic AtHome Internet Appliance did not have any storage and was useful only for connecting to the Internet (by phone modem) and browsing the Internet.

The stock price dropped and sales dropped; even with prices that were comparable to giving away the device, consumers were no longer interested as 2001 came to an end.

When faced with such a situation, what does a company do? The company faced a real challenge—go out of business or reorganize. In this case AtHome, which had expertise in hardware and telecommunications, restructured into a security company. With September 11, 2001, bringing calls for better security, AtHome scrambled to create a hardware device that would sit between the Internet connection and a business network. To keep their stock listed on the New York Stock Exchange, AtHome did a 15-to-1 reverse stock split and changed their name to indicate a new focus. Having been burned by consumers' whims, they set their sights on capturing major corporate business. It took two long years before their device started to be noticed—and just paying the employees almost ate up the available funds before sales of the new device started to kick in. The reorganized company is now recognized as a leader in the intrusion-prevention field.

A company that falls from consumer favor cannot always restructure itself to become successful in an alternative area. In this case, there was success from failure.

Questions

1. When should a company that has lost in the consumer marketplace re-create itself for the corporate market?
2. How might a systems analyst for the AtHome company learn to change with the times and adapt to the new environment?

Business Process Improvement (BPI)

BPI makes moderate changes to the way the organization operates in order to take advantage of new opportunities offered by technology or to copy what competitors are doing. BPI can improve efficiency (i.e., doing things right) and improve effectiveness (i.e., doing the right things). Planners of BPI projects also spend time understanding the as-is system, but much less time than with BPA projects; their primary focus is on improving business processes, so time is spent on the as-is only to help with the improvement analyses and the to-be system requirements. *Duration analysis, activity-based costing*, and *informal benchmarking* are three popular BPI activities.

Duration Analysis Duration analysis requires a detailed examination of the amount of time it takes to perform each process in the current as-is system. The analysts begin by determining the total amount of time it takes, on average, to perform a set of business processes for a typical input. They then time each of the individual steps (or subprocesses) in the business process. The time to complete the basic steps are then totaled and compared to the total for the overall process. A significant difference between the two—and in our experience the total time often can be 10 or even 100 times longer than the sum of the parts—indicates that this part of the process is badly in need of a major overhaul.

For example, suppose that the analysts are working on a home mortgage system and discover that on average, it takes thirty days for the bank to approve a mortgage. They then look at each of the basic steps in the process (e.g., data entry, credit check, title search, appraisal) and find that the total amount of time actually spent on each mortgage is about eight hours. This is a strong indication that the overall process is badly broken, because it takes thirty days to perform one day's work.

These problems probably occur because the process is badly fragmented. Many different people must perform different activities before the process finishes. In the mortgage example, the application probably sits on many people's desks for long periods of time before it is processed.

Processes in which many different people work on small parts of the inputs are prime candidates for *process integration* or *parallelization*. Process integration means changing the fundamental process so that fewer people work on the input, which often requires changing the processes and retraining staff to perform a wider range of duties. Process parallelization means changing the process so that all the individual steps are performed at the same time. For example, in the mortgage application case, there is probably no reason that the credit check cannot be performed at the same time as the appraisal and title check.

CONCEPTS IN ACTION: 3-C Duration Analysis

A group of executives from a Fortune 500 company used duration analysis to discuss their procurement process. Using a huge wall of Velcro and a handful of placards, a facilitator mapped out the company's process for procuring a $50 software upgrade. Having quantified the time it took to complete each step, she then assigned costs based on the salaries of the employees involved. The fifteen-minute exercise left the group stunned. Their procurement process had gotten so convoluted that it took eighteen days, countless hours of paperwork, and nearly $22,000 in employee time to get the product ordered, received, and up and running on the requester's desktop.

Source:"For Good Measure" Debby Young, *CIO Magazine* (March 1, 1999).

Activity-Based Costing Activity-based costing is a similar analysis; it examines the cost of each major process or step in a business process rather than the time taken.[6] The analysts identify the costs associated with each of the basic functional steps or processes, identify the most costly processes, and focus their improvement efforts on them.

Assigning costs is conceptually simple. Analysts simply examine the direct cost of labor and materials for each input. Materials costs are easily assigned in a manufacturing process, whereas labor costs are usually calculated based on the amount of time spent on the input and the hourly cost of the staff. However, as you may recall from a managerial accounting course, there are indirect costs such as rent, depreciation, and so on, that also can be included in activity costs.

Informal Benchmarking Benchmarking refers to studying how other organizations perform a business process in order to learn how your organization can do something better. Benchmarking helps the organization by introducing ideas that employees may never have considered but that have the potential to add value.

Informal benchmarking is fairly common for customer-facing business processes (i.e., processes that interact with the customer). With informal benchmarking, the managers and analysts think about other organizations or visit them as customers to watch how the business process is per-

formed. In many cases, the business studied may be a known leader in the industry or simply a related firm. For example, suppose the team is developing a website for a car dealer. The project sponsor, key managers, and key team members would likely visit the websites of competitors as well as those of others in the car industry (e.g., manufacturers, accessories suppliers) and those in other industries that have won awards for their websites.

Business Process Reengineering

BPR means changing the fundamental way the organization operates, obliterating the current way of doing business and making major changes to take advantage of new ideas and new technology. Planners of BPR projects spend little time understanding the as-is, because their goal is to focus on new ideas and new ways of doing business. Outcome analysis, technology analysis, and activity elimination are three popular BPR activities.

Outcome Analysis *Outcome analysis* focuses on understanding the fundamental outcomes that provide value to customers. Although these outcomes sound as though they should be obvious, they often are not. For example, consider an insurance company. One of its customers has just had a car accident. What is the fundamental outcome from the *customer's* perspective? Traditionally, insurance companies have answered this question by assuming the customer wants to receive the insurance payment quickly. To the customer, however, the payment is only a *means* to the real outcome: a repaired car. The insurance company might benefit by extending its view of the business process past its traditional boundaries to include not paying for repairs but performing the repairs or contracting with an authorized body shop to do them.

With this approach, system analysts encourage the managers and project sponsor to pretend they are customers and to think carefully about what the organization's products and services enable the customers to do—and what they *could* enable the customer to do.

Technology Analysis Many major changes in business since the turn of the century have been enabled by new technologies. *Technology analysis* starts by having the analysts and managers develop a list of important and interesting technologies. Then the group systematically identifies how every technology could be applied to the business process and identifies how the business would benefit.

For example, one useful technology is the Internet. Saturn, the car manufacturer, took this idea and developed an extranet application for its suppliers. Rather than ordering parts for its cars, Saturn made its production schedule available electronically to its suppliers, who shipped the parts

Saturn needed so that they arrived at the plant just in time. This saved Saturn significant costs because it eliminated the need for people to monitor the production schedule and issue purchase orders.

Activity Elimination *Activity elimination* is exactly what it sounds like. The analysts and managers work together to identify how the organization could eliminate each activity in the business process, how the function could operate without it, and what effects are likely to occur. Initially, managers are reluctant to conclude that processes can be eliminated, but this is a force-fit exercise in that they must eliminate each activity. In some cases the results are silly; nonetheless, participants must address every activity in the business process.

For example, in the home mortgage approval process discussed earlier, the managers and analysts would start by eliminating the first activity, entering the data into the mortgage company's computer. This leads to two obvious possibilities: eliminate the use of a computer system or make someone else do the data entry (e.g., the customer over the Web). They would then eliminate the next activity, the credit check. Silly, right? After all, making sure the applicant has good credit is critical in issuing a loan. Not really. The real answer depends upon how many times the credit check identifies bad applications. If all or almost all applicants have good credit and are seldom turned down by a credit check, then the cost of the credit check might not be worth the cost of the few bad loans it prevents. Eliminating it might actually result in lower costs, even with the cost of bad loans.

Selecting Appropriate Strategies

Each technique discussed in this chapter has its own strengths and weaknesses (see **Figure 3-5**). No one technique is inherently better than the others, and in practice most projects use a combination of techniques.

Potential Business Value *Potential business value* varies with the analysis strategy. Although BPA has the potential to improve the business, most of the benefits from BPA are tactical and small. Because BPA does not seek to change the business processes, it can only improve their efficiency. BPI usually offers moderate potential benefits, depending upon the scope of the project, because it seeks to change the business in some way. It can increase both efficiency and effectiveness. BPR creates large *potential* benefits because it seeks to radically improve the nature of the business.

Project Cost *Project cost* is always important. In general, BPA has the lowest cost because it has the narrowest focus and seeks to make the fewest changes. BPI can be moderately expensive, depending upon the scope of the project. BPR is usually expensive, because of the amount of

time required of senior managers and the amount of redesign to business processes.

Breadth of Analysis *Breadth of analysis* refers to the scope of analysis, or whether analysis includes business processes within a single business function, processes that cross the organization, or processes that interact with those in customer or supplier organizations. BPR takes a broad perspective, often spanning several major business processes, even across multiple organizations. BPI has a much narrower scope that usually includes one or several business functions. BPA typically examines a single process.

YOUR TURN: 3-2 IBM Credit

*I*BM Credit was a wholly owned subsidiary of IBM responsible for financing mainframe computers sold by IBM. Although some customers bought mainframes outright or obtained financing from other sources, financing computers provided significant additional profit.

When an IBM sales representative made a sale, he or she would immediately call IBM Credit to obtain a financing quote. The call was received by a credit officer, who would record the information on a request form. The form would then be sent to the credit department to check the customer's credit status. This information would be recorded on the form, which was then sent to the business practices department, who would write a contract (sometimes reflecting changes requested by the customer). The form and the contract would then go to the pricing department, which used the credit information to establish an interest rate and recorded it on the form. The form and contract were then sent to the clerical group, where an administrator would prepare a cover letter quoting the interest rate and send the letter and contract via Federal Express to the customer.

The problem at IBM Credit was a major one. Getting a financing quote took anywhere for four to eight days (six days on average), giving the customer time to rethink the order or find financing elsewhere. While the quote was being prepared, sales representatives would often call to find out where the quote was in the process so they could tell the customer when to expect it. However, no one at IBM Credit could answer the question because the paper forms could be in any department, and it was impossible to locate one without physically walking through the departments and going through the piles of forms on everyone's desk.

IBM Credit examined the process and changed it so that each credit request was logged into a computer system and each department could record an application's status as they completed it and sent it to the next department. In this way, sales representatives could call the credit office and quickly learn the status of each application. IBM used some sophisticated management science queuing theory analysis to balance workloads and staff across the different departments so none would be overloaded. They also introduced performance standards for each department (e.g., the pricing decision had to be completed within one day after that department received an application).

However, process times got worse, even though each department was achieving almost 100 percent compliance on its performance goals. After some investigation, managers found that when people got busy, they conveniently found errors that forced them to return credit requests to the previous department for correction, thereby removing it from their time measurements.

Questions

1. What techniques can you use to identify improvements?
2. Choose one technique and apply it to this situation. What improvements did you identify?

Source: M. Hammer and J. Champy, *Reengineering the Corporation* (1993). New York, NY: Harper Business.

Risk One final issue is *risk* of failure, which is the likelihood of failure due to poor design, unmet needs, or too much change for the organization to handle. BPA and BPI have low to moderate risk because the to-be system is fairly well defined and well understood, and its potential impact on the business can be assessed before it is implemented. BPR projects, on the other hand, are less predictable. BPR is extremely risky and is not something to be undertaken unless the organization and its senior leadership are committed to making significant changes. Mike Hammer, the father of BPR, estimates that 70 percent of BPR projects fail.

