

## System Development

An *information system* is a collection of hardware, software, data, people, and procedures that work together to produce information. As a user of technology in a business, you someday may participate in the modification of an existing information system or the development of a new one. Thus, it is important that you understand system development.

**System development** is a set of activities used to build an information system. System development activities often are grouped into larger categories called *phases*. This collection of phases sometimes is called the **system development life cycle (SDLC)**. Many traditional SDLCs contain five phases (Figure 11-11):

1. Planning
2. Analysis
3. Design
4. Implementation
5. Support and Security

Each system development phase consists of a series of activities, and the phases form a loop. In theory, the five system development phases often appear sequentially, as shown in Figure 11-11. In reality, activities within adjacent phases often interact with one another, making system development a dynamic, iterative process.

Diagram: Figure 11-11: The System Development Life Cycle (SDLC)

## System Development Guidelines

System development should follow three general guidelines: group activities into phases, involve users, and define standards.

1. **Group activities into phases.** Many SDLCs contain the same phases shown in Figure 11-11. Others have more or fewer phases. Regardless, all system development cycles have similar activities and tasks.
2. **Involve users.** Users include anyone for whom the system is being built. Customers, employees, students, data entry specialists, accountants, sales managers, and owners all are examples of users. Users are more apt to accept a new system if they contribute to its design.
3. **Define standards.** *Standards* are sets of rules and procedures an organization expects employees to accept and follow. Standards help people working on the same project produce consistent results.

## Who Participates in System Development?

System development should involve representatives from each department in which the proposed system will be used. This includes both nontechnical users and IT professionals. Although the roles and responsibilities of members of the system development team may change from organization to organization, this chapter presents general descriptions of tasks for various team members.

During system development, the systems analyst meets and works with a variety of people. A **systems analyst** is responsible for designing and developing an information system. The systems analyst is the users' primary contact person. Depending on the size of the organization, the tasks performed by the systems analyst may vary. Smaller organizations may have one systems analyst or even one person who assumes the roles of both systems analyst and software developer. Larger organizations often have multiple systems analysts who discuss various aspects of the development project with users, management, other analysts, database analysts, database administrators, network administrators, web developers, software developers, vendors, and the steering committee.

For each system development project, an organization usually forms a *project team* to work on the project from beginning to end. The project team consists of users, the systems analyst, and other IT professionals.

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**BTW**  
Steering Committee  
A *steering committee* is a decision-making body in an organization.

## Project Management

Project management is the process of planning, scheduling, and then controlling the activities during system development. The goal of project management is to deliver an acceptable system to the user in an agreed-upon time frame, while maintaining costs.

In smaller organizations or projects, one person manages the entire project. For larger projects, the project management activities often are separated between a project manager and a project leader. In this situation, the *project leader* manages and controls the budget and schedule of the project, and the *project manager* controls the activities during system development. Project leaders and/or project managers are part of the project team. If the systems analyst is not the project manager, he or she works closely with the project manager.

To plan and schedule a project effectively, the project leader identifies the following elements:

- Goals, objectives, and expectations of the project, collectively called the *scope*
- Required activities
- Time estimates for each activity
- Cost estimates for each activity
- Order of activities
- Activities that can take place at the same time



