CHAPTER 13

Project Supply Chain Management

CHAPTER OBJECTIVES

After completing this chapter, you should be able to:

CORE OBJECTIVES:

- Identify the role of supply chain management in project management and its importance for ensuring project success.
- Describe how to plan, conduct, control, and close project procurements.

BEHAVIORAL OBJECTIVES:

- Explain how to use the contemporary approach to project partnering and collaboration.

TECHNICAL OBJECTIVES:

- Describe the various formats for supply contracts and when each type is appropriate.
- Given a project situation, determine which activities, supplies, or service should be purchased, create bid documents for one of them, determine the criteria you would use to select a seller, and then determine and justify the type of contract to be used.

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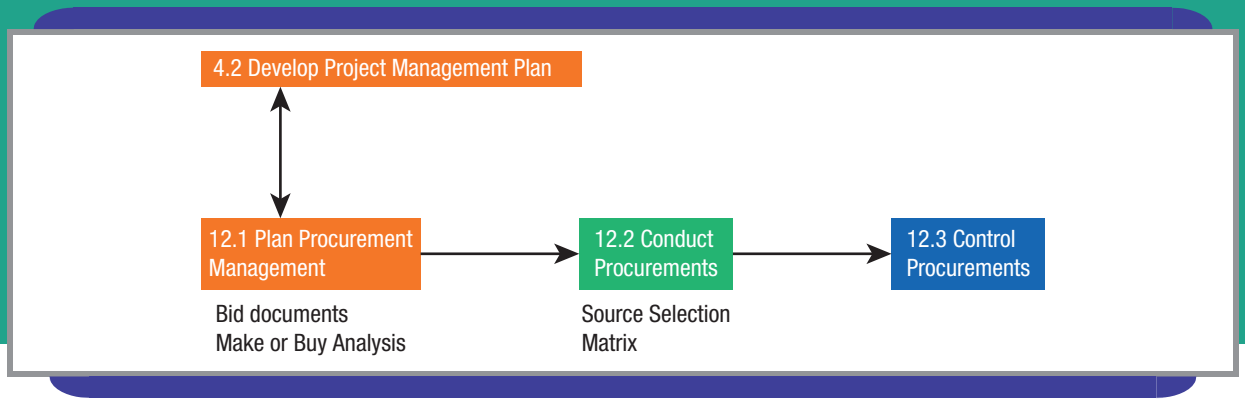
The Challenge—As an independent inventor, IP owner, and entrepreneur, the greatest challenge is the need to muster the required organizational support, critical capital, and project management input while staying agile and responsive to developing conditions. Project management adds crucial skills you need to generate cooperation from your resources without implicit or granted hierarchal authority.

Background—This story was born when I encountered a challenge on a landscaping project. The solution to the previous project became a significant independent project called Super Absorbent Polymer Turf (SAPTURF). The problem is that synthetic turf systems generate extreme heat of 50 to 60 degrees above the ambient temperature on the surface, which is unpleasant and even dangerous. As a small, independent individual, I developed and patented a polymer that solves this problem in many situations.

Initially, I chose a large multinational based in Europe to partner with on the next step in commercializing SAPTURF. I chose this international partner because they are the market leaders. I still controlled the intellectual property (IP) and entered into an agreement to further test my technology to calibrate the value.