	Business Process Automation	Business Process Improvement	Business Process Reengineering
Potential business value	Low–moderate	Moderate	High
Project cost	Low	Low–moderate	High
Breadth of analysis	Narrow	Narrow–moderate	Very broad
Risk	Low–moderate	Low–moderate	Very high

FIGURE 3-5 Characteristics of Analysis Strategies

YOUR TURN: 3-3 Analysis Strategy

*S*uppose you are the analyst charged with developing a new website for a local car dealer who wants to be very innovative and try new things. What analysis strategies would you recommend? Why?

CONCEPTS IN ACTION: 3-D Implementing a Satellite Data Network

A major retail store recently spent $24 million on a large private satellite communication system. The system provides state-of-the-art voice, data, and video transmission between stores and regional headquarters. When an item is sold, the scanner software updates the inventory system in real time. As a result, store transactions are passed on to regional and national headquarters instantly, which keeps inventory records up to date. One of their major competitors has an older system, where transactions are uploaded at the end of a business day. The first company feels such instant communication and feedback allows them to re-

act more quickly to changes in the market and gives them a competitive advantage. For example, if an early winter snowstorm causes stores across the upper Midwest to start selling high-end (and high-profit) snowblowers, the nearest warehouse can quite quickly prepare next-day shipments to maintain a good inventory balance, whereas the competitor might not move quite as quickly and thus will lose out on such quick inventory turnover.

Questions

1. Do you think a $24 million investment in a private satellite communication system could be justified by a cost–benefit analysis? Could this be done with a standard communication line (with encryption)?
2. How might the competitor in this example attempt to close the information gap?

REQUIREMENTS-GATHERING TECHNIQUES

An analyst is very much like a detective (and business users are sometimes like elusive suspects). He or she knows that there is a problem to be solved and therefore must look for clues that uncover the solution. Unfortunately, the clues are not always obvious (and are often missed), so the analyst needs to notice details, talk with witnesses, and follow leads just as Sherlock Holmes would have done. The best analysts thoroughly gather requirements using a variety of techniques and make sure that the current business processes and the needs for the new system are well understood before moving into design. Analysts don't want to discover later that they have key requirements wrong—such surprises late in the development process can cause all kinds of problems.

The requirements-gathering process is used for building political support for the project and establishing trust and rapport between the project team building the system and the users who ultimately will choose to use or not use the system. Involving someone in the process implies that the project teams view that person as an important resource and value his or her opinions. All the key stakeholders (the people who can affect the system or who will be affected by the system) must be included in the requirements-gathering process. The stakeholders might include managers, employees, staff members, and even some customers and suppliers. If a key person is not involved, that individual might feel slighted, which can cause problems during implementation (e.g., How could they have developed the system without my input?).

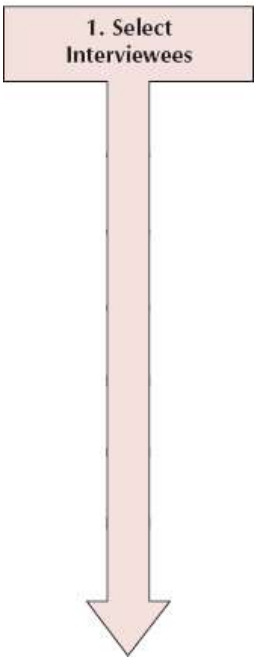
The second challenge of requirements gathering is choosing the way(s) information is collected. There are many techniques for gathering requirements that vary from asking people questions to watching them work. In this section, we focus on the five most commonly used techniques: interviews, JAD sessions (a special type of group meeting), questionnaires, document analysis, and observation. Each technique has its

own strengths and weaknesses, many of which are complementary, so most projects use a combination of techniques.[7]

Interviews

An interview is the most commonly used requirements-gathering technique. After all, it is natural—if you need to know something, you usually ask someone. In general, interviews are conducted one-on-one (one interviewer and one interviewee), but sometimes, owing to time constraints, several people are interviewed at the same time. There are five basic steps to the interview process: selecting interviewees, designing interview questions, preparing for the interview, conducting the interview, and postinterview follow-up.[8]

The first step in interviewing is to create an *interview schedule* listing all the people who will be interviewed, when, and for what purpose (see **Figure 3-6**). The schedule can be an informal list that is used to help set up meeting times or a formal list that is incorporated into the workplan. The people who appear on the interview schedule are selected based on the analyst's information needs. The project sponsor, key business users, and other members of the project team can help the analyst determine who in the organization can best provide important information about requirements. These people are listed on the interview schedule in the order in which they should be interviewed.



People at different levels of the organization have different perspectives on the system, so it is important to include both managers who manage the processes and staff who actually perform the processes to gain both high-level and low-level perspectives on an issue. Also, the kinds of interview subjects needed can change over time. For example, at the start of

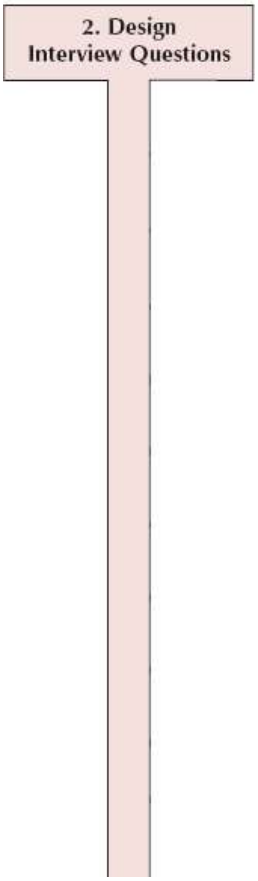
the project, the analyst has a limited understanding of the as-is business process. It is common to begin by interviewing one or two senior managers to get a strategic view and then to move to midlevel managers, who can provide broad, overarching information about the business process and the expected role of the system being developed. Once the analyst has a good understanding of the big picture, lower-level managers and staff members can fill in the exact details of how the process works. Like most other things about systems analysis, this is an iterative process—starting with senior managers, moving to midlevel managers, then staff members, back to midlevel managers, and so on, depending upon what information is needed along the way.

It is quite common for the list of interviewees to grow, often by 50 to 75 percent. As people are interviewed, more information that is needed and additional people who can provide the information will probably be identified.

Name	Position	Purpose of Interview	Meeting
Andria McClellan	Director, Accounting	Strategic vision for new accounting system	Mon., March 1 8:00–10:00 AM
Jennifer Draper	Manager, Accounts Receivable	Current problems with accounts receivable process; future goals	Mon., March 1 2:00–3:15 PM
Mark Goodin	Manager, Accounts Payable	Current problems with accounts payable process; future goals	Mon., March 1 4:00–5:15 PM
Anne Asher	Supervisor, Data Entry	Accounts receivable and payable processes	Wed., March 3 10:00–11:00 AM
Fernando Merce	Data Entry Clerk	Accounts receivable and payable processes	Wed., March 3 1:00–3:00 PM

FIGURE 3-6 Sample Interview Schedule

There are three types of interview questions: closed-ended questions, open-ended questions, and probing questions. *Closed-ended questions* are those that require a specific answer. They are similar to multiple-choice or arithmetic questions on an exam (see **Figure 3-7**). Closed-ended questions are used when an analyst is looking for specific, precise information (e.g., how many credit card requests are received per day). In general, precise questions are best. For example, rather than asking, Do you handle a lot of requests? it is better to ask, How many requests do you process per day? Closed-ended questions enable analysts to control the interview and obtain the information they need. However, these types of questions don't uncover *why* the answer is the way it is, nor do they uncover information that the interviewer does not think to ask for ahead of time.

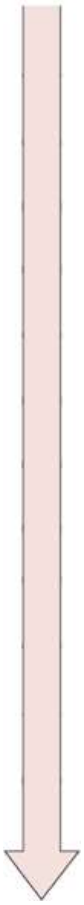


Open-ended questions are those that leave room for elaboration on the part of the interviewee. They are similar in many ways to essay questions that you might find on an exam (see **Figure 3-7** for examples). Open-ended questions are designed to gather rich information and give the interviewee more control over the information that is revealed during the interview. Sometimes the information that the interviewee chooses to discuss uncovers information that is just as important as the answer (e.g., if the interviewee talks only about other departments when asked for problems, it may suggest that he or she is reluctant to admit his or her own problems).

The third type of question is the *probing question*. Probing questions follow up on what has just been discussed in order to learn more, and they often are used when the interviewer is unclear about an interviewee's answer. They encourage the interviewee to expand on or to confirm information from a previous response, and they signal that the interviewer is listening and is interested in the topic under discussion. Many beginning analysts are reluctant to use probing questions because they are afraid that the interviewee might be offended at being challenged or because they believe it shows that they didn't understand what the interviewee said. When done politely, probing questions can be a powerful tool in requirements gathering.

In general, an interviewer should not ask questions about information that is readily available from other sources. For example, rather than asking what information is used to perform to a task, it is simpler to show the interviewee a form or report (see the section on document analysis) and ask what information on it is used. This helps focus the interviewee on the task and saves time, because the interviewee does not need to describe the information detail—he or she just needs to point it out on the form or report.

No type of question is better than another, and a combination of questions is usually used during an interview. At the initial stage of an IS development project, the as-is process can be unclear, so the interview process begins with *unstructured interviews*, interviews that seek broad and roughly defined information. In this case, the interviewer has a general sense of the information needed but has few closed-ended questions to ask. These are the most challenging interviews to conduct because they require the interviewer to ask open-ended questions and probe for important information on the fly.



As the project progresses, the analyst comes to understand the business process much better and needs very specific information about how business processes are performed (e.g., exactly how a customer credit card is approved). At this time, the analyst conducts *structured interviews*, in which specific sets of questions are developed before the interviews.

There usually are more closed-ended questions in a structured interview then in the unstructured approach.

No matter what kind of interview is being conducted, interview questions must be organized into a logical sequence so that the interview flows well. For example, when trying to gather information about the current business process, it can be useful to move in logical order through the process or from the most important issues to the least important.

There are two fundamental approaches to organizing the interview questions: top down or bottom up (see **Figure 3-8**). With the *top-down interview*, the interviewer starts with broad, general issues and gradually works toward more-specific ones. With the *bottom-up interview*, the interviewer starts with very specific questions and moves to broad questions. In practice, analysts mix the two approaches, starting with broad, general issues, moving to specific questions, and then returning to general issues.

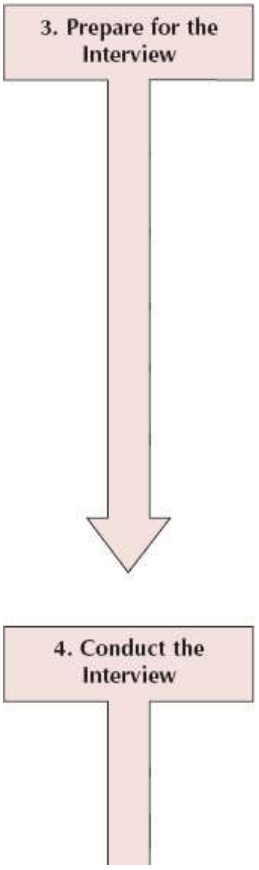
The top-down approach is an appropriate strategy for most interviews (it is certainly the most common approach). The top-down approach enables the interviewee to become accustomed to the topic before he or she needs to provide specifics. It also enables the interviewer to understand the issues before moving to the details because the interviewer might not have sufficient information at the start of the interview to ask very specific questions. Perhaps most importantly, the top-down approach enables the interviewee to raise a set of big-picture issues before becoming enmeshed in details, so the interviewer is less likely to miss important issues.