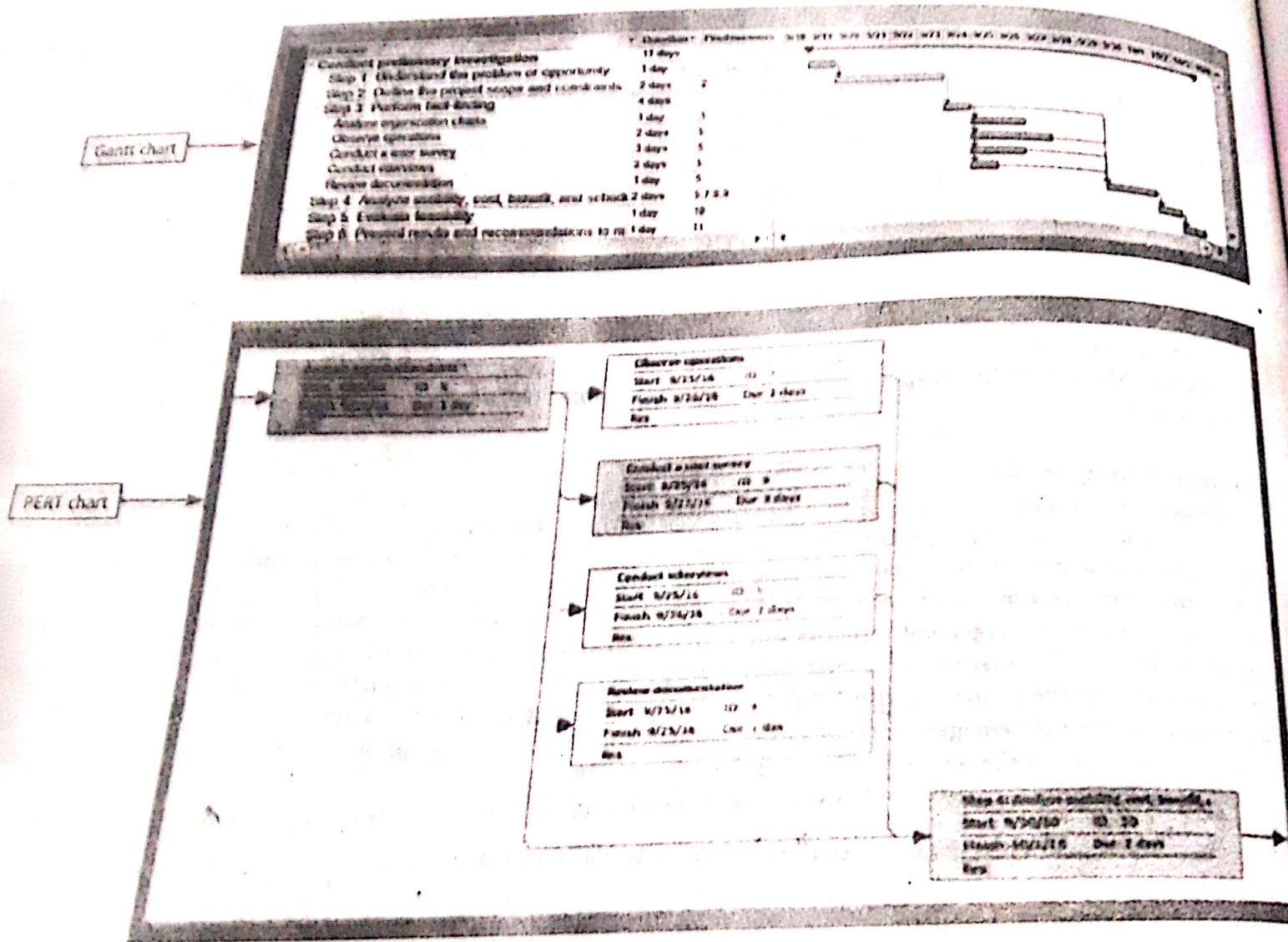
After these items are identified, the project leader usually records them in a project plan. Project leaders can use **project management software** to assist them in planning, scheduling, and controlling development projects. One aspect of managing projects is to ensure that everyone submits deliverables on time and according to plan. A *deliverable* is any tangible item, such as a chart, diagram, report, or program file.

**Gantt and PERT Charts** Popular tools used to plan and schedule the time relationships among project activities are Gantt and PERT charts (Figure 11-12).

- A *Gantt chart*, developed by Henry L. Gantt, is a bar chart that uses horizontal bars to show project phases or activities. The left side, or vertical axis, displays the list of required activities. A horizontal axis across the top or bottom of the chart represents time.
- Developed by the U.S. Department of Defense, a *PERT chart*, short for Program Evaluation and Review Technique chart, analyzes the time required to complete a task and identifies the minimum time required for an entire project.

PERT charts, sometimes called network diagrams, can be more complicated to create than Gantt charts, but are better suited than Gantt charts for planning and scheduling large, complex projects.

complex projects.



**Figure 11-12** Project managers use software to create Gantt charts, PERT charts, and other charts and diagrams.

Page Learning



## Feasibility Assessment

**Feasibility** is a measure of how suitable the development of a system will be to the organization. A project that is feasible at one point during system development might become infeasible at a later point. Systems analysts, therefore, frequently reevaluate feasibility during the system development project.

