ONLINE SUPPLEMENTAL APPENDIX

A

PRINCIPLES OF PROJECT MANAGEMENT

People often think of project management only as a set of skills that one acquires through inherent capabilities or on-the-job practice. While good project managers do possess skills to successfully execute projects, project management is also a complex topic with its own body of knowledge. This body of knowledge consists of principles and practices that form the foundation for understanding and developing effective project management skills.

As the world becomes smaller and more competitive, corporations worldwide have had to become more flexible, more attuned to the marketplace, and more responsive to customer desires. In order to do so, many companies have turned toward managing internal activities by identifying an objective or goal and then forming a project team to accomplish that objective. Consequently, the need for good project management skills has escalated in recent years. In industry, a large number of training companies now provide project management training seminars and workshops. As a result of this broad-based need for project managers, many universities now also offer project management courses. These courses are housed in all academic disciplines, but most frequently in the management, information systems, or engineering curricula. Of course, systems development projects have always required good project managers. Fortunately, this widespread interest in project management has promoted a deeper understanding of the principles, practices, and skills that are necessary to effectively manage a complex project.

There are two primary approaches to teaching project management. One method is to focus on and teach the specific tasks that are required to manage a project. These types of courses are usually organized around the sequence of activities for a typical project. The first topics of such courses teach how to initiate and plan a project. Next, they explain how to build a schedule. The specific skills, techniques, and processes are taught in the context of a typical project. *Systems Analysis and Design in a Changing World* takes this approach. We discuss specific tasks and skills associated with the various phases and activities of a project.

Another approach to learning about project management is to concentrate on its principles and practices apart from the processes of a project. This appendix focuses on fundamental principles that underlie specific project management tasks. In other words, it teaches project management from the principles and concepts point of view. Both approaches have strengths and weaknesses for learning project management. We included both approaches in this textbook so you could have the advantage of learning the strengths of each. We strongly suggest that you take the time to understand the concepts in this appendix. It will serve you well in your career, no matter what alternative you pursue.

With in-depth understanding of the various project management areas, you can develop a broad foundation to prepare for your career as an IT professional, as a knowledgeable participant in any type of project, and someday as a project manager. In successful projects, every member of the team helps with project management tasks. By studying this appendix early in the course, you will be better prepared to learn the details of the various project management techniques presented in the textbook. This appendix should be an excellent resource as you begin your study of project management.

PROJECT MANAGEMENT KNOWLEDGE AREAS

This appendix is based on the Project Management Body of Knowledge (PMBOK) that has been developed by the Project Management Institute (PMI). PMI is a nonprofit professional organization with members from every industry and large organization in the United States, as well as major international organizations. It is the largest project management organization in the world, with more than 250,000 members. It sponsors various conferences and workshops around the globe on project management. It also offers various training courses, extensive project management books and materials, and various certification programs.

One of PMI's major contributions is the development of a comprehensive set of principles for project management, called the PMBOK. The PMBOK is divided into nine major categories, which we briefly discuss in this appendix:

- Project scope management
- Project time management
- Project cost management
- Project quality management
- Project human resources management
- Project communications management
- Project risk management
- Project procurement management
- Project integration management

To learn more about project management and find additional resources, you should visit the Project Management Institute Web site at *www.pmi.org*.

PROJECT SCOPE MANAGEMENT

Need and Objectives

One common thread throughout almost every failed development project is vague or constantly changing system requirements. Project scope management is critically important for predictive projects because the entire project plan and schedule is based on a stable definition of requirements. Even though adaptive projects are built to allow for uncertainty in the requirements, user requirements that constantly change or increase in number and size can also ruin a project. Probably the most pervasive problem of every development project, and the most difficult to control, is **scope creep**. Scope creep is the addition of new system requirements without regard to its impact on the project. For predictive projects, it occurs after the discovery activities and system specifications are completed. It can occur throughout a project. The problem of scope creep can become just as serious in projects that use an adaptive approach. Because adaptive projects, especially those based on an agile approach, have a development philosophy that embraces change, it can become easy to allow any and all changes so that the project never comes to completion. If requirements are allowed to continually change, there is a high risk that the scope can grow uncontrollably. The project manager must continually emphasize the impact of added requirements for both the team members

scope creep
the addition of new functions to the scope of a system that cause the project to increase in size

and users. Frequently, neither the user nor the developer realizes the effect that one little addition can have on a project. Depending on when the additional request is added to the project, even a simple change can have far-reaching effects. For example, a simple addition of a new data variable sometimes can affect the database, input forms, output reports, control algorithms, update algorithms, system testing plans and tests, data conversion, system interfaces, and system and user documentation. Early in the project, during elaboration iterations, this may not be a problem. Later, however, during construction and final testing iterations, a "simple" change may not be so simple.