One case in which the bottom-up strategy may be preferred is when the analyst already has gathered a lot of information about issues and just needs to fill in some holes with details. Bottom-up interviewing may be appropriate if lower-level staff members feel threatened or unable to answer high-level questions. For example, How can we improve customer service? might be too broad a question for a customer service clerk, whereas a specific question is readily answerable (e.g., How can we speed up customer returns?). In any event, all interviews should begin with noncontroversial questions and then gradually move into more contentious issues after the interviewer has developed some rapport with the interviewee.

Types of Questions	Examples
Closed-ended questions	• How many telephone orders are received per day? • How do customers place orders? • What information is missing from the monthly sales report?
Open-ended questions	• What do you think about the current system? • What are some of the problems you face on a daily basis? • What are some of the improvements you would like to see in a new system?
Probing questions	• Why? • Can you give me an example? • Can you explain that in a bit more detail?

FIGURE 3-7 Three Types of Questions

FIGURE 3-8 Top-Down and Bottom-Up Questioning Strategies



It is important to prepare for the interview in the same way that you would prepare to give a presentation. The interviewer should have a general interview plan listing the questions to be asked in the appropriate order, should anticipate possible answers and provide follow-up with them, and should identify segues between related topics. The interviewer should confirm the areas in which the interviewee has knowledge so as not to ask questions that the interviewee cannot answer. Review the topic areas, the questions, and the interview plan, and clearly decide which have the greatest priority in case time runs short.

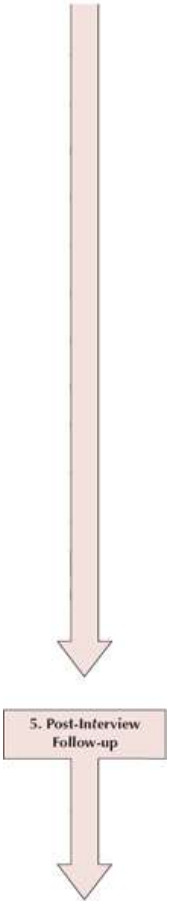
In general, structured interviews with closed-ended questions take more time to prepare than unstructured interviews. Some beginning analysts prefer unstructured interviews, thinking that they can wing it. This is very dangerous and often counterproductive, because any information not gathered in the first interview will require follow-up efforts, and most users do not like to be interviewed repeatedly about the same issues.

The interviewer should be sure to prepare the interviewee as well. When the interview is scheduled, the interviewee should be told the reason for the interview and the areas that will be discussed far enough in advance so that he or she has time to think about the issues and organize his or her thoughts. This is particularly important when the interviewer is an outsider to the organization and for lower-level employees, who often are not asked for their opinions and who may be uncertain about why they are being interviewed.

In starting the interview, the first goal is to build rapport with the interviewee, so that he or she trusts the interviewer and is willing to tell the whole truth, not just give the answers that he or she thinks are wanted. The interviewer should appear to be professional and an unbiased, independent seeker of information. The interview should start with an explanation of why the interviewer is there and why he or she has chosen to interview the person; then the interviewer should move into the planned interview questions.

It is critical to carefully record all the information that the interviewee provides. In our experience, the best approach is to take careful notes—write down *everything* the interviewee says, even if it does not appear immediately relevant. The interviewer shouldn't be afraid to ask the person to slow down or to pause while writing, because this is a clear indication that the interviewee's information is important. One potentially controversial issue is whether or not to tape-record an interview. Recording ensures that the interviewer does not miss important points, but it can be intimidating for the interviewee. Most organizations have policies or generally accepted practices about the recording of interviews, so they should be determined before an interview. If the interviewer is worried

about missing information and cannot tape the interview, then he or she can bring along a second person to take detailed notes.



As the interview progresses, it is important to understand the issues that are discussed. If the interviewer does not understand something, he or she should be sure to ask. The interviewer should not be afraid to ask dumb questions, because the only thing worse than appearing dumb is to be dumb by not understanding something. If the interviewer doesn't understand something during the interview, he or she certainly won't understand it afterwards. Jargon should be recognized and defined; any jargon not understood should be clarified. One good strategy to increase understanding during an interview is to periodically summarize the key points that the interviewee is communicating. This avoids misunderstandings and also demonstrates that the interviewer is listening.

Finally, facts should be separated from opinion. The interviewee may say, for example, We process too many credit card requests. This is an opinion, and it is useful to follow this up with a probing question requesting support for the statement (e.g., Oh, how many do you process in a day?). It is helpful to check the facts because any differences between the facts and the interviewee's opinions can point out key areas for improvement. Suppose the interviewee complains about a high or increasing number of errors, but the logs show that errors have been decreasing. This suggests

that errors are viewed as a very important problem that should be addressed by the new system, even if they are declining.

As the interview draws to a close, the interviewee should have time to ask questions or provide information that he or she thinks is important but was not part of the interview plan. In most cases, the interviewee has no additional concerns or information, but in some cases this leads to unanticipated, but important, information. Likewise, it can be useful to ask the interviewee if there are other people who should be interviewed. The interview should end on time (if necessary, some topics can be omitted or another interview can be scheduled).

As a last step in the interview, the interviewer should briefly explain what will happen. The interviewer shouldn't prematurely promise certain features in the new system or a specific delivery date, but he or she should reassure the interviewee that his or her time was well spent and very helpful to the project.

After the interview is over, the analyst needs to prepare an *interview report* that describes the information from the interview (**Figure 3-9**). The report contains *interview notes*, information that was collected over the course of the interview and is summarized in a useful format. In general, the interview report should be written within forty-eight hours of the interview, because the longer the interviewer waits, the more likely he or she is to forget information.

Often, the interview report is sent to the interviewee with a request to read it and inform the analyst of clarifications or updates. The interviewee needs to be convinced that the interviewer genuinely wants his or her corrections to the report. Usually there are few changes, but the need for any significant changes suggests that a second interview will be required. Never distribute someone's information without prior approval.

Interview Notes Approved by: Linda Estey

Person Interviewed: Linda Estey,
Director, Human Resources

Interviewer: Barbara Wixom

Purpose of Interview:

- Understand reports produced for Human Resources by the current system
- Determine information requirements for future system

Summary of Interview:

- Sample reports of all current HR reports are attached to this report. The information that is not used and missing information are noted on the reports.
- Two biggest problems with the current system are:
  1. The data are too old (the HR Department needs information within two days of month end; currently information is provided to them after a three-week delay)
  2. The data are of poor quality (often reports must be reconciled with departmental HR database)
- The most common data errors found in the current system include incorrect job level information and missing salary information.

Open Items:

- Get current employee roster report from Mary Skudrna (extension 4355).
- Verify calculations used to determine vacation time with Mary Skudrna.
- Schedule interview with Jim Wack (extension 2337) regarding the reasons for data quality problems.

Detailed Notes: See attached transcript.

FIGURE 3-9 Interview Report

CONCEPTS IN ACTION: 3-E Selecting the Wrong People

In 1990, I led a consulting team for a major development project for the U.S. Army. The goal was to replace eight existing systems used on virtually every Army base across the United States. The as-is process and data models for these systems had been built, and our job was to identify improvement opportunities and develop to-be process models for each of the eight systems.

For the first system, we selected a group of midlevel managers (captains and majors) recommended by their commanders as being the experts in the system under construction. These individuals were the first-and second-line managers of the business function. The individuals were expert at managing the process but did not know the exact details of how the process worked. The resulting to-be process model was very general and nonspecific.

Alan Dennis

Question

Suppose you were in charge of the project. What interview schedule for the remaining seven projects would you use?

YOUR TURN: 3-4 Interview Practice

Interviewing is not as simple as it first appears. Select two people from class to go to the front of the room to demonstrate an interview. (This also can be done in groups.) Have one person be the interviewer and the other be the interviewee. The interviewer should conduct a five-minute interview regarding the school's course registration system. Gather information about the existing system and how the system can be improved. If there is time, repeat with another pair.

Questions

1. What was the body language of the interview pair like?
2. What kind of interview was conducted?
3. What kinds of questions were asked?
4. What was done well? How could the interview be improved?

PRACTICAL TIP: 3-1 Developing Interpersonal Skills 

Interpersonal skills are skills that enable you to develop rapport with others, and they are very important for interviewing. They help you to communicate with others effectively. Some people develop good interpersonal skills at an early age; they simply seem to know how to communicate and interact with others. Other people are less lucky and need to work hard to develop their skills.

Interpersonal skills, like most skills, can be learned. Here are some tips:

- **Don't worry, be happy.** Happy people radiate confidence and project their feelings on others. Try interviewing someone while smiling and then interviewing someone else while frowning and see what happens.
- **Pay attention.** Pay attention to what the other person is saying (which is harder than you might think). See how many times you catch yourself with your mind on something other than the conversation at hand.
- **Summarize key points.** At the end of each major theme or idea that someone explains, repeat the key points back to the speaker (e.g., Let me make sure I understand. The key issues are....”). This demonstrates that you consider the information important, and it also forces you to pay attention (you can't repeat what you didn't hear).
- **Be succinct.** When you speak, be succinct. The goal in interviewing (and in much of life) is to learn, not to impress. The more you speak, the less time you give to others.
- **Be honest.** Answer all questions truthfully, and if you don't know the answer, say so.
- **Watch body language (yours and theirs).** The way a person sits or stands conveys much information. In general, a person who is interested in what you are saying sits or leans forward, makes eye contact, and often touches his or her face. A person leaning away from you or with an arm over the back of a chair is uninterested. Crossed arms indicate defensiveness or uncertainty, and steepling (sitting with hands raised in front of the body with fingertips touching) indicates a feeling of superiority.

Joint Application Development (JAD)

JAD is an information-gathering technique that allows the project team, users, and management to work together to identify requirements for the system. IBM developed the JAD technique in the late 1970s, and it is often the most useful method for collecting information from users.[9] Capers Jones claims that JAD can reduce scope creep by 50 percent, and it prevents the system's requirements from being too specific or too vague,

both of which cause trouble during later stages of the development process.[10]

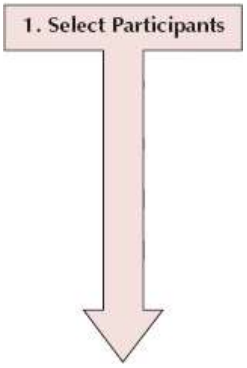
JAD is a structured process in which ten to twenty users meet together under the direction of a *facilitator* skilled in JAD techniques. The facilitator is a person who sets the meeting agenda and guides the discussion but does not join in the discussion as a participant. He or she does not provide ideas or opinions on the topics under discussion so as to remain neutral during the session. The facilitator must be an expert in both group-process techniques and systems-analysis and design techniques. One or two *scribes* assist the facilitator by recording notes, making copies, and so on. Often the scribes use computers and CASE tools to record information as the JAD session proceedings.

The JAD group meets for several hours, several days, or several weeks until all the issues have been discussed and the needed information is collected. Most JAD sessions take place in a specially prepared meeting room, away from the participants' offices so that they are not interrupted. The meeting room is usually arranged in a U-shape so that all participants can easily see each other (see **Figure 3-10**). At the front of the room (the open part of the U), are a whiteboard, flip chart, and/or overhead projector for use by the facilitator leading the discussion.