A systems analyst typically uses at least four tests to evaluate feasibility of a project: operational feasibility, schedule feasibility, technical feasibility, and economic feasibility.

- **Operational feasibility** measures how well the proposed information system will work. Will the users like the new system? Will they use it? Will it meet their requirements? Will it cause any changes in their work environment? Is it secure?
- **Schedule feasibility** measures whether the established deadlines for the project are reasonable. If a deadline is not reasonable, the project leader might make a new schedule. If a deadline cannot be extended, then the scope of the project might be reduced to meet a mandatory deadline.
- **Technical feasibility** measures whether the organization has or can obtain the computing resources, software services, and qualified people needed to develop, deliver, and then support the proposed information system. For most information system projects, hardware, software, and people typically are available to support an information system. An organization's choice for using computing resources and software services in-house or on the cloud may impact a system's technical feasibility.
- **Economic feasibility**, also called *cost/benefit feasibility*, measures whether the lifetime benefits of the proposed information system will be greater than its lifetime costs. A systems analyst often consults the advice of a business analyst, who uses many financial techniques, such as return on investment (ROI) and payback analysis, to perform a cost/benefit analysis.

## Documentation

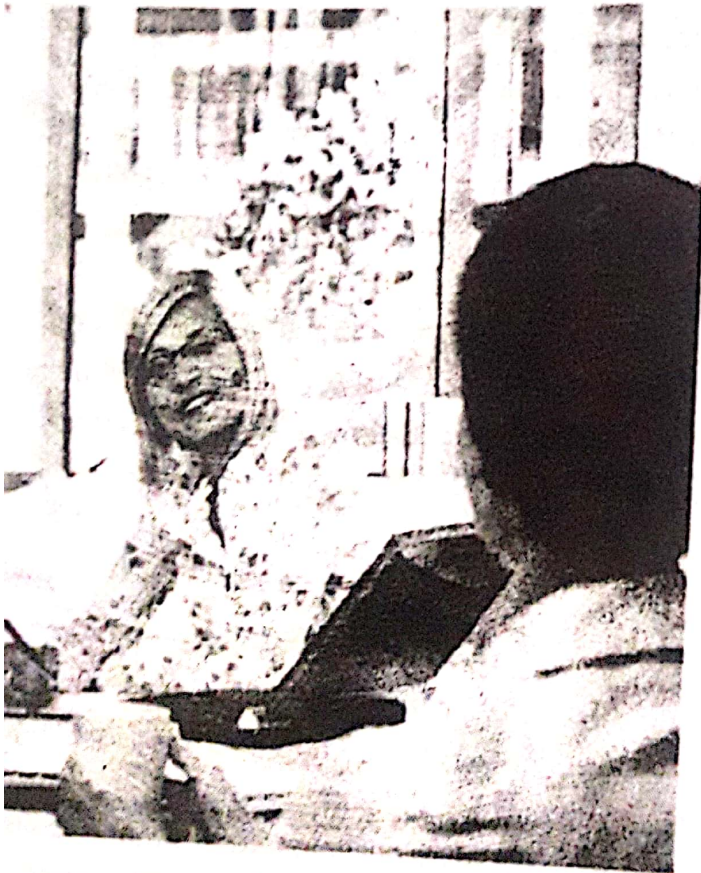
During system development, project members produce a large amount of documentation. Documentation is the collection and summarization of data, information, and deliverables. It is important that all documentation be well written, thorough, consistent, and understandable. The final information system should be reflected accurately and completely in documentation developed throughout the development project. Maintaining up-to-date documentation should be an ongoing part of system development. Too often, project team members put off documentation until the end of the project because it is time consuming, but these practices typically result in lower-quality documentation.



## Data and Information Gathering Techniques

During system development, members of the project team gather data and information. They need accurate and timely data and information for many reasons. They must keep a project on schedule, evaluate feasibility, and be sure the system meets requirements. Systems analysts and other IT professionals use several techniques to gather data and information. They review documentation, observe, survey, interview, conduct joint-application design sessions, and research.