Thus, scope management is a key project management activity for both predictive and adaptive projects. The objectives of project scope management are the following:

- To precisely define the functions and capabilities to be included in the new system
- To verify that the identified capabilities are necessary and are important priorities for the project at hand
- To control the set of functions so that it does not grow inappropriately

Scope management includes managing the original definition of the system requirements so that they can be accomplished within the allotted time and budget of the project. Obviously, the requirements must be comprehensive to include the needed functions; however, they must also be realistic in not including unnecessary functions. Project managers must verify that the selected functions are indeed essential for the intended use of the new system. Finally, they must control additional requests to avoid the problems associated with scope creep.

Techniques

There are three main categories of scope management techniques: (1) defining the scope, (2) verifying the scope, and (3) controlling the scope. Within those categories are supporting techniques.

Defining the Scope Generally, every project has two levels of scope definition. The overall scope of the new system is delineated when the project begins. A high-level document will provide information about expected business benefits and system capabilities.

The second level entails the details of the project scope, which are further defined as the system specifications are developed. For predictive projects, this occurs during the analysis and requirements activities. For adaptive projects, each iteration includes detailed scope definition tasks. However, even for adaptive projects, the set of functions included in the new system should still be controlled by the overall scope definition. Team members gather information from the users and develop system requirements. As these processing requirements are developed and documented, they become system specifications. As noted in Chapter 3, a major cause of project failure is a lack of precisely defined system requirements.

Verifying the Scope A universal truth is always that more system functionality is requested than can be included within the allowable time and budget. Hence, user requirements should be approved before they are included in the system scope. The project team should analyze the impact of each requirement and its cost to the project build, testing, and deployment activities. For example, a requirement to produce a certain report may be easily added as a prototype or initial mock-up; however, it may require extensive database and security programming later during the construction iterations. There is nothing intrinsically wrong with expensive requirements, but the users should understand the true cost of each additional requirement so that they can make effective decisions and establish clear priorities. As it is defined, each system capability should be assigned a priority such as "nice to have," "important," or "critical." This verification step usually does not require much time, but it is important to ensure that the scope is precisely defined and that all participants—users, clients, and developers—agree on what is to be included.

change control log
a log or list of requested changes to the existing set of functions

Controlling the Scope As indicated earlier, controlling the project's scope is just as important as initially defining it. A formal mechanism should be established to review additional requests for new system functions that appear during the construction phase. One effective way to track and control these changes is to set up a **change control log** and change control committee. Any proposed change is added to the log, along with a statement of its importance and priority. Team members estimate the impact of the change on the workload, schedule, resources, and budget. The change control committee then meets regularly and decides which, if any, of the additions should be made.

Formalizing the changes has several obvious benefits. First, only important and critical functions are added to the system. Second, everyone knows and agrees on the changes. Third, the client is not surprised by extensions of the schedule. Fourth, groups of changes can be made at the same time, which frequently can reduce the overall impact.

PROJECT TIME MANAGEMENT

Need and Objectives

Possibly the most-asked question any project team hears is, "When can I have it?" Another common variation on this question is "We need the system to be operational by June 1st." All too often a project manager, especially a new one, will try to accommodate the client by agreeing to a schedule that is far too optimistic. As developers, we often delude ourselves by thinking that we can work harder, or get more people, or find some new tool that will make the project go faster. Of course, this never works, and when the project is not completed on time, everyone wonders what the problem is with the project team and the project manager. In reality, the only problem may be that the original schedule was unrealistic.

The objectives of project time management are multifaceted:

- To ensure that the project schedule accurately accommodates the work to be done
- To effectively use resources and techniques to accelerate the overall time to completion
- To accurately measure completed work to correctly assess the percentage completed

Basically, these objectives mean that the project manager must build an accurate schedule, use it to allocate the work to get maximum productivity, and then monitor and control progress based on scheduled tasks and milestones.

Techniques

The core element in project time management is the schedule, and developing the schedule is one of the most important tasks of the project manager. Time management techniques include building the project schedule, making changes to it, monitoring progress based on the scheduled dates, and shortening the project schedule using optimization techniques. Overall project time for adaptive projects is especially difficult to estimate, so it is hard to build a schedule. For adaptive projects, two types of schedules must be maintained. First, an overall project schedule is built. Its purpose is to measure progress and to evaluate estimated time until deployment. In addition to the overall schedule, detailed schedules are built for each iteration. The detailed iteration schedules serve as working documents for assigning work and managing the tasks within each iteration.