One problem with JAD is that it suffers from the traditional problems associated with groups: Sometimes people are reluctant to challenge the opinions of others (particularly their boss), a few people often dominate the discussion, and not everyone participates. In a fifteen-member group, for example, if everyone participates equally, then each person can talk for only four minutes each hour and must listen for the remaining fifty-six minutes—not a very efficient way to collect information.

A new form of JAD called *electronic JAD*, or *e-JAD*, attempts to overcome these problems by using groupware. In an e-JAD meeting room, each participant uses special software on a networked computer to send anonymous ideas and opinions to everyone else. In this way, all participants can contribute at the same time without fear of reprisal from people with differing opinions. Initial research suggests that e-JAD can reduce the time required to run JAD sessions by 50 to 80 percent.[11] A good JAD approach follows a set of five steps.

First, selecting JAD participants is done in the same basic way as selecting interview participants. Participants are selected based on the information they can contribute in order to provide a broad mix of organizational levels and to build political support for the new system. The need for all JAD participants to be away from their office at the same time can be a major problem. The office might need to be closed or operate with a skeleton staff until the JAD sessions are complete.



Ideally, the participants who are released from regular duties to attend the JAD sessions should be the very best people in that business unit. However, without strong management support, JAD sessions can fail because those selected to attend the JAD session are people who are less likely to be missed (i.e., the least competent people).

The facilitator should be someone who is an expert in JAD or e-JAD techniques and, ideally, someone who has experience with the business under discussion. In many cases, the JAD facilitator is a consultant external to the organization because the organization might not have a recurring need for JAD or e-JAD expertise. Developing and maintaining this expertise in-house can be expensive.

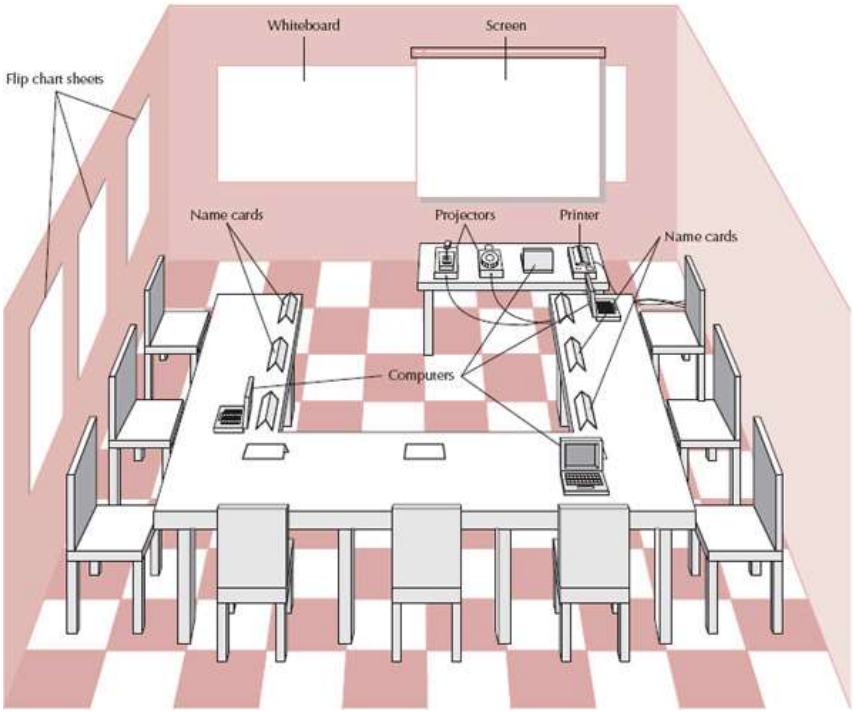
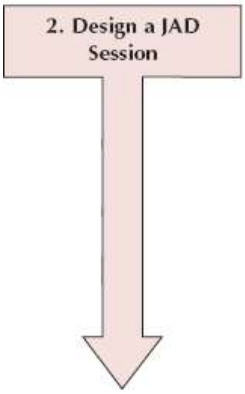


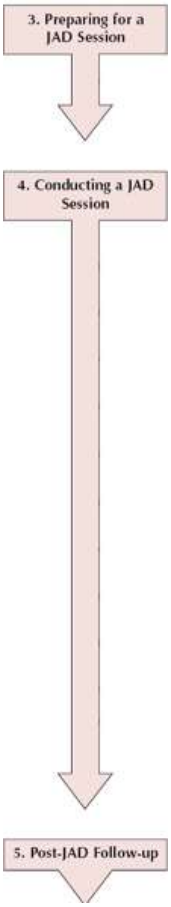
FIGURE 3-10 JAD Meeting Room



Second, JAD sessions can run from as little as half a day to several weeks, depending upon the size and scope of the project. In our experience, most JAD sessions tend to last five to ten days, spread over a three-week period. Most e-JAD sessions tend to last one to four days in a one-week period. JAD and e-JAD sessions usually go beyond collecting information and move into analysis. For example, the users and the analysts collectively can create analysis deliverables, such as the functional models or the requirements definition.

As with interviewing, success depends upon a careful plan. JAD sessions usually are designed and structured using the same principles as interviews. Most JAD sessions are designed to collect specific information from users, and this requires developing a set of questions before the meeting. One difference between JAD and interviewing is that all JAD sessions are structured—they *must* be carefully planned. In general, closed-ended questions are seldom used because they do not spark the open and frank discussion that is typical of JAD. In our experience, it is better to proceed top down in JAD sessions when gathering information. Typically thirty minutes is allocated to each separate agenda item, and frequent breaks are scheduled throughout the day because participants tire easily.

Third, as with interviewing, it is important to prepare the analysts and participants for a JAD session. Because the sessions can go beyond the depth of a typical interview and are usually conducted off-site, participants can be more concerned about how to prepare. It is important that the participants understand what is expected of them. If the goal of the JAD session, for example, is to develop an understanding of the current system, then participants can bring procedure manuals and documents with them. If the goal is to identify improvements for a system, then before they come to the JAD session they can think about how they would improve the system.



Fourth, most JAD sessions try to follow a formal agenda, and most have formal *ground rules* that define appropriate behavior. Common ground rules include following the schedule, respecting others' opinions, accepting disagreement, and ensuring that only one person talks at a time.

The role of a JAD facilitator can be challenging. Many participants come to a JAD session with strong feelings about the system to be discussed. Channeling these feelings so that the session moves forward in a positive direction and getting participants to recognize and accept—but not necessarily agree on—opinions and situations different from their own requires significant expertise in systems analysis and design, JAD, and interpersonal skills. Few systems analysts attempt to facilitate JAD sessions without being trained in JAD techniques, and most apprentice with a skilled JAD facilitator before they attempt to lead their first session.

The JAD facilitator performs three key functions. First, he or she ensures that the group sticks to the agenda. The only reason to digress from the agenda is when it becomes clear to the facilitator, project leader, and project sponsor that the JAD session has produced some new information that is unexpected and requires the JAD session (and perhaps the project) to move in a new direction. When participants attempt to divert the discussion away from the agenda, the facilitator must be firm but polite in leading discussion back to the agenda and getting the group back on track.

Second, the facilitator must help the group understand the technical terms and jargon that surround the system-development process and help the participants understand the specific analysis techniques used. Participants are experts in their area, or their part of the business, but they are not experts in systems analysis. The facilitator must, therefore, minimize the learning required and teach participants how to effectively provide the right information.

Third, the facilitator records the group's input on a public display area, which can be a whiteboard, flip chart, or computer display. He or she structures the information that the group provides and helps the group recognize key issues and important solutions. Under no circumstance should the facilitator insert his or her opinions into the discussion. The facilitator must remain neutral at all times and simply help the group through the process. The moment the facilitator offers an opinion on an issue, the group will see him or her not as a neutral party but rather as someone who could be attempting to sway the group into some predetermined solution.

However, this does not mean that the facilitator should not try to help the group resolve issues. For example, if two items appear to be the same to the facilitator, the facilitator should not say, "I think these may be similar." Instead, the facilitator should ask, "Are these similar?" If the group decides they are, the facilitator can combine them and move on. However, if the group decides they are not similar (despite what the facilitator believes), the facilitator should accept the decision and move on. The group is *always* right, and the facilitator has no opinion.

Fifth, as with interviews, a JAD *post-session report* is prepared and circulated among session attendees. The post-session report is essentially the same as the interview report in **Figure 3-9**. Because the JAD sessions are longer and provide more information, it usually takes a week or two after the JAD session before the report is complete.

PRACTICAL TIP: Managing Problems in JAD Sessions

I have run more than a hundred JAD sessions and have learned several standard "facilitator tricks." Here are some common problems and some ways to deal with them.

- **Domination.** The facilitator should ensure that no one person dominates the group discussion. The only way to deal with someone who dominates is head on. During a break, approach the person, thank him or her for his or her insightful comments, and ask the person to help you make sure that others also participate.

- **Noncontributors.** Drawing out people who have participated very little is challenging because you want to bring them into the conversation so that they will contribute again. The best approach is to ask a direct factual question that you are certain they can answer. And it helps to ask the question in a long way to give them time to think. For example, “Pat, I know you've worked shipping orders a long time. You've probably been in the shipping department longer than anyone else. Could you help us understand exactly what happens when an order is received in shipping?”
- **Side discussions.** Sometimes participants engage in side conversations and fail to pay attention to the group. The easiest solution is simply to walk close to the people and continue to facilitate right in front of them. Few people will continue a side conversion when you are two feet from them and the entire group's attention is on you and them.
- **Agenda merry-go-round.** The merry-go-round occurs when a group member keeps returning to the same issue every few minutes and won't let go. One solution is to let the person have five minutes to ramble on about the issue while you carefully write down every point on a flip chart or computer file. This flip chart or file is then posted conspicuously on the wall. When the person brings up the issue again, you interrupt them, walk to the paper and ask them what to add. If they mention something already on the list, you quickly interrupt, point out that it is there, and ask what other information to add. Don't let them repeat the same point, but write any new information.
- **Violent agreement.** Some of the worst disagreements occur when participants really agree on the issues but don't realize that they agree because they are using different terms. An example is arguing whether a glass is half empty or half full; they agree on the facts but can't agree on the words. In this case, the facilitator has to translate the terms into different words and find common ground so the parties recognize that they really agree.
- **Unresolved conflict.** In some cases, participants don't agree and can't understand how to determine what alternatives are better. You can help by structuring the issue. Ask for criteria by which the group will identify a good alternative (e.g., “Suppose this idea really did improve customer service. How would I recognize the improved customer service?”). Then once you have a list of criteria, ask the group to assess the alternatives using them.
- **True conflict.** Sometimes, despite every attempt, participants just can't agree on an issue. The solution is to postpone the discussion and move on. Document the issue as an open issue and list it prominently on a flip chart. Have the group return to the issue hours later. Often the issue will have resolved itself by then and you haven't wasted time on it. If the issue cannot be resolved later, move it to the list of issues to be decided by the project sponsor or some other more senior member of management.
- **Humor.** Humor is one of the most powerful tools a facilitator has and thus must be used judiciously. The best JAD humor is always in context; never tell jokes but take the opportunity to find the humor in the situation.
  Alan Dennis

Questionnaires

A questionnaire is a set of written questions used to obtain information from individuals. Questionnaires are often used when there is a large number of people from whom information and opinions are needed. In

our experience, questionnaires are a common technique with systems intended for use outside the organization (e.g., by customers or vendors) or for systems with business users spread across many geographic locations. Most people automatically think of paper when they think of questionnaires, but today more questionnaires are being distributed in electronic form, either via e-mail or on the Web. Electronic distribution can save a significant amount of money as compared to distributing paper questionnaires. A good process to use when using questionnaires follows four steps.