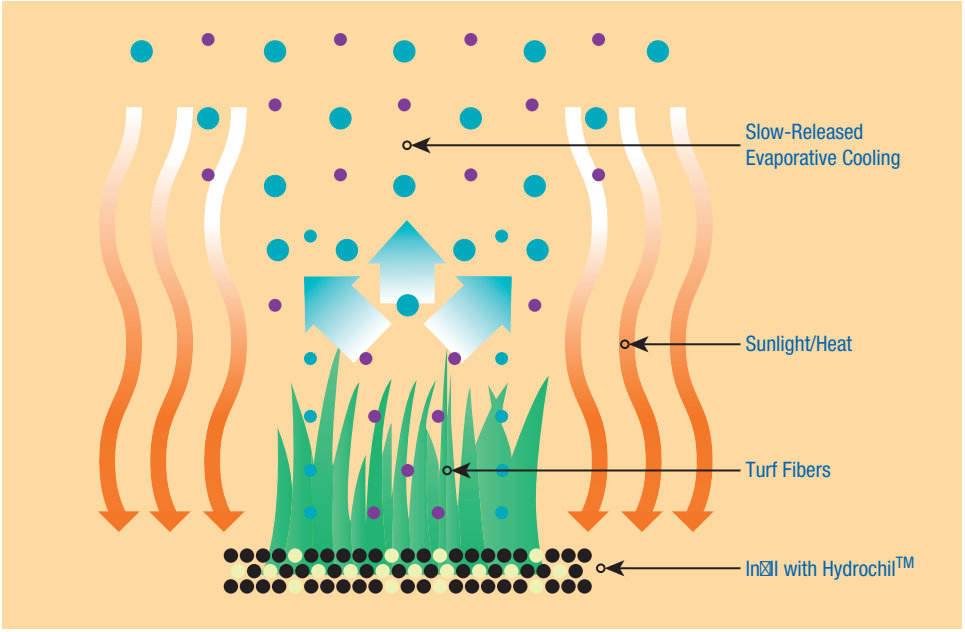
PMBOK® GUIDE

Topics:

- Plan procurement management
- Conduct procurements
- Control procurements

CHAPTER OUTPUTS

- Make or buy analysis
- Bid documents
- Source selection matrix



Stay Agile—After the trial process, I ended up choosing a different firm in the synthetic turf industry as a long-term partner and licensee. I chose Shaw Industry, a Berkshire Hathaway company. Shaw Industries operates three synthetic turf divisions. Shaw's experience as the largest flooring manufacturer in the United States and its financial stability as a Berkshire Hathaway company were additional reasons I selected them as a long-term partner. I also developed confidence that they would respect both my knowledge and my intellectual property.

I entered into a long-term license agreement with Shaw Industries and they trademarked my technology "HydroChill." HydroChill is being commercialized worldwide.

In addition to my license agreement, I provide consultancy services to Shaw Industries and some of their affiliates on an ongoing basis, which allows me to stay close to the *"shop floor"* and facilitates ongoing implementation and improvement of the HydroChill technology. This also allows me to share some of my tacit knowledge to increase probabilities that applications are successful.

The Product—Our technology is applied to a field where components react and form a coating on the infill. The field is watered to activate HydroChill, and then energy from sunlight drives out water, removing heat from the surface.

The cooling effect of HydroChill after watering can last two to three days. Watering alone can result in some cooling, but temperatures can rise and quickly exceed uncomfortable levels of heat. HydroChill creates a substantial and sustained temperature difference.

Applications—HydroChill projects have been executed in the categories of large-scale athletic fields, parks, roof gardens, and residential lawns throughout the world. One of the most recent and notable HydroChill projects is a complete par three golf course in the French Riviera town of Grimaud. A few of the other applications include:

Athletic field HydroChill application, http://www.shawsportsturf.com/, http://www.shawhydrochill.com/

Landscape and Golf HydroChill application, http://www.southwestgreens.com/, https://www.youtube.com/watch?v=m8As-rUnOZA, https://www.youtube.com/watch?v=ZR-B68MBdJY, http://hydrochill.cool

And the Beat Goes On …

Our flexible contracts for licensing the technology and for supporting further development allow us to continue our first love—developing exciting new projects. My son and I are developing other applications outside the synthetic turf industry under the Taro Inc. flag. One application we are currently commercializing is Equestrian footing product. Operators in the dressage, jumper, and rodeo categories have embraced the Equestrian footing application.

—Chris Tetrault, owner and founder, SAPTURF

13-1 Introduction to Project Supply Chain Management

Can you provide a project example that is fully completed by the project organization itself, without using any products or services from outside suppliers? Most likely, the answer is no. As the opening case illustrates, in-house personnel complete almost no serious projects from scratch anymore. In fact, outsourcing part of project tasks has been a well-established practice in various industries for a long time. In many cases, companies have to rely on external suppliers for acquiring many of the unique resources they need. In this chapter, we consider the interorganizational purchasing-related issues (hereafter referred to as supply chain management) in the context of project management.

A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. In project management, this request can be made by the project team in order to acquire some specific product or service required for completing various stages of the project. The customer can also make the request. As a result, supply chain operations require managerial processes that span functional areas within individual organizations and link trading partners and customers across organizational boundaries.

In recent years, the topic of supply chain management has evolved into a systematic approach for managing all material, service, monetary, and information flows across supply chain partners. With its broader coverage and profound impact, project supply chain management has become a challenge to many firms. Because the ultimate goal of serving project customers hinges on the systematic and coordinated performance of all partners (suppliers, transporters, and so forth), supply chain management becomes a critical project management activity. However, many companies traditionally have been concerned with purchasing and procurement, where the goal was to obtain necessary goods and services at the lowest

possible price. In this chapter, we cover not only traditional procurement and contractual management topics but also supplier partnership and collaboration issues.