Building the Project Schedule Building the schedule involves considering many aspects of the project. System functionality (scope), available resources, cost, and system quality all affect the details of the schedule. The project team uses the work breakdown structure to develop a comprehensive list of all the project activities, estimating the size of each activity and determining activity dependencies. The objective is an accurate estimate of the work to be done. The two most critical considerations to ensure accuracy are identifying all activities and realistically estimating the size of each activity.

Modifying the Overall Project Schedule Schedules may need to be modified for three main reasons: (1) additional activities are added to the project, (2) the time estimates of activities are expanded because of complexity, and (3) resources are not available at the expected time.

Occasionally, the time estimates for activities need to be modified because of unanticipated complexity in the new system, or because of changes in the system scope, as mentioned previously. The development team should analyze major changes to activity duration, identifying all potential problems and complexities that could have a negative impact on the project. According to project managers and technical staff, one of the toughest jobs of time management is estimating the complexity of the problems that need to be solved.

Monitoring Progress One of the early responsibilities of a project manager is to identify specific milestones or deliverables for the project. These milestones can be associated either with the completion of certain iterations or with specific deliverables that are expected throughout the project.

One cardinal rule for identifying and measuring milestones is to insist that milestones be measured either as "complete" or "not complete." Many new project managers get bogged down in the so-called **80/20 syndrome**, which states that 80 percent of the progress only requires 20 percent of the time. Therefore, a report of "we are 80 percent done" really can mean that "the last 20 percent will take 80 percent of the time." In fact, some projects reach 80 percent completion and stall—never finishing the last 20 percent.

80/20 syndrome
80 percent of the progress takes 20 percent of the effort, so the last 20 percent of progress can take 80 percent more time

PROJECT COST MANAGEMENT

Need and Objectives

Earlier we said that the most frequent question from clients is "When can I have it?" Because schedule and cost are so closely linked, another frequent version of this question is: "When can I have it, *and how much will it cost*?" In most systems development projects, the primary costs are for human resources, so projects that require much more time and effort naturally cost more.

Projects are initiated after estimated benefits are compared with anticipated costs. During the project, the effectiveness of cost control can mean the difference between making profits or not. Cost control is closely associated with all the other areas of project management, and in many ways it is simply a reflection of the entire management of the project. Projects that get off schedule cost more, and projects that suffer from scope creep cost more. Cost control is as critical for outsourced projects as it is for in-house development.

The specific objectives associated with project cost management are:

- To accurately estimate the anticipated project costs
- To accurately predict the cash flow and timing of expenditures
- To confine actual project expenditures to those that are included within the plan
- To capture and record actual project expenditures correctly

Techniques

Project cost management techniques are based on fundamental accounting principles, which you learn in your cost accounting and managerial accounting classes. This section limits the discussion to identifying some of these basic techniques.

Estimating Costs Every company has its own set of rules to determine which costs should be included in project costs. Direct costs are those that can be directly attributed to the project, such as salaries of project team members, costs of software licenses, and fees paid to contract personnel such as programmers. Other costs may be partly or fully allocated to the project based on company rules. For example, new computer equipment may be shared by programmers working on multiple projects (concurrently or over time). Project managers must ensure that all expenditures that will be directly assigned to the project are identified in

the original estimate. A project's budget can be severely affected by unexpected costs, such as the cost of licensing software, if they are not anticipated at the project's initiation.

Once a company has estimated the cost of a project, it performs an economic feasibility analysis for the new system. Chapter 3 explains the details of calculating net present value and other measures to determine a project's feasibility. A major difficulty of project cost management is that costs sometimes must be estimated before the exact scope of the system is known. That is, an organization wants to know whether a project is economically feasible before it knows the detailed system requirements. To respond to this need, the project manager first develops a rough order of magnitude (ROM) estimate and indicates the possible range of the costs. Ranges can vary widely—it is not unusual to see a ROM estimate with a range of 100 percent. A doubled cost range may seem incredible, but when you consider that some projects are over budget by factors of 3, 5, and even 10, an initial ROM with a factor of 2 may be acceptable.

Predicting Cash Flows Part of the approval and initiation of a project involves estimating the timing of expenditures so that the organization can budget for monthly and yearly expenses. Cash flow estimates can be based on the project schedule, including work to be done and purchases to be made.

Controlling Expenditures Effective project managers try to achieve a balance between stinginess and overly wasteful procedures. Such techniques as monitoring overtime, using standard off-the-shelf components, and careful pricing of vendor contracts are standard cost-control procedures that effective managers use. A project manager should be concerned if spending exceeds what was planned. She should also be concerned if the spending is substantially lower than planned, because it may indicate that work is not being done and that the schedule could be delayed. Sometimes such underspending is an early warning sign that the project is not progressing as planned. A comprehensive set of metrics and cost indices are available to help project managers measure the effectiveness and efficiency of project expenditures versus progress.