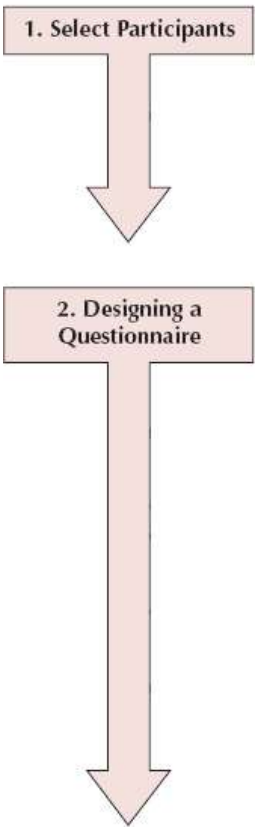
YOUR TURN: 3-5 JAD Practice

Organize yourselves into groups of four to seven people, and pick one person in each group to be the JAD facilitator. Using a blackboard, whiteboard or flip chart, gather information about how the group performs some process (e.g., working on a class assignment, making a sandwich, paying bills, getting to class).

Questions

1. How did the JAD session go?
2. Based on your experience, what are pros and cons of using JAD in a real organization?

First, as with interviews and JAD sessions, the first step is to identify the individuals to whom the questionnaire will be sent. However, it is not usual to select every person who could provide useful information. The standard approach is to select a *sample*, or subset, of people who are representative of an entire group. Sampling guidelines are discussed in most statistics books, and most business schools include courses that cover the topic, so we do not discuss it here. The important point in selecting a sample, however, is to realize that not everyone who receives a questionnaire will actually complete it. On average, only 30 to 50 percent of paper and e-mail questionnaires are returned. Response rates for Web-based questionnaires tend to be significantly lower (often only 5 to 30 percent).



Second, because the information on a questionnaire cannot be immediately clarified for a confused respondent, developing good questions is critical for questionnaires. Questions on questionnaires must be very clearly written and leave little room for misunderstanding, so closed-ended questions tend to be most commonly used. Questions must clearly enable the analyst to separate facts from opinions. Opinion questions often ask respondents the extent to which they agree or disagree (e.g., Are network problems common?), whereas factual questions seek more precise values (e.g., How often does a network problem occur: once an hour, once a day, once a week?). See **Figure 3-11** for guidelines on questionnaire design.

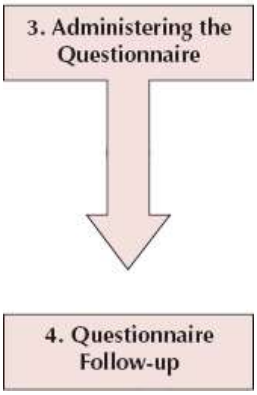
Perhaps the most obvious issue—but one that is sometimes overlooked—is to have a clear understanding of how the information collected from the questionnaire will be analyzed and used. This issue must be addressed before the questionnaire is distributed, because it is too late afterward.

Questions should be relatively consistent in style, so that the respondent does not have to read instructions for each question before answering it. It is generally good practice to group related questions together to make them simpler to answer. Some experts suggest that questionnaires should start with questions important to respondents, so that the questionnaire immediately grabs their interest and induces them to answer it. Perhaps the most important step is to have several colleagues review the questionnaire and then pretest it with a few people drawn from the groups to

whom it will be sent. It is surprising how often seemingly simple questions can be misunderstood.

- Begin with nonthreatening and interesting questions.
- Group items into logically coherent sections.
- Do not put important items at the very end of the questionnaire.
- Do not crowd a page with too many items.
- Avoid abbreviations.
- Avoid biased or suggestive items or terms.
- Number questions to avoid confusion.
- Pretest the questionnaire to identify confusing questions.
- Provide anonymity to respondents.

FIGURE 3-11 Good Questionnaire Design



Third, the key issue in administering the questionnaire is getting participants to complete the questionnaire and send it back. Dozens of marketing research books have been written about ways to improve response rates. Commonly used techniques include clearly explaining why the questionnaire is being conducted and why the respondent has been selected; stating a date by which the questionnaire is to be returned; offering an inducement to complete the questionnaire (e.g., a free pen); and offering to supply a summary of the questionnaire responses. Systems analysts have additional techniques to improve response rates inside the organization, such as personally handing out the questionnaire and personally contacting those who have not returned them after a week or two, as well as requesting the respondents' supervisors to administer the questionnaires in a group meeting.

Fourth, it is helpful to process the returned questionnaires and develop a questionnaire report soon after the questionnaire deadline. This ensures that the analysis process proceeds in a timely fashion and that respondents who requested copies of the results receive them promptly.

YOUR TURN: 3-6 Questionnaire Practice

Organize yourselves into small groups. Have each person develop a short questionnaire to collect information about how often group members perform some process (e.g., working on a class assignment, making a sandwich, paying bills,

getting to class), how long it takes them, how they feel about the process, and opportunities for improving the process.

Once everyone has completed his or her questionnaire, ask each member to pass it to the right and then complete his or her neighbor's questionnaire. Pass the questionnaire back to the creator when it is completed.

Questions

1. How did the questionnaire you completed differ from the one you created?
2. What are the strengths of each questionnaire?
3. How would you analyze the survey results if you had received fifty responses?
4. What would you change about the questionnaire that you developed?

Document Analysis

Project teams often use document analysis to understand the as-is system. Under ideal circumstances, the project team that developed the existing system will have produced documentation that was then updated by all subsequent projects. In this case, the project team can start by reviewing the documentation and examining the system itself.

Unfortunately, most systems are not well documented because project teams fail to document their projects along the way, and when the projects are over, there is no time to go back and document. Therefore, there might not be much technical documentation about the current systems available, or it might not contain updated information about recent system changes. However, many helpful documents do exist in an organization: paper reports, memorandums, policy manuals, user-training manuals, organization charts, forms, and, of course, the user interface with the existing system.

But these documents tell only part of the story. They represent the *formal system* that the organization uses. Quite often, the real, or *informal, system* differs from the formal one, and these differences, particularly large ones, give strong indications of what needs to be changed. For example, forms or reports that are never used should probably be eliminated. Likewise, boxes or questions on forms that are never filled in (or are used for other purposes) should be rethought. See **Figure 3-12** for an example of how a document can be interpreted.

The most powerful indication that the system needs to be changed is when users create their own forms or add additional information to existing ones. Such changes clearly demonstrate the need for improvements to existing systems. Thus, it is useful to review both blank and completed forms to identify these deviations. Likewise, when users access multiple

reports to satisfy their information needs, it is a clear sign that new information or new information formats are needed.

CONCEPTS IN ACTION: 3-F Publix Credit-Card Forms

*A*t my neighborhood Publix grocery store, the cashiers always hand-write the total amount of the charge on every credit-card charge form, even though it is printed on the form. Why? Because the "back office" staff people who reconcile the cash in the cash drawers with the amount sold at the end of each shift find it hard to read the small print on the credit-card forms. Writing in large print makes it easier for them to add the values up. However, cashiers sometimes make mistakes and write the wrong amount on the forms, which causes problems.

Questions

1. What does the credit-card charge form indicate about the existing system?
2. How can you make improvements with a new system?

Barbara Wixom

Observation

Observation, the act of watching processes being performed, is a powerful tool for gathering information about the as-is system because it enables the analyst to see the reality of a situation, rather than listening to others describe it in interviews or JAD sessions. Several research studies have shown that many managers really do not remember how they work and how they allocate their time. (Quick, how many hours did you spend last week on each of your courses?) Observation is a good way to check the validity of information gathered from indirect sources such as interviews and questionnaires.

In many ways, the analyst becomes an anthropologist as he or she walks through the organization and observes the business system as it functions. The goal is to keep a low profile, to not interrupt those working, and to not influence those being observed. Nonetheless, it is important to understand that what analysts observe may not be the normal day-to-day routine because people tend to be extremely careful in their behavior when they are being watched. Even though normal practice may be to break formal organizational rules, the observer is unlikely to see this. (Remember how you drove the last time a police car followed you?) Thus, what you see might *not* be what you get.

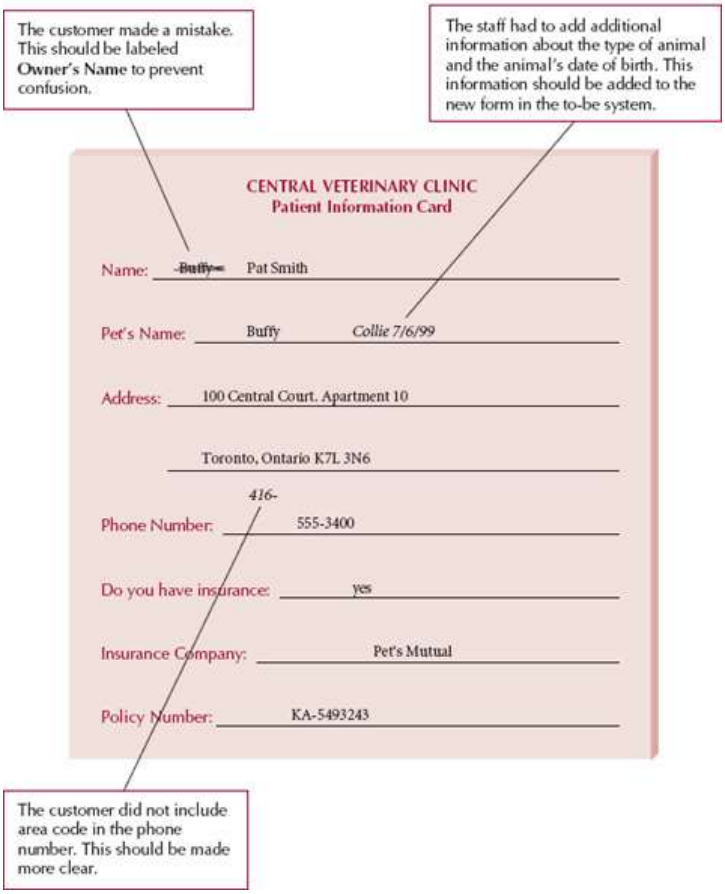


FIGURE 3-12 Performing a Document Analysis

YOUR TURN: 3-7 Observation Practice

*V*isit the library at your college or university and observe how the book checkout process occurs. First watch several students checking books out, and then check one out yourself. Prepare a brief summary report of your observations.

When you return to class, share your observations with others.

Questions

1. Why might the reports present different information?
2. How would the information be different had you used the interview or JAD technique?

	Interviews	Joint Application Design	Questionnaires	Document Analysis	Observation
Type of information	As-is, improvements, to-be	As-is, improvements, to-be	As-is, improvements	As-is	As-is
Depth of information	High	High	Medium	Low	Low
Breadth of information	Low	Medium	High	High	Low
Integration of information	Low	High	Low	Low	Low
User involvement	Medium	High	Low	Low	Low
Cost	Medium	Low–Medium	Low	Low	Low to Medium

FIGURE 3-13 Table of Requirements-Gathering Techniques

Observation is often used to supplement interview information. The location of a person's office and its furnishings give clues to the person's power and influence in the organization and can be used to support or refute information given in an interview. For example, an analyst might become skeptical of someone who claims to use the existing computer system extensively if the computer is never turned on while the analyst visits. In most cases, observation supports the information that users provide in interviews. When it does not, it is an important signal that extra care must be taken in analyzing the business system.