- **Review documentation:** By reviewing documentation such as organization charts, memos, and meeting minutes, systems analysts learn about the history of a project. Documentation also provides information about the organization, such as its operations, weaknesses, and strengths.
- **Observe:** Observing people helps systems analysts understand exactly how they perform a task. Likewise, observing a machine allows you to see how it works.
- **Survey:** To obtain data and information from a large number of people, systems analysts distribute surveys.
- **Interview:** The interview is the most important data and information gathering technique for the systems analyst. It allows the systems analyst to clarify responses and probe during face-to-face feedback.



session, the systems analyst is the moderator, or her member, called the scribe, records facts and the session.

- **JAD sessions:** Instead of a single one-on-one interview, analysts often use joint-application design sessions to gather data and information. A *joint-application design (JAD) session*, or *focus group*, consists of a series of lengthy, structured group meetings in which users and IT professionals work together to design or develop an application (Figure 11-13).
- **Research:** Newspapers, technology magazines and journals, reference books, trade shows, the web, vendors, and consultants are excellent sources of information. These sources can provide the systems analyst with information, such as the latest hardware and software products and explanations of new processes and procedures. In addition, systems analysts often collect website statistics, such as the number of visitors and most-visited webpages, etc., and then evaluate these statistics as part of their research.



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## Planning Phase

The planning phase for a project begins when the steering committee receives a project request. This committee usually consists of five to nine people and typically includes a mix of vice presidents, managers, nonmanagement users, and IT personnel.

During the **planning phase**, four major activities are performed: (1) review and approve the project requests, (2) prioritize the project requests, (3) allocate resources, such as money, people, and equipment to approved projects, and (4) form a project development team for each approved project.

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system.

## Analysis Phase

The analysis phase consists of two major activities: (1) conduct a preliminary investigation and (2) perform detailed analysis.

### The Preliminary Investigation

The main purpose of the preliminary investigation, sometimes called the *feasibility study*, is to determine the exact nature of the problem or improvement and decide whether it is worth pursuing. Should the organization continue to assign resources to this project? To answer this question, the systems analyst conducts a general study of the project.

The first task in the preliminary investigation is to interview the user who submitted the project request. Depending on the nature of the request, project team members may interview other users, too. In addition to interviewing, members of the project team may use other data gathering techniques, such as reviewing existing documentation. Often, the preliminary investigation is completed in just a few days.

Upon completion of the preliminary investigation, the systems analyst writes the feasibility report. This report presents the team's findings to the steering committee.

**Discover More:** Visit this chapter's free resources for a discussion of the preliminary investigation process in the analysis phase in a system development case study, along with an example of a feasibility report.



**Detailed Analysis** *Detailed analysis* involves three major activities: (1) study how the current system works, (2) determine the users' wants, needs, and requirements, and (3) recommend a solution. Detailed analysis sometimes is called *logical design* because the systems analysts develop the proposed solution without regard to any specific hardware or software. That is, they make no attempt to identify the procedures that should be automated and those that should be manual.

While studying the current system and identifying user requirements, the systems analyst collects a great deal of data and information. A major task for the systems analyst is to document these findings in a way that can be understood by everyone. Systems analysts use diagrams to describe the processes that transform inputs into outputs and diagrams that graphically show the flow of data in the system. Both users and IT professionals refer to this documentation.

**The System Proposal** After the systems analyst has studied the current system and determined all user requirements, the next step is to communicate possible solutions for the project in a system proposal. The purpose of the system proposal is to assess the feasibility of each alternative solution and then recommend the most feasible solution for the project, which often involves modifying or expanding the current system. The systems analyst presents the system proposal to the steering committee. If the steering committee approves a solution, the project enters the design phase.

When the steering committee discusses the system proposal and decides which alternative to pursue, it considers whether to modify the existing system, buy retail software from an outside source, use web apps, build its own custom software, and/or outsource some or all of its IT needs to an outside firm. The final decision often is a mix of these options. Read Secure IT 11-2 for issues related to outsourcing.

**Discover More:** Visit this chapter's free resources for a discussion of the detailed analysis process in a system development case study, along with an example of a feasibility report.