Flexibility Matrix

flexibility matrix or triple constraint
refers to the interdependency of scope, cost, and schedule in which changes to one affect the other two

The first three knowledge areas—scope management, time management, and cost management—are very closely related. A change in one area always causes a change in the other two areas. For example, an increase in scope will require an addition to the schedule time, an increase in expenditures, or both. This interdependency goes by various names, such as the **flexibility matrix**, the **triple constraint**, or the scope triangle.

Experienced project managers use the flexibility matrix to help manage the project in accordance with the client's wishes. Each of the three areas is assigned a unique flexibility attribute, either (1) flexible, (2) moderately flexible, or (3) inflexible. These values are assigned based on the client's priorities. For example, if cost is most flexible, schedule is moderate, and scope is inflexible, then the project manager should have the liberty to hire extra staff for this project if necessary. If the schedule slips a bit, that might be acceptable. However, she must deliver all of the defined functionality with no decrease in capability.

Sometimes a client will say, "All three are important," meaning that all three are inflexible. At this point, the project manager may want to update her resume. Very few projects ever reach completion without some shift in schedule, costs, or resources. For an example of a flexibility matrix, see Figure 9-3 of *Systems Analysis and Design in a Changing World*, which shows a project monitoring dashboard, including a flexibility matrix.

PROJECT QUALITY MANAGEMENT

Need and Objective

An important responsibility of a project manager is to ensure the quality of the final product. But software is especially subject to errors and failures. The failure of a single line of code can bring down an entire system. Many software systems are used in critical life situations, such

as air traffic control, patient monitoring, and space exploration. Even noncritical systems demand extremely high levels of accuracy and performance—for example, banking and customer account systems, telephone and communication systems, and point-of-sale retail systems. Modern society relies more and more on technology, and these systems have become the fabric of our daily lives. Without technology, companies could not function. So, effective project management always includes substantial quality control.

The single objective of project quality management is to produce a system that is:

- Easy to use
- Fit for its intended purpose
- Robust
- Reliable
- Secure
- Maintainable

One problem with project quality management is that these characteristics are difficult to measure. How do you measure "ease of use"? Even though a precise metric may not exist, project managers must still attempt to provide high-quality software.

Ease of use is a measure of how easily and quickly the users understand and become proficient with the system. Ease of use includes evaluating the intuitive nature of the system, the efficiency of performing specific tasks, and the supporting tools and help systems.

Fitness for purpose gauges how well a system satisfies the business need for which it was developed. Fitness is also hard to measure because it depends not only on how well the system meets the user requirements, but also on its completeness and accuracy as well. The key question is, "Does the system support all the activities and procedures of the defined business function?"

Robustness means how tough the system is in handling adverse situations such as bad data or even malfunctioning equipment. Is it free of errors that cause it to crash? Is it available 24/7 (or whatever the requirement)?

Reliability relates to the ability to always give correct results. With all different types of input data and combinations of scenarios, does the system provide results that are correct? Can the users depend on the results to be absolutely correct all the time?

Security is a newly added quality characteristic of systems. In today's environment, where many systems are exposed to the world via the Internet and thus to possible attacks, new systems must be designed with security in mind. An unsecured system may not only be subject to destruction itself, it may open vulnerabilities to the rest of the organization. New systems must be secure in three areas: (1) data transmission, (2) data storage, and (3) data processing.

Maintainability is associated with the ease of modifying and upgrading the system over its lifetime of use. The business environment for every organization changes over time, and almost all systems must be upgraded and enhanced to support new business requirements. A system that is written correctly is designed and constructed so that modifications are straightforward. Again, it is difficult to define a specific metric to measure good maintainability, but it is obvious to developers when a system is obtuse, has introverted logic, and is hard to maintain.

Techniques

All too frequently, project managers focus exclusively on program testing to ensure a high-quality system. But quality control should be planned from the beginning, and procedures should be integrated throughout all activities of the project. Every milestone and intermediate delivery should contain specific reviews and measurements to test for quality. As shown in Figure A-1, the automated system depends on the design, the design depends on the specifications, and the specifications depend on the requirements. Errors and problems anywhere along the chain will reduce the quality of the final system. So, quality control needs to begin with the user requirements and continue with every milestone.