Selecting the Appropriate Techniques

Each of the requirements-gathering techniques discussed earlier has strengths and weaknesses. No one technique is always better than the others, and in practice most projects use a combination of techniques. Thus, it is important to understand the strengths and weaknesses of each technique and when to use each (see **Figure 3-13**). One issue not discussed is that of the analysts' experience. In general, document analysis and observation require the least amount of training, whereas JAD sessions are the most challenging.

Type of Information The first characteristic is type of information. Some techniques are more suited for use at different stages of the analysis process, whether understanding the as-is system, identifying improvements, or developing the to-be system. Interviews and JAD are commonly used in all three stages. In contrast, document analysis and observation usually are most helpful for understanding the as-is, although occasionally they provide information about current problems that need to be improved. Questionnaires are often used to gather information about the as-is system as well as general information about improvements.

Depth of Information The depth of information refers to how rich and detailed the information is that the technique usually produces and the extent to which the technique is useful for obtaining not only facts and opinions but also an understanding of *why* those facts and opinions exist. Interviews and JAD sessions are very useful for providing a good depth of rich and detailed information and helping the analyst to understand the reasons behind them. At the other extreme, document analysis and observation are useful for obtaining facts, but little beyond that. Questionnaires can provide a medium depth of information, soliciting both facts and opinions with little understanding of why they exist.

Breadth of Information Breadth of information refers to the range of information and information sources that can be easily collected using the chosen technique. Questionnaires and document analysis are both easily capable of soliciting a wide range of information from a large number of information sources. In contrast, interviews and observation require the

analyst to visit each information source individually and, therefore, take more time. JAD sessions are in the middle because many information sources are brought together at the same time.

Integration of Information One of the most challenging aspects of requirements gathering is integrating the information from different sources. Simply put, different people can provide conflicting information. Combining this information and attempting to resolve differences in opinions or facts is usually very time consuming because it means contacting each information source in turn, explaining the discrepancy, and attempting to refine the information. In many cases, the individual wrongly perceives that the analyst is challenging his or her information, when in fact it is another user in the organization who is doing so. This can make the user defensive and make it hard to resolve the differences.

All techniques suffer integration problems to some degree, but JAD sessions are designed to improve integration because all information is integrated when it is collected, not afterward. If two users provide conflicting information, the conflict becomes immediately obvious, as does the source of the conflict. The immediate integration of information is the single most important benefit of JAD that distinguishes it from other techniques, and this is why most organizations use JAD for important projects.

User Involvement User involvement refers to the amount of time and energy the intended users of the new system must devote to the analysis process. It is generally agreed that as users become more involved in the analysis process, the chance of success increases. However, user involvement can have a significant cost, and not all users are willing to contribute valuable time and energy. Questionnaires, document analysis, and observation place the least burden on users, whereas JAD sessions require the greatest effort.

Cost Cost is always an important consideration. In general, questionnaires, document analysis, and observation are low-cost techniques (although observation can be quite time consuming). The low cost does not imply that they are more or less effective than the other techniques. Interviews and JAD sessions generally have moderate costs. In general, JAD sessions are much more expensive initially, because they require many users to be absent from their offices for significant periods of time, and they often involve highly paid consultants. However, JAD sessions significantly reduce the time spent in information integration and thus can cost less in the long term.

Combining Techniques In practice, requirements gathering combines a series of different techniques. Most analysts start by using interviews with senior manager(s) to gain an understanding of the project and the

big-picture issues. From these interviews, it becomes clear whether large or small changes are anticipated. These interviews are often followed with analysis of documents and policies to gain some understanding of the as-is system. Usually interviews come next to gather the rest of the information needed for the as-is picture.

In our experience, identifying improvements is most commonly done using JAD sessions because the JAD session enables the users and key stakeholders to work together through an analysis technique and come to a shared understanding of the possibilities for the to-be system. Occasionally, these JAD sessions are followed by questionnaires sent to a much wider set of users or potential users to see whether the opinions of those who participated in the JAD sessions are widely shared.

Developing the concept for the to-be system is often done through interviews with senior managers, followed by JAD sessions with users of all levels to make sure the key needs of the new system are well understood.

CONCEPTS IN ACTION: 3-G Campus Technology Updates

Colleges and universities need to stay current with technologies. Many campuses have adopted laptop programs, where students are expected to purchase or lease a particular model of laptop that will be preloaded with appropriate software and used for the students' collegiate careers. Likewise, the campuses need to update their infrastructure—such as increasing bandwidth (to handle more video, such as YouTube)—and to provide wireless communication.

The University of Northern Wisconsin is a campus that is trying to remain current with technology. Campus budgets are almost always tight. UNW offers programs from its Superior, Wisconsin, main campus as well as programs on two satellite campuses in Ashland and Rhinelander. Users on the two satellite campuses frequently do not get the same level of service as students on the main campus. Internet access is generally slower and not all the software is the same. For example, students at the main campus have access to Bloomberg systems for analysis of financial trading data. The campus opted to build an Internet portal for all students to get to the same software and systems, set up by student ID and student profiles and permissions.

Questions

1. What technologies would be needed to make your campus a premier technology-oriented school?
2. How might a college campus be like a business with multiple locations and software needs?

ALTERNATIVE REQUIREMENTS DOCUMENTATION TECHNIQUES

Some other very useful requirements-gathering and documentation techniques include throwaway prototyping, use cases, role-playing CRC cards with use case–based scenarios, concept mapping, recording user stories on story cards, and task lists. Throwaway prototyping was described in **Chapter 1**. In essence, throwaway prototypes are created to better understand some aspect of the new system. In many cases, they are used to test out some technical aspect of a nonfunctional requirement, such as connecting a client workstation to a server. If you have never done this before, it will be a lot easier to develop a very small example system to test out the necessary design of the connection from the client workstation to the server instead of trying to do it the first time with the full blown system. Throw-away prototyping is very useful when designing the physical architecture of the system (see **Chapter 11**). Throwaway prototyping can also be very useful in designing user interfaces (see **Chapter 10**).

Use cases, as described in **Chapter 1**, are the fundamental approach that the Unified Process and Unified Modeling Language (UML) use to document and gather functional requirements. We describe them in **Chapter 4**. Role-playing CRC cards with use case–based scenarios are very useful when creating functional (see **Chapter 4**), structural (see **Chapter 5**), and behavioral (see **Chapter 6**) models. We describe this approach in **Chapter 5**. The remainder of this section describes the use of concept mapping, story cards, and task lists.

Concept Maps

Concept maps represent meaningful relationships between concepts. They are useful for focusing individuals on the small number of key ideas on which they should concentrate. A concept map is essentially a node-and-arc representation, where the nodes represent the individual requirements and the arcs represent the relationships among the requirements. Each arc is labeled with a relationship name. Concept maps also have been recommended as a possible technique to support modeling requirements for object-oriented systems development and knowledge-management systems.[12] *Concept mapping* is an educational psychology technique that has been used in schools, corporations, and health-care agencies to facilitate learning, understanding, and knowledge creation.[13] The advantage of the concept-mapping approach to representing requirements over the typical textual approach (see **Figure 3-3**) is that a concept map is not limited to a hierarchical representation. Concept maps allow the relationships among the functional and nonfunctional requirements to be explicitly represented. **Figure 3-14** shows a concept map that portrays the information contained in the requirements definition shown in **Figure 3-3**. By using a concept map to represent the requirements instead of the textual approach, the relationship between the functional and nonfunctional requirements can be made explicit. For example, the two security requirements, Only Doctors Set Availability and Only Managers Can

Produce Schedule are explicitly linked to the Record Doctor Availability and Produce Schedule functional requirements, respectively. This is very difficult to represent in a text-only version of the requirements definition. Also, by having the user and analyst focus on the graphical layout of the map, additional requirements can be discovered. One obvious issue with this approach is that if the number of requirements become many and the relationships between them become complex, then the number of nodes and arcs will become so intertwined that the advantage of being able to explicitly see the relationships will be lost. However, by combining both text and concept-map representations, it is possible to leverage the strength of both textual and graphical representations to more completely represent the requirements.

Story Cards and Task Lists

The use of *story cards* and *task lists* is associated with the agile development approaches. From an agile perspective, documentation is only a necessary evil and should be minimized. Both story cards and task lists are considered to be lightweight approaches to documenting and gathering requirements.[14] A story card is typically an index card with a single requirement (functional or nonfunctional) written on it. For example, with regard to the doctor's office appointment example, a story card could simply have “Make Appointment” written on it, while another could have “Back up Schedule Daily” written on it (see **Figure 3-15**). Once the requirement is written down, it is discussed to determine the amount of effort it will take to implement it. During the discussion, a task list is created for the requirement (story). If the requirement is deemed to be too large—for example, there are too many tasks on the task list—the requirement is split up into multiple story cards and the tasks are allocated across the new stories. In many shops, once a set of tasks have been identified with a story, the story and its tasks are taped on a wall together so that all members of the development team can see the requirements. The story can be prioritized by importance by placing a rating on the card. The story can also be evaluated for the level of risk associated with it. The importance level and amount of risk associated with the story can be used to help choose which requirements to implement first. Advantages of using story cards and task lists to document requirements is that they are very low tech, high touch, easily updatable, and very portable.

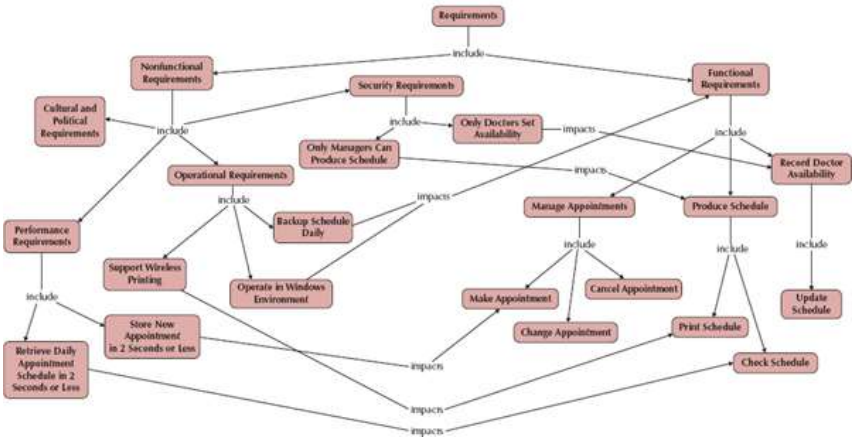


FIGURE 3-14 Sample Requirements Concept Map

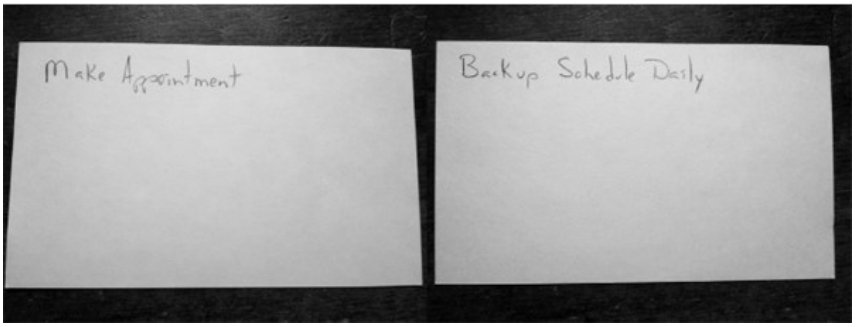


FIGURE 3-15 Sample Story Cards

THE SYSTEM PROPOSAL

A system proposal brings together into a single comprehensive document the material created during planning and analysis. The system proposal typically includes an executive summary, the system request, the work-plan, the feasibility analysis, the requirements definition, and the evolving models that describe the new system. The evolving models include functional models (see **Chapter 4**), structural models (see **Chapter 5**), and behavioral models (see **Chapter 6**).[15] The executive summary provides all critical information in a very concise form. It can be thought of as a summary of the complete proposal. Its purpose is to allow a busy executive to quickly read through it and determine which parts of the proposal he or she needs to go through more thoroughly. The executive summary is typically no more than a single page long. **Figure 3-16** provides a template for a system proposal and references to where the other sections of the proposal are described.