## Design Phase

The design phase consists of two major activities: (1) if necessary, acquire hardware and software and (2) develop all of the details of the new or modified information system. The systems analyst often performs these two activities at the same time instead of sequentially.

When the steering committee approves a solution, the systems analyst begins the activity of obtaining additional hardware or software or evaluating cloud providers that offer the computing services to meet the organization's needs. The systems analyst may skip this activity if the approved solution does not require new hardware or software. If this activity is required, it consists of four major tasks: (1) identify technical specifications, (2) solicit vendor proposals, (3) test and evaluate vendor proposals, and (4) make a decision.

**Discover More:** Visit this chapter's free resources to learn more about cloud providers.

**Identify Technical Specifications** The first step in acquiring necessary hardware and software is to identify all the hardware and software requirements of the new or modified system. To do this, systems analysts use a variety of research techniques. They talk with other systems analysts, visit vendors' stores, and search the web. Many trade journals, newspapers, and magazines provide some or all of their printed content online.

After the systems analyst defines the technical requirements, the next step is to summarize these requirements for potential vendors. The systems analyst can use three basic types of documents for this purpose: an RFQ, an RFP, or an RFI.

- A *request for quotation (RFQ)* identifies the required product(s). With an RFQ, the vendor quotes a price for the listed product(s).
- With a *request for proposal (RFP)*, the vendor selects the product(s) that meets specified requirements and then quotes the price(s).
- A *request for information (RFI)* is a less formal method that uses a standard form to request information about a product or service.



**Solicit Vendor Proposals** Systems analysts send the RFQ, RFP, or RFI to potential hardware and software vendors. Another source for hardware and software products is a value-added reseller. A *value-added reseller (VAR)* is an organization that purchases products from manufacturers and then resells these products to the public — offering additional services with the product (Figure 11-14).

Instead of using vendors, some organizations hire an IT consultant or a group of IT consultants. An *IT consultant* is a professional who is hired based on technical expertise, including service and advice.

**Test and Evaluate Vendor Proposals** After sending RFQs, RFPs, or RFIs to potential vendors, the systems analyst will receive completed quotations and proposals. Evaluating the proposals and then selecting the best one often is a difficult task.

Systems analysts use many techniques to test the various software products from vendors. They obtain a list of user references from the software vendors. They also talk to current users of the software to solicit their opinions. Some vendors will provide a demonstration of the product(s) specified. Others supply demonstration copies or trial versions, allowing the organizations to test the software themselves.



**Figure 11-14** Many VARs provide complete systems, often



Sometimes it is important to know whether the software can process a certain volume of transactions efficiently. In this case, the systems analyst conducts a benchmark test. A benchmark test measures the performance of hardware or software. For example, a benchmark test could measure the time it takes a payroll program to print 50 paychecks. Comparing the time it takes various accounting programs to print the same 50 paychecks is one way of measuring each program's performance.

**Make a Decision** Having rated the proposals, the systems analyst presents a recommendation to the steering committee. The recommendation could be to award a contract to a vendor or to not make any purchases at this time.

**Discover More:** Visit this chapter's free resources for a discussion of the hardware acquisition process in the design phase in a system development case study.

**Detailed Design** The next step is to develop detailed design specifications for the components in the proposed solution. The activities to be performed include developing designs for the databases, inputs, outputs, and programs.

- During database design, the systems analyst works closely with the database administrators to identify those data elements that currently exist within the organization and those that are new. The systems analyst also addresses user access privileges.
- During detailed design of inputs and outputs, the systems analyst carefully designs every menu, screen, and report specified in the requirements. The outputs often are designed first because they help define the requirements for the inputs.

The systems analyst may develop a mock-up and/or a layout chart for each input and output. A *mock-up* is a sample of the input or output that contains actual data (Figure 11-15). The systems analyst shows mock-ups to users for their approval. After users approve the mock-up, the systems analyst develops a layout chart for the software developer. A layout chart is more technical and contains programming-like notations. Many database programs provide tools for technical design (Figure 11-16).

Other issues that must be addressed during input and output design include the types of media to use (paper, video, or audio); formats (graphical or narrative); and data entry validation techniques, which include making sure the entered data is correct (for example, a state code has to be one of the fifty valid two-letter state abbreviations).