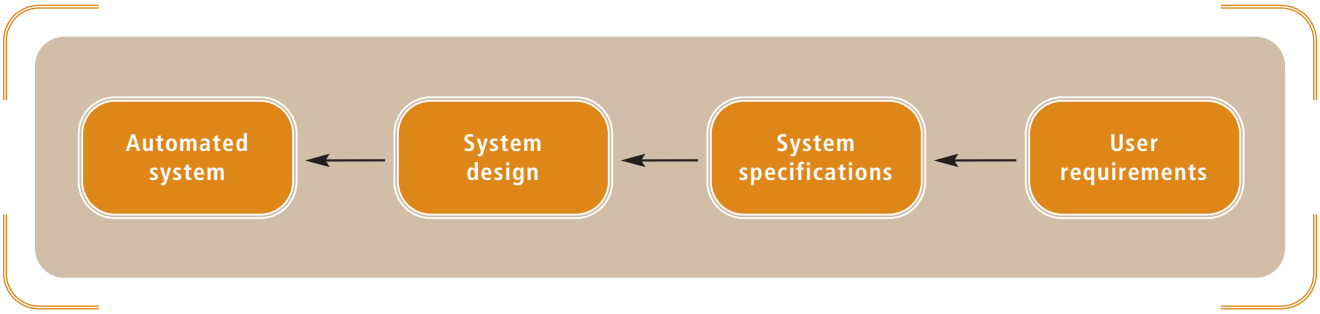

Figure A-1
Quality-control dependencies of intermediate development steps

The specific techniques to ensure quality in each of these intermediate steps are well documented and widely described. The real problem for a project manager is to integrate quality reviews into the schedule and to ensure that they are done. Quality reviews do not happen automatically. Specific checks and safeguards (with appropriate documentation) need to be included as part of the project plan. Some of the newer techniques associated with Extreme Programming and other adaptive approaches facilitate the writing of good systems. For example, pair programming provides ongoing verification of design and code during the construction of the system.

Two types of quality checks need to be done for each deliverable. The first type, often called *validation*, checks to be sure that the deliverable conforms to external requirements. Take user requirements, for example. Do the user requirements accurately describe the needs of the users? Are they complete? Are they comprehensive? This type of quality check needs to involve people who provided the external requirements. In this case, the users must review the requirements to verify their accuracy and completeness.

The other type of quality check is for internal consistency, which is frequently referred to as *verification*. Again, considering the user requirements, project managers should review requirements to make sure that some parts do not contradict other parts. Another element of this review is to make sure that the system is complete—that there are no omissions in the description of the deliverable.

PROJECT HUMAN RESOURCES MANAGEMENT

Need and Objectives

Many companies say, "Our employees are our most important asset." But many of those same companies do not treat their employees that way. The project team is the most important part of a development project. Even though the project manager's time is important, the project team does most of the work to develop most of the new system. Therefore, another important responsibility of a project manager is to establish an environment that allows team members to work as rapidly and efficiently as possible. In other words, a project manager clears roadblocks so that the project team can develop the intermediate deliverables and the final system.

There are six primary objectives for project human resources management:

- **Staff acquisition.** To ensure that the project team is staffed at the right time with people who have adequate skills in the right mix
- **Personnel development.** To provide appropriate training for members of the team
- **Team organization.** To organize the project team and subteams for effective work
- **Team building.** To encourage work teams to become effective working units
- **Team member motivation.** To provide the leadership and vision necessary to encourage and motivate members of the team
- **Work environment optimization.** To ensure that the working environment, including facilities, tools, and support, is conducive to accomplishing work

Techniques

Human resource management is a broad and well-developed area. It is outside the scope of this short appendix to explain the multitude of theories and techniques for team management extensively. Numerous courses, books, and other resources that thoroughly discuss this topic are available.

Given this limitation, this section simply provides a few tips and fundamental ideas that a project manager should keep in mind. Project managers should always remember that their primary responsibility is to enable and allow the team members to do their best work.

Staff Acquisition The various phases of system development require different levels of staffing and different sets of skills. A key staffing factor in a development project is the formation of teams with diverse members who have complementary skills. A development team frequently starts with a few core members and grows during later iterations as the tasks become more elaborate. In addition, the mix of required skills often changes during the life of a project, and the makeup of the project team can change over time.

If the available team members do not have the adequate skills or experience to carry out their functions, the project manager must ensure that they receive training. Experienced project managers do not risk project failure by asking team members to function in areas in which they have no experience or training. It is better to add more team members, hire consultants, provide training, or do all three to reduce risk and ensure that the team will make good technical decisions.

Team Organization There are two main considerations with team organization: (1) the overall hierarchy of the project and (2) the structure of each work team. Larger projects may be divided into teams by subsystem or by functional department. Many structures and compositions are possible. The only caveat is to keep the overhead low; that is, do not insert intermediate team leaders. "Lean and mean" is usually the best team organization philosophy. The current practice in today's adaptive approaches is to allow the team members to organize themselves, to assign individual tasks, and to coordinate activities within the team.