We define project **supply chain management** as a system's approach to managing the entire flows of physical products, information, and funds from suppliers and producers, through resellers, and finally through the project organization for creating customer satisfaction. A sample project supply chain is shown in Exhibit 13.1.

The traditional purchasing perspective is only concerned with the relationship between the project team and its supplier(s)—those who supply the project organization directly. At its most extensive, supply chain management involves strategic and operational issues concerned with all organizational partners involved in projects. Doubtless, all supply chain parties need to work together to complete the project faster, better, and/or cheaper. They all need to remember that the key project stakeholders determine the trade-offs for better results in achieving project outcomes.

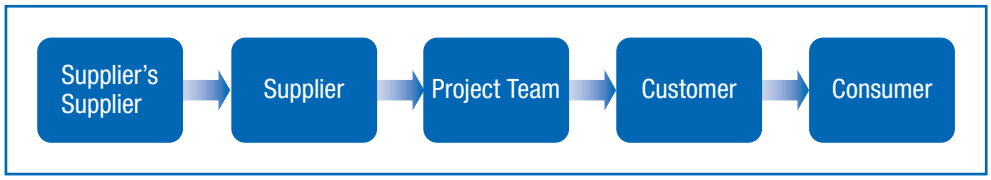
In traditional project procurement management literature, *purchasing, supply chain management,* and *procurement* are usually used interchangeably to refer to the integration of related functions to purchase or acquire the needed materials and services for the project team. Thus, procurement management is concerned with more than the standard steps in the purchasing process, such as recognizing needs, translating needs into commercially equivalent descriptions, and searching for suppliers. Further responsibilities of a project supply chain may also include receiving, inspection, storage, inbound and outbound transportation, and disposal. Project procurement management can also be extended to cover various stages of the supply chain for providing the necessary goods or services (e.g., the supplier's supplier). It is helpful to think in terms of the following:

- **Owner**—the "person or entity that owns the product of the project and to whom that product will be handed over at the time of its completion"[1]
- **General contractor**—a person or agency that "does not specialize in one kind of work; often used to refer to the primary contractor who employs specialty subcontractors"[2]
- **Subcontractor**—a "contractor who is holding a contract with a prime contractor (also referred to as a first-tier subcontractor) or is holding a contract with a subcontractor to the prime contractor (i.e., lower-tier subcontractor)"[3]

Though supply chain management (SCM) and project management (PM) are traditionally separate business areas, we find that integrating SCM into PM can significantly enhance the effectiveness of project management. We also discuss project procurement management. The last section of the chapter covers how to improve project supply chain performance.

EXHIBIT 13.1

A PROJECT SUPPLY CHAIN VIEW



13-1a SCM Components

In particular, this chapter focuses on the following project supply chain management components:

- **Make-or-buy decisions**—These are "the act of choosing between manufacturing a product in-house or purchasing it from an external supplier."[4]
- Contract types—We introduce the contact types and compare their advantages and disadvantages in case a buy decision is warranted.
- Collaboration and cooperation—As different firms take care of their own interests, it is essential to coordinate their project activities to ensure the deliverables are produced as scheduled. The project at hand should become the common goal of all the parties concerned.
- System integration—This concerns the trade-offs among project goals such as time, cost, and quality.

13-1b SCM Factors

Generally, supply chain management is more important to projects in which a large portion of the work is being subcontracted and more collaboration is needed. Other factors include the following:

- The value of the outsourced products or services relative to the total value of the project
- The timing of the work being purchased
- The capability of the project team
- The role of the outsourced work in the entire project
- The number of suppliers required
- The structure of the procurement supply chain (the number of stages in the supply chain and the nature of the intercompany relationship)

As noted earlier, it is common for a significant part of the value of a project to come from various external suppliers. It is also increasingly common for some organizations to exist only as coordinators of activities, without having their own capability of producing and offering the project deliverables. In the meantime, not only do large companies outsource project tasks, but many small businesses also outsource. In fact, small firms tend to rely more on outside resources as they may not have the special capability of in-house execution for certain project activities or the working capital to own and employ resources.