1. **Table of Contents**
2. **Executive Summary**
   A summary of all the essential information in the proposal so a busy executive can read it quickly and decide what parts of the proposal to read in more depth.
3. **System Request**
   The revised system request form (see Chapter 2).
4. **Workplan**
   The original workplan, revised after having completed analysis (see Chapter 2).
5. **Feasibility Analysis**
   A revised feasibility analysis, using the information from analysis (see Chapter 2).
6. **Requirements Definition**
   A list of the functional and nonfunctional business requirements for the system (this chapter).
7. **Functional Model**
   An activity diagram, a set of use case descriptions, and a use-case diagram that illustrate the basic processes or external functionality that the system needs to support (see Chapter 4).
8. **Structural Models**
   A set of CRC cards, class diagram, and object diagrams that describe the structural aspects of the to-be system (see Chapter 5). This may also include structural models of the current as-is system that will be replaced.
9. **Behavioral Models**
   A set of sequence diagrams, communication diagrams, behavioral-state machines, and a CRUDE matrix that describe the internal behavior of the to-be system (see Chapter 6). This may include behavioral models of the as-is system that will be replaced.
10. **Appendices**
    These contain additional material relevant to the proposal, often used to support the recommended system. This might include results of a questionnaire survey or interviews, industry reports and statistics, and so on.

FIGURE 3-16 System Proposal Template

APPLYING THE CONCEPTS AT CD SELECTIONS

In this chapter, we introduced how the requirements are determined in object-oriented systems development projects. Specifically, we described what a requirement is, how to create a requirements definition, and a set of problems that can arise when determining requirements. Next, we reviewed three different requirements analysis strategies, along with a set of techniques that can be used in conjunction with the strategies. After that, we reviewed a set of generic requirements-gathering techniques and a couple of alternative techniques that can be used with an object-oriented system development project. Finally, we showed how the results of the requirements determination processes, along with an updated system request, feasibility analysis, and workplan, are organized into and documented by a system proposal. In this installment of the CD Selections case, we see how Alec and Margaret work through all of these topics with regards to the Web-based solution that they hope to create.

SUMMARY

Requirements Determination

Requirements determination is the part of analysis whereby the project team turns the very high-level explanation of the business requirements stated in the system request into a more precise list of requirements. A requirement is simply a statement of what the system must do or what characteristic it needs to have. Business requirements describe the "what" of the systems, and system requirements describe how the system will be implemented. A functional requirement relates directly to a

process the system has to perform or information it needs to contain. Nonfunctional requirements refer to behavioral properties that the system must have, such as performance and usability. All the functional and nonfunctional business requirements that fit within the scope of the system are written in the requirements definition, which is used to create other analysis deliverables and leads to the initial design for the new system.

Requirements Analysis Strategies

The basic process of analysis is divided into three steps: understanding the as-is system, identifying improvements, and developing requirements for the to-be system. Three requirements analysis strategies—BPA, BPI, and BPR—help the analyst lead users through the analysis steps so that the vision of the system can be developed. BPA means leaving the basic way the organization operates unchanged and using computer technology to do some of the work. Problem analysis and root-cause analysis are two popular BPA techniques. BPI means making moderate changes to the way the organization operates to take advantage of new opportunities offered by technology or to copy what competitors are doing. Duration analysis, activity-based costing, and information benchmarking are three popular BPI activities. BPR means changing the fundamental way the organization operates. Outcome analysis, technology analysis, and activity elimination are three popular BPR activities.

Requirements-Gathering Techniques

Five techniques can be used to gather the business requirements for the proposed system: interviews, joint application development, questionnaires, document analysis, and observation. Interviews involve meeting one or more people and asking them questions. There are five basic steps in the interview process: selecting interviewees, designing interview questions, preparing for the interview, conducting the interview, and performing postinterview follow-up. JAD allows the project team, users, and management to work together to identify requirements for the system. Electronic JAD attempts to overcome common problems associated with groups by using groupware. A questionnaire is a set of written questions for obtaining information from individuals. Questionnaires are often used when information and opinions are needed from a large number of people. Document analysis entails reviewing the documentation and examining the system itself. It can provide insights into the formal and informal system. Observation, the act of watching processes being performed, is a powerful tool for gathering information about the as-is system because it enables the analyst to see the reality of a situation firsthand.

Alternative Requirements Documentation Techniques

In addition to the five traditional approaches to gathering and documenting requirements, a set of alternative approaches may be useful. Concept maps are not limited to supporting hierarchical relationships; they support networked or Web-based relationships. Concept maps, therefore, can provide a more complete picture of the relationships among the functional and nonfunctional requirements. Story cards and task lists from the agile methodologies provide a low-tech, high-touch, easily updatable, and very portable approach that users find simple and intuitive to use to document both functional and nonfunctional requirements.

The System Proposal

The system proposal documents the results of the planning and analysis activities in a single comprehensive document. The actual format of the system proposal depends somewhat on the client. For example, the federal government has very specific requirements that a system proposal must meet, whereas a small locally owned bike shop would be willing to use a much simpler format.

KEY TERMS

1. Activity elimination, 123
2. Activity-based costing, 121
3. Analysis, 118
4. As-is system, 110
5. Benchmarking, 121
6. Bottom-up interview, 128
7. Breadth of analysis, 123
8. Business process automation (BPA), 116
9. Business process improvement (BPI), 116
10. Business process reengineering (BPR), 116
11. Business requirements, 112
12. Closed-ended question, 127
13. Concept mapping, 144
14. Concept maps, 144
15. Critical thinking skills, 118
16. Document analysis, 138
17. Duration analysis, 121
18. Electronic JAD (e-JAD), 133
19. Facilitator, 133
20. Formal system, 139
21. Functional requirements, 112
22. Ground rules, 135
23. Informal benchmarking, 121
24. Informal system, 139
25. Interpersonal skills, 132
26. Interview, 126

27. Interview notes, 130
28. Interview report, 130
29. Interview schedule, 126
30. JAD (joint application development), 132
31. Nonfunctional requirements, 112
32. Observation, 139
33. Open-ended question, 127
34. Outcome analysis, 122 Parallelization, 121
35. Process Integration, 121
36. Post-session report, 135
37. Potential business value, 123
38. Probing question, 127
39. Problem analysis, 119
40. Project cost, 123
41. Questionnaire, 136
42. Requirement, 112
43. Requirements definition, 115
44. Requirements determination, 110
45. Risk, 124
46. Root cause, 119
47. Root-cause analysis, 119
48. Sample, 137
49. Scribe, 133
50. Story cards, 144
51. Structured interview, 128
52. System proposal, 110
53. System requirements, 112
54. Task lists, 144
55. Technology analysis, 122
56. To-be system, 110
57. Top-down interview, 128
58. Unstructured interview, 128
59. Walkthrough, 110

QUESTIONS

1. What are the key deliverables that are created during analysis? What is the final deliverable from analysis, and what does it contain?
2. What is the difference between an as-is system and a to-be system?
3. What is the purpose of the requirements definition?
4. What are the three basic steps of the analysis process? Which step is sometimes skipped or done in a cursory fashion? Why?
5. Compare and contrast the business goals of BPA, BPI, and BPR.
6. Compare and contrast problem analysis and root-cause analysis. Under what conditions would you use problem analysis? Under what conditions would you use root-cause analysis?

7. Compare and contrast duration analysis and activity-based costing.
8. Assuming time and money were not important concerns, would BPR projects benefit from additional time spent understanding the as-is system? Why or why not?
9. What are the important factors in selecting an appropriate analysis strategy?
10. Describe the five major steps in conducting interviews.
11. Explain the differences among a closed-ended question, an open-ended question, and a probing question. When would you use each?
12. Explain the differences between unstructured interviews and structured interviews. When would you use each approach?
13. Explain the difference between a top-down and bottom-up interview approach. When would you use each approach?
14. How are participants selected for interviews and JAD sessions?
15. How can you differentiate between facts and opinions? Why can both be useful?
16. Describe the five major steps in conducting JAD sessions.
17. How does a JAD facilitator differ from a scribe?
18. What are the three primary things that a facilitator does in conducting the JAD session?
19. What is e-JAD and why might a company be interested in using it?
20. How does designing questions for questionnaires differ from designing questions for interviews or JAD sessions?
21. What are typical response rates for questionnaires and how can you improve them?
22. What is document analysis?
23. How does the formal system differ from the informal system? How does document analysis help you understand both?
24. What are the key aspects of using observation in the information-gathering process?
25. Explain factors that can be used to select information-gathering techniques.
26. What is the primary advantage that concept maps have over traditional textual requirements documents techniques?
27. What are some of the advantages of using story cards and task lists as a requirements-gathering and documentation technique?
28. What information is typically included in a system proposal?
29. What is the purpose of the executive summary of the system proposal?

EXERCISE

1. Review the **Amazon.com** website. Develop the requirements definition for the site. Create a list of functional business requirements that the system meets. What different kinds of nonfunctional business requirements does the system meet? Provide examples for each kind.

2. Suppose you are going to build a new system that automates or improves the interview process for the career services department of your school. Develop a requirements definition for the new system. Include both functional and nonfunctional system requirements. Pretend you will release the system in three different versions. Prioritize the requirements accordingly.
3. Describe in very general terms the as-is business process for registering for classes at your university. What BPA technique would you use to identify improvements? With whom would you use the BPA technique? What requirements-gathering technique would help you apply the BPA technique? List some examples of improvements that you would expect to find.
4. Describe in very general terms the as-is business process for registering for classes at your university. What BPI technique would you use to identify improvements? With whom would you use the BPI technique? What requirements-gathering technique would help you apply the BPI technique? List some examples of improvements that you would expect to find.
5. Describe in very general terms the as-is business process for registering for classes at your university. What BPR technique would you use to identify improvements? With whom would you use the BPR technique? What requirements-gathering technique would help you apply the BPR technique? List some examples of improvements that you would expect to find.
6. Suppose your university is having a dramatic increase in enrollment and is having difficulty finding enough seats in courses for students. Perform a technology analysis to identify new ways to help students complete their studies and graduate.
7. Suppose you are the analyst charged with developing a new system for the university bookstore so students can order books online and have them delivered to their dorms or off-campus housing. What requirements-gathering techniques will you use? Describe in detail how you would apply the techniques.
8. Suppose you are the analyst charged with developing a new system to help senior managers make better strategic decisions. What requirements-gathering techniques will you use? Describe in detail how you would apply the techniques.
9. Find a partner and interview each other about what tasks each did in the last job you held (full-time, part-time, past, or current). If you haven't worked before, then assume your job is being a student. Before you do this, develop a brief interview plan. After your partner interviews you, identify the type of interview, interview approach, and types of questions used.
10. Find a group of students and run a 60-minute JAD session on improving alumni relations at your university. Develop a brief JAD plan, select two techniques that will help identify improvements, and then de-

velop an agenda. Conduct the session using the agenda, and write your post-session report.