Team Building Any project, especially a large one, consists of groups of work teams. Frequently, people are assigned to the teams with little thought about team dynamics for effective work relationships. Teams that can form a strong work unit become extremely productive. Team building includes training, social interactions, personality profiling, and other activities to teach team members to work together smoothly.

Team Member Motivation Novice project managers often assume that all members are motivated by money, particularly wage increases and bonuses. Yet, different people are motivated in different ways. Job satisfaction and motivation can come from work responsibilities, rank advancement, acquisition of new skills, performance recognition, and satisfaction with the job itself.

One of the most important contributions to team motivation is a clear vision of the project and its potential benefits to the organization. A key role of project managers is leadership, which entails sharing the vision of the project with all team members. Communication with the team must be frequent and explicit. As team members internalize the vision, their motivation and commitment to the project increase. On the other hand, a lack of communication can hurt their motivation. If people do not know what is going on with the project, they become less committed and less motivated to work hard.

PROJECT COMMUNICATIONS MANAGEMENT

Need and Objectives

Probably the most fundamental tool to effective teamwork is the ability to communicate. Communication is essential for every member of the project team, but even more critical for the project manager. There are many different aspects of communication and corresponding skills to enable good communication. These topics range from interpersonal communication

to presentation skills, from good listening skills to conflict management skills, and so forth. The focus of project communications management, however, is limited to the collection, storage, and dissemination of project-related information. For simplicity, this section organizes the discussion of communications according to their sources—incoming, outgoing, and internal communication.

First is the need to receive communication or to gather information. One of the most critical elements of project success is careful gathering of information to understand the user requirements. Information is also collected from vendors and other project stakeholders. In addition, the project manager must gather and understand information from the team regarding status, milestones, problems, and technical issues. So, procedures need to be established for the entire team to ensure that information gathering is timely and accurate.

Second, the project team must disseminate information. Each member of the team should report his or her status, progress, and results. In addition, team members must explain technical issues to users and other stakeholders. The project manager has the overall responsibility to report the status of the project, explain problems, and discuss additional project needs with all stakeholders.

Finally, internal communication among team members is extremely important. All team members must keep each other informed about progress, technical issues and decisions, specifications, and a multitude of other details. Specific procedures should be established to ensure that internal communication is timely and appropriate to communicate vision and provide motivation and encouragement to team members.

Project communication management can also be organized to accomplish the following objectives:

- To ensure that the necessary information is gathered in a timely manner and is complete and accurate
- To ensure that project information is disseminated frequently and is an accurate representation of the project
- To ensure that members of the project team have current information
- To capture and record important project information in a central information repository

Techniques

A multitude of techniques and approaches exist for achieving good communications. Often, project managers outline a plan for communications early to ensure a smooth flow of information throughout the project. The four objectives just listed provide a starting point.

The plan for gathering information should address such questions as:

- What information is to be gathered?
- Who should gather the information?
- What methods should they use?
- How should information be recorded?
- How is it verified for accuracy?

The plan for internal communications should answer these questions:

- What internal information must be maintained and tracked?
- Who needs to be included in which types of internal information?
- What internal procedures are needed to ensure that information is disseminated accurately and in a timely fashion?
- What methods should be used to capture and record internal information?
- What kinds of meetings are necessary (and unnecessary)?

Planning for dissemination of project information should include these questions:

- How is status and progress information collected?
- How is it reported—how frequently and in what format?
- Who needs to receive progress information?
- What types of information should be disseminated?

The results of communication planning will identify the specific techniques, meetings, reports, tracking logs, forms, and templates that may be needed to maintain effective project communications. Electronic techniques, such as e-mail, bulletin boards, Web sites, and CASE tools as central repositories, can facilitate many types of communication. However, face-to-face meetings and reviews are still necessary and should not be eliminated. Communication is such an integral part of every project that careful consideration should be given to ensure a comprehensive approach to gathering, recording, and disseminating information.

PROJECT RISK MANAGEMENT

Need and Objectives

Software development is a high-risk activity, and information systems history is strewn with failed projects. Experienced project managers in all industries have concluded that risk management is critical for success.

We define *risk* as the possibility of failure or loss. Because projects are organized to accomplish an end result, project risks are any hindrances or obstacles to achieving the result or a portion of it. Risk is such a pervasive problem in software development that entire development approaches have been created to reduce it. For example, the spiral SDLC approach was invented to include risk assessment as a primary ingredient. The prototyping approach to software development is used to reduce the risk associated with incomplete or inaccurate understanding of user requirements. The primary motivation of phased delivery and conversion approaches is the reduction of risk.