- During program design, the systems analyst prepares the *program specification package*, which identifies required programs and the relationship among each program, as well as the input, output, and database specifications.



**prototyping** Many systems analysts today use prototypes during detailed design. A **prototype**, sometimes called a *proof of concept*, is a working model of the proposed system's essential functionality. The systems analyst actually builds a functional form of the solution during design. The main advantage of a prototype is users can work with the system before it is completed to make sure it meets their needs. As soon as users approve a prototype, systems analysts can implement a solution more quickly than without a prototype.

process in a system development case study.

## Implementation Phase

The purpose of the implementation phase is to construct, or build, the new or modified system and then deliver it to the users. Members of the system development team perform four major activities in this phase: (1) develop programs and apps, (2) install and test the new system, (3) train users, and (4) convert to the new system.

**Develop Programs and Apps** If the organization purchases retail software or no modifications to existing custom software are required, the development team may skip this activity. For custom software that is new or requires modification, however, programs and apps are developed or modified either by an outside firm or in-house.

Software developers write or modify programs and apps from the program specification package created during the analysis phase. Just as system development follows an organized set of activities, so does program development. These program development activities are known as the *program development life cycle*.




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**Install and Test the New System** If the organization acquires new hardware or software, someone must install and test it. The systems analysts should test individual programs. They also should be sure that all the programs work together in the system. Systems analysts and users develop test data so that they can perform various tests.

- A *unit test* verifies that each individual program or object works by itself.
- A *systems test* verifies that all programs in an application work together properly.
- An *integration test* verifies that an application works with other applications.
- An *acceptance test* is performed by end users and checks the new system to ensure that it works with actual data.



**Train Users** Training involves showing users exactly how they will use the new hardware and software in the system. Some training takes place as one-on-one sessions or classroom-style lectures (Figure 11-17). Other organizations use web-based training, which is a self-directed, self-paced online instruction method. Whichever technique is used, it should include hands-on sessions with realistic sample data. Users should practice on the actual system during training. Users also should be provided access to printed or online user manuals for reference. It is the systems analyst's responsibility to create user manuals.



itions must ensure that users are trained properly  
e training method uses hands-on classes to learn

analyst's responsibility for creating user manuals.

**Convert to the New System** The final implementation activity is to change from the old system to the new system. This change can take place using one or more of the following conversion strategies: direct, parallel, phased, or pilot.

- With *direct conversion*, the user stops using the old system and begins using the new system on a certain date. The advantage of this strategy is that it requires no transition costs and is a quick implementation technique. The disadvantage is that it is extremely risky and can disrupt operations seriously if the new system does not work correctly the first time.
- *Parallel conversion* consists of running the old system alongside the new system for a specified time. Results from both systems are compared. The advantage of this strategy is that you can fix any problems in the new system before you terminate the old system. The disadvantage is that it is costly to operate two systems at the same time.
- In a *phased conversion*, each location converts at a separate time. For example, an accounting system might convert its accounts receivable, accounts payable, general ledger, and payroll sites in separate phases. Each site can use a direct or parallel conversion. Larger systems with multiple sites may use a phased conversion.
- With a *pilot conversion*, only one location in the organization uses the new system — so that it can be tested. After the pilot site approves the new system, other sites convert using one of the other conversion strategies.

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phase in a system development cycle.

### **Support and Security Phase**

The purpose of the support and security phase is to provide ongoing assistance for an information system and its users after the system is implemented. The support and security phase consists of three major activities: (1) perform maintenance activities, (2) monitor system performance, and (3) assess system security.

Information system maintenance activities include fixing errors in, as well as improving, a system's operations. To determine initial maintenance needs, the systems analyst should meet with users. The purpose of this meeting, often called the *post-implementation system review*, is to discover whether the information system is performing according to the users' expectations. In some cases, users would like the system to do more. Maybe they have enhancements or additional requirements that involve modifying or expanding an existing information system.

During this phase, the systems analyst monitors performance of the new or modified information system. The purpose of performance monitoring is to determine whether the system is inefficient or unstable at any point. If it is, the systems analyst must investigate solutions to make the information system more efficient and reliable — back to the planning phase.