11. Find a questionnaire on the Web that has been created to capture customer information. Describe the purpose of the survey, the way questions are worded, and how the questions have been organized. How can it be improved? How will the responses be analyzed?
12. Develop a questionnaire that will help gather information regarding processes at a popular restaurant or the college cafeteria (e.g., ordering, customer service). Give the questionnaire to ten to fifteen students, analyze the responses, and write a brief report that describes the results.
13. Contact the career services department at your university and find all the pertinent documents designed to help students find permanent and/or part-time jobs. Analyze the documents and write a brief report.

MINICASES

1. The State Firefighter's Association has a membership of 15,000. The purpose of the organization is to provide some financial support to the families of deceased member firefighters and to organize a conference each year bringing together firefighters from all over the state. Members are billed dues and calls annually. Calls are additional funds required to take care of payments made to the families of deceased members. The bookkeeping work for the association is handled by the elected treasurer, Bob Smith, although it is widely known that his wife, Laura, does all the work. Bob runs unopposed each year at the election, because no one wants to take over the tedious and time-consuming job of tracking memberships. Bob is paid a stipend of $8,000 per year, but his wife spends well over twenty hours per week on the job. The organization, however, is not happy with their performance.
   A computer system is used to track the billing and receipt of funds. This system was developed in 1984 by a computer science student and his father. The system is a DOS-based system written using dBase 3. The most immediate problem facing the treasurer and his wife is the fact that the software package no longer exists, and there is no one around who knows how to maintain the system. One query, in particular, takes seventeen hours to run. Over the years, they have just avoided running this query, although the information in it would be quite useful. Questions from members concerning their statements cannot easily be answered. Usually Bob or Laura just jots down the inquiry and returns a call with the answer. Sometimes it takes three to five hours to find the information needed to answer the question. Often, they have to perform calculations manually because the system was not programmed to handle certain types of queries. When member information is entered into the system, each field is presented one at a time, which makes it very difficult to return to a field and correct

a value that was entered. Sometimes a new member is entered but disappears from the records. The report of membership used in the conference materials does not alphabetize members by city. Only cities are listed in the correct order.

What requirements analysis strategy or strategies would you recommend for this situation? Explain your answer.

2. Brian Callahan, IS project manager, is just about ready to depart for an urgent meeting called by Joe Campbell, manager of manufacturing operations. A major BPI project sponsored by Joe recently cleared the approval hurdle, and Brian helped bring the project through project initiation. Now that the approval committee has given the go-ahead, Brian has been working on the project's analysis plan.

   One evening, while playing golf with a friend who works in the manufacturing operations department, Brian learned that Joe wants to push the project's time frame up from Brian's original estimate of 13 months. Brian's friend overheard Joe say, “I can't see why that IS project team needs to spend all that time analyzing things. They've got two weeks scheduled just to look at the existing system! That seems like a real waste. I want that team to get going on building my system.” Because Brian has a little inside knowledge about Joe's agenda for this meeting, he has been considering how to handle Joe. What do you suggest Brian tell Joe?

3. Barry has recently been assigned to a project team that will be developing a new retail store management system for a chain of submarine sandwich shops. Barry has several years of experience in programming, but he has not done much analysis in his career. He was a little nervous about the new work he would be doing, but he was confident he could handle any assignment he was given.

   One of Barry's first assignments was to visit one of the submarine sandwich shops and prepare an observation report on how the store operates. Barry planned to arrive at the store around noon, but he chose a store in an area of town he was unfamiliar with, and due to traffic delays and difficulty in finding the store, he did not arrive until 1:30. The store manager was not expecting him and refused to let a stranger behind the counter until Barry had her contact the project sponsor (the director of store management) at company headquarters to verify who he was and what his purpose was.

   After finally securing permission to observe, Barry stationed himself prominently in the work area behind the counter so that he could see everything. The staff had to maneuver around him as they went about their tasks, but there were only minor occasional collisions. Barry noticed that the store staff seemed to be going about their work very slowly and deliberately, but he supposed that was because the store wasn't very busy. At first, Barry questioned each worker about what he or she was doing, but the store manager eventually asked him not

to interrupt their work so much—he was interfering with their service to the customers.

By 3:30, Barry was a little bored. He decided to leave, figuring he could get back to the office and prepare his report before 5:00 that day. He was sure his team leader would be pleased with his quick completion of his assignment. As he drove, he reflected, “There really won't be much to say in this report. All they do is take the order, make the sandwich, collect the payment, and hand over the order. It's really simple!” Barry's confidence in his analytical skills soared as he anticipated his team leader's praise.

Back at the store, the store manager shook her head, commenting to her staff, “He comes here at the slowest time of day on the slowest day of the week. He never even looked at all the work I was doing in the back room while he was here—summarizing yesterday's sales, checking inventory on hand, making up resupply orders for the weekend… plus he never even considered our store-opening and -closing procedures. I hate to think that the new store management system is going to be built by someone like that. I'd better contact Chuck [the director of store management] and let him know what went on here today.”

Evaluate Barry's conduct of the observation assignment.

4. Anne has been given the task of conducting a survey of sales clerks who will be using a new order-entry system being developed for a household products catalog company. The goal of the survey is to identify the clerks’ opinions on the strengths and weaknesses of the current system. There are about 50 clerks who work in three different cities, so a survey seemed like an ideal way of gathering the needed information from the clerks.

   Anne developed the questionnaire carefully and pretested it on several sales supervisors who were available at corporate headquarters. After revising it based on their suggestions, she sent a paper version of the questionnaire to each clerk, asking that it be returned within one week. After one week, she had only three completed questionnaires returned. After another week, Anne received just two more completed questionnaires. Feeling somewhat desperate, Anne then sent out an e-mail version of the questionnaire, again to all the clerks, asking them to respond to the questionnaire by e-mail as soon as possible. She received two e-mail questionnaires and three messages from clerks who had completed the paper version expressing annoyance at being bothered with the same questionnaire a second time. At this point, Anne has just a 14 percent response rate, which she is sure will not please her team leader. What suggestions do you have that could have improved Anne's response rate to the questionnaire?

---

1 For example, see *The Scope of Software Development Project Failures* (Dennis, MA: The Standish Group, 1995).

2 A concise discussion of the Sarbanes-Oxley Act is presented in G. P. Lander, *What is Sarbanes-Oxley?* (New York: McGraw-Hill, 2004). A good reference for Sarbanes-Oxley Act–based security requirements is D. C. Brewer, *Security Controls for Sarbanes-Oxley Section 404 IT Compliance: Authorization, Authentication, and Access* (Indianapolis, IN: Wiley, 2006). For detailed information on COBIT, see **www.isaca.org**, for ISO 9000, see **www.iso.org**, and for details on the Capability Maturity Model, see **www.sei.cmu.edu/cmmi/**.

3 T. L. Friedman, *The World is Flat: A Brief History of the Twenty-First Century, Updated and Expanded Edition.* (New York: Farrar, Straus, and Giroux, 2006). For a criticism of Friedman's view, see R. Aronica and M. Ramdoo, *The World is FLAT? A Critical Analysis of Thomas L. Friedman's New York Times Bestseller* (Tampa, FL: MeghanKiffer Press, 2006).

4 See D. Avison and G. Fitzgerald, *Information Systems Development: Methodologies, Techniques, & Tools*, 4th Ed. (London: McGraw-Hill, 2006).

5 Two good books that discuss the difficulty in finding the root causes to problems are: E. M. Goldratt and J. Cox, *The Goal* (Croton-on-Hudson, NY: North River Press, 1986); and E. M. Goldratt, *The Haystack Syndrome* (Croton-on-Hudson, NY: North River Press, 1990).

6 Many books have been written on activity-based costing. Useful ones include K. B. Burk and D. W. Webster, *Activity-Based Costing* (Fairfax, VA: American Management Systems, 1994); and D. T. Hicks, *Activity-Based Costing: Making It Work for Small and Mid-sized Companies* (New York: Wiley, 1998). The two books by Eli Goldratt mentioned previously (*The Goal* and *The Haystack Syndrome*) also offer unique insights into costing.

7 Some excellent books that address the importance of gathering requirements and various techniques include Alan M. Davis, *Software Requirements: Objects, Functions, & States, Revision* (Englewood Cliffs, NJ: Prentice Hall, 1993); Gerald Kotonya and Ian Sommerville, *Requirements Engineering* (Chichester, England: Wiley, 1998); and Dean Leffingwell and Don Widrig, *Managing Software Requirements: A Unified Approach* (Reading, MA: Addison-Wesley, 2000).

8 A good book on interviewing is that by Brian James, *The Systems Analysis Interview* (Manchester, England: NCC Blackwell, 1989).

9 More information on JAD can be found in J. Wood and D. Silver, *Joint Application Development* (New York: Wiley, 1989); and Alan Cline, “Joint

Application Development for Requirements Collection and Management," **http://www.carolla.com/wp-jad.htm**.

---

10 See Kevin Strehlo, "Catching up with the Jones and 'Requirement' Creep," *Infoworld* (July 29, 1996); and Kevin Strehlo, "The Makings of a Happy Customer: Specifying Project X," *Infoworld* (November 11, 1996).

---

11 For more information on e-JAD, see A. R. Dennis, G. S. Hayes, and R. M. Daniels, "Business Process Modeling with Groupware," *Journal of Management Information Systems* 15, no. 4 (1999): 115–142.

---

12 See B. Henderson-Sellers, A. Simons, and H. Younessi, *The OPEN Toolbox of Techniques* (Harlow, England: Addison-Wesley, 1998).

---

13 For more information on concept mapping, see J. D. Novak and D. B. Gowin, *Learning How to Learn* (Cambridge, UK: Cambridge University Press, 1984); and J. D. Novak, *Learning, Creating, and Using Knowledge: Concept Maps™ as Facilitative Tools in Schools and Corporations* (Mahwah, NJ: Lawrence Erlbaum Associates, Publishers, 1998). Also, a free concept mapping tool is available from the Institute of Human and Machine Cognition at cmap.ihmc.us.

---

14 For more information on story cards and task lists see M. Lippert, S. Roock, H. Wolf, *eXtreme Programming in Action: Practical Experiences from Real World Projects* (Chichester, England: Wiley & Sons, Ltd., 2002); and C. Larman, *Agile & Iterative Development: A Manager's Guide* (Boston, MA: Addison-Wesley, 2004).

---

15 Depending on the client, much more detailed specifications may be required; for example Department of Defense, NASA, IEEE/ANSI, and the Naval Research Laboratory all have very specific formats that must be followed. For more information on these more detailed specifications see A. M Davis, *Software Requirements, Revision* (Upper Saddle River, NJ: Prentice Hall, 1993); G. Kotonya and I. Sommerville, *Requirements Engineering* (Chichester, England: Wiley, 1998); and R. H. Thayer and M. Dorfman (eds.), *Software Requirements Engineering*, 2nd ed. (Los Alamitos, CA: IEEE Computer Society Press, 1997).