Risk management is unique because it varies tremendously with the type of project undertaken. We identify three primary objectives of risk management:

- To determine the potential areas of high risk for the project
- To develop strategies and plans of actions to reduce the identified risks
- To carry out the plans of action to monitor and control the project risks

Techniques

Risk management techniques vary from project to project. Probably the toughest part of risk management is to be realistic in assessing the risks and potential problems of a given project. People tend not to see problems in projects with which they are integrally involved, so one technique of risk assessment is to put an outsider on the risk assessment team.

Risk Identification and Tracking A common technique for identifying project risks is to have an open session on risk identification and tracking that includes senior project members, outsiders, and even team members. Team members can often observe risks that senior management may not see.

Risk identification and tracking meetings should be held from time to time, perhaps monthly, and certainly at the beginning of each new project phase. At each meeting, attendees should compile a list of the top project risks, along with a trigger that will help identify when the risk has become a problem. In addition to identifying risks, the team should develop a strategy and plan of action to reduce the risks or to solve the problems. As later meetings are held, the list is updated by removing risks that are resolved and adding new risks that appear. Figure A-2 illustrates an example of a Top 10 risk list.

Rank	Risk description	Contact person	Reduction strategy	Reduction progress
1	Undefined objectives	R. Jones	Meet with VP of marketing to define	None yet
2	New networking software	B. Hardy	Send staff to training or hire expert	Training scheduled
3	Late delivery of contractor subsystem	T. Hansen	Closer monitoring of contractor milestones	Begun this week
4	Poor quality of contractor subsystem	T. Hansen	Begin testing prior to normal test plan	Scheduled to start next month
5	Project team understaffed	A. Wilson	Expedite hiring and training or find additional contract staff	HR director made it highest priority; no solution in sight
6	Response time of high-volume inquiry transactions	B. Hardy	Write database access routines in low-level code	Approach defined; prototype needs to be built to test it
. . .	. . .	. . .	. . .	. . .
Off list	No users assigned to data conversion	B. Marble		Fixed—one user full time, two part time

Figure A-2
Top 10 risk list

PROJECT PROCUREMENT MANAGEMENT

Need and Objectives

As the complexity of information systems increases, more and more systems are built by integrating separate systems. A team of inside developers, hardware vendors, software vendors, and consulting firms often builds these systems. In many companies today, this mix of in-house staff and outside consultants is now normal for developing new systems. One benefit of seeking outside assistance is the ability to tap into the knowledge and expertise of others.

These types of projects create two issues for project managers: (1) handling all the normal concerns, such as cost, scope, and quality, and (2) finding and working with a provider or providers. We use the term **provider** to mean an outside firm that offers specific hardware and software or services such as programming. So, project procurement management includes both finding the needed goods or services and managing and controlling the performance of the provider.

provider
an organization that sells systems or consulting services to other organizations

Specific objectives of project procurement management are:

- To plan the procurement process
- To ensure that solicitation documents are complete and accurate
- To evaluate and select alternative providers
- To ensure that contracts are adequate, with sufficient performance controls and metrics
- To monitor and control deliverables

Techniques

Project procurement management is a complex and wide-ranging area, from the development of a request for proposal (RFP), to contract negotiations, to performance assessment, to daily work relationships and chains of authority, and even to arbitration and litigation. Unfortunately, little training is available to strengthen these skills. In addition, each company has its own procedures for working with providers, and this knowledge is often disseminated through many levels and departments within the organization. Project managers need to seek out this information wherever it is.

Procurement Planning Planning for procuring system components frequently begins as soon as the project begins. As the project manager develops the schedule, she should

assess whether it is feasible to purchase components or services for the project. Because it is less risky and often less expensive to buy a solution than to build one, the project manager should survey the industry to see whether total or partial solutions are available for purchase. The results of this survey help determine the direction of the rest of the project.

Developing Solicitation Documents The solicitation documents that are needed vary with the types of components that are purchased. An RFP is a comprehensive document specifying the requirements that must be met for the new system. Developing an RFP is a major effort that should be included in the project schedule. Users should be involved to ensure that requirements are specified correctly in the request, and with adequate detail. Companies frequently have their own internal procedures for RFP development. Project managers must ensure that the document is a complete and comprehensive description of the requirements.

Evaluating Providers and Alternatives Providers and development alternatives are usually evaluated by measuring their relative merits. Project managers often use a weighting scheme that measures performance in the areas of technical requirements, functional requirements, and general provider performance. By having a quantitative weighting scheme, project managers can ensure a more objective evaluation of the various alternatives.

Developing the Contract Writing contracts is a fairly complex process that requires technical expertise, an understanding of working relationships, and knowledge of legal issues. The best technique to ensure a good contract is to involve experienced technical team members, managers, the project manager, and legal staff. Bad contracts result from not consulting interested stakeholders. A good contract provides protection for both the provider and the purchaser. A win-win contract is the best way to ensure that cooperative relationships are established at the outset.

Monitoring and Controlling Delivery The success of monitoring and controlling provider delivery is a direct consequence of a solid contract. Generally, timing and quality of intermediate deliverables, achievement of milestones, and review processes should be established early and occur throughout the project, just as for in-house staff. It is always better to identify problems early, when they can be corrected easily and at less cost.

PROJECT INTEGRATION MANAGEMENT

Need and Objectives

The previous eight knowledge areas describe a set of principles and skills that are necessary to successfully manage a systems development project. However, these eight knowledge areas do not describe the processes (work flows) that are required. In other words, how do knowledge areas such as communication management, cost management, scope management, and quality management fit together in the work flow of a real project? Earlier we explained that project management is taught either from the point of view of the project's sequence of activities, or from the point of view of the principles and practices. Even though the PMBOK orientation takes the principles and practices viewpoint, the activities and processes of a project are not ignored. They are addressed in the knowledge area of project integration management.

The primary objective of integration management is to see that the work of the project is completed successfully. Project integration management focuses on the specific tasks that ensure the project is coordinated, executed, and controlled properly. This knowledge area is described through the processes that occur during the life of a project. The skills from all the other knowledge areas are included in the project processes of integration management.

Techniques

Seven primary processes are included within integration management.

Develop the Project Charter Developing the project charter is the activity that initiates the project. When approved, the project charter is the document that authorizes the project and allows the sponsoring organization to provide funding and allocate resources.

Develop the Project Scope Document This document is the high-level definition of the organization's need and the proposed solution. It defines the scope of the project and the scope of the solution system. The document also includes preliminary approaches to how the project will progress.

Develop the Project Management Plan Basically, this plan describes how the project will be executed, monitored, and managed. It provides the overall vision of all other plans and activities for the project.

Manage Project Execution This process consists of all activities required to coordinate the work for the project. The execution of the project work normally is driven by the project schedule and defined milestones.

Monitor and Control Project Activities This process focuses on collecting information about the project's progress and identifies and carries out necessary corrective actions to maintain project schedules.

Manage Change Control Every project has changes over its lifetime. This process includes all the mechanisms that identify and manage changes to scope, deliverables, and work plans.

Close the Project The process of closing down the project includes all the tasks required to turn over the final deliverables, obtain client signoff, reallocate project team resources, close financial accounts, and evaluate the project team performance.

KEY TERMS

change control log, p. 4
80/20 syndrome, p. 5
flexibility matrix or triple constraint, p. 6
provider, p. 12
scope creep, p. 2

REVIEW QUESTIONS

1. What are the nine knowledge areas in the project management body of knowledge?
2. What are the specific objectives of project scope management?
3. What is meant by scope creep?
4. What techniques would you use to control the project scope?
5. What are the specific objectives of project time management?
6. What is the 80/20 rule? Why is it a problem in project management?
7. What are the specific objectives of project cost management?
8. What techniques would you use to estimate a project's cost?
9. What are the characteristics of quality in a new system?
10. Why is it important to monitor quality throughout a project?
11. What techniques, besides program testing, can be used to monitor quality?
12. What are the objectives of project human resources management?
13. What are the important factors that affect team member motivation?
14. Name the three types of communication that project teams must manage.
15. What techniques would you use to ensure that information is gathered correctly?
16. What would you do to be sure information is disseminated thoroughly?
17. Discuss the importance of risk management in information systems development.
18. What techniques would you use to manage project risk?
19. What are the objectives of project procurement management?
20. What document do you use to elicit bids for a new system?
21. What is the objective of project integration management?
22. What are the seven primary processes of integration management?

THINKING CRITICALLY

1. Are there other areas of project management that you would include besides the nine knowledge areas listed? What are they, and why would you include them?
2. Discuss ways you might measure the quality of a system. What specific metrics would you use?
3. Discuss the importance of team-building exercises to strengthen team performance. Find an article on team building and summarize it in one page. Describe some examples of your own experiences working in teams.
4. This appendix focuses on responsibilities of a project manager in managing the team and the project. What other responsibilities might a project manager have, particularly concerning the relationship of the project with the sponsoring organization?
5. Find a project manager who has developed some successful projects. Discuss what techniques she considers to be most important in good project management. Write a report about your discussion.
6. Go to the Project Management Institute's (PMI) Web site at *www.pmi.org* and learn more about the Project Management Body of Knowledge (PMBOK). Write a one-page report about the PMI, including its background and its objectives. You should also access the PMBOK Guidebook, review some of the excerpts, and include a summary of what you learned.