13-1c SCM Decisions

Some of the major project supply chain management decisions are:

- Distribution network configuration
- Inventory control in a supply chain
- Logistics
- Supply contracts
- Distribution strategies
- Supply chain integration and strategic partnering
- Outsourcing and procurement strategies
- Product design
- Information technology and decision-support systems
- Matching internal inadequacies with external expertise

In practice, these decisions often involve quantitative analysis. All of these decisions can play an important role in managing a complex project. The implication is that project managers must be aware of these methodologies for ensuring project completion in a timely and cost-effective way.

13-1d Project Procurement Management Processes

Project procurement management includes the following three processes.

1. Plan procurement management
2. Conduct procurements
3. Control procurements

13-2 Plan Procurement Management

Plan procurement management is determining how project procurement decisions, approach, and dealing with sellers will be accomplished and documented. It identifies those project needs that can be met by acquiring products or services from outside suppliers, determines what to purchase or acquire, and finalizes when and how to do so. On some projects, a portion of the services or materials may be sourced from another company; on other projects, the bulk or even all of the work may be performed by an external company. A client company needs to plan for purchasing and acquisition, whether it is for part or all of a project. The needs of the parent organization should be considered as well as those of the project when deciding how to acquire necessary items because it may be better for the parent organization to buy an item rather than to rent it for the current project and then rent it again for a future project.

To effectively plan for purchasing and acquisition of materials and services, a project team typically finishes identifying customer requirements and most of the project planning to understand what are the true project needs. At a minimum, the project team requires knowing the project scope, which was defined in Chapter 1 as the entirety of what will and will not be done to meet the specified requirements. Once the requirements are identified, a project manager should be able to determine whether or not to buy and if buying, what to buy and the quantity to buy.

13-2a Outputs of Planning

One primary output of this planning is a **procurement management plan,** which is the portion of the project management plan that describes how a project team will acquire goods and services they choose to purchase. The procurement management plan can include guidance for types of contracts to be used, risk management issues, and how to select potential suppliers. This plan guides the client company's efforts through all activities dealing with the acquisition of all the necessary materials and services to complete the project. Another major output is the **procurement statement of work,** which documents the portion of work to be purchased, described in enough detail so potential suppliers can decide if they feel they are capable of and interested in providing it. This document should ensure that both the contractor and the client companies clearly understand the work that is being requested; for example, the document should provide information such as specifications, quantity desired, quality standards, performance data, work requirements, schedules, inspections, and other needs.

13-2b Make-or-Buy Decisions

Project procurement can be considered from the view of the buyer–seller interface. Depending on the application areas, the seller can be called a supplier, supplier's supplier, or contractor. Depending on the buyer's position in the project acquisition cycle, the buyer can be called an owner, a customer, a service requestor, or a purchaser. The seller can be viewed during the contract life cycle first as a bidder and then as the contracted supplier or vendor.

For any products or services needed in a project, during the purchase planning phase, the project team determines which project needs can best be met by purchasing or acquiring products and services from an outside provider and which project needs can be accomplished by the project team. Buying from an outside supplier to meet project needs is a well-established practice. For example, many firms outsource information technology requirements, accounting work, legal functions, logistics, and so on.

REASONS TO BUY OR SELL The make-or-buy decision is not trivial. It involves intricate issues such as a project organization's competitive analysis and demand analysis. The project team also needs to evaluate the advantages and disadvantages of outsourcing from the viewpoint of time, cost, and performance control. The analysis should also include both direct and indirect costs so that the final decision is based on equal comparisons. The project personnel evaluate alternative suppliers and provide current, accurate, and complete data that are relevant to the buy alternative. Exhibit 13.2 lists a variety of considerations for make-or-buy decisions.

Most firms begin conducting a strategic outsourcing analysis by identifying their major strengths and then building on them. A firm's competitive advantage is often defined as lower cost, product differentiation (better quality), and/or responsiveness (fast delivery). To project teams, these have different levels of importance, depending on the wishes of the customer and the progress the project is making at the moment. Project time-cost analysis often helps generate insights about making efficient procurement decisions. For example, a noncritical activity may be outsourced with a focus on minimizing cost but not necessarily receiving the fastest delivery. However, during different stages of a project, a noncritical task can become a critical task, which raises the importance of timing and shifting priorities. Factors like this can hold quite different implications for a make-or-buy decision in different phases of project execution.

While make-or-buy investigations usually begin with a cost analysis, various qualitative factors frequently portend more far-reaching consequences than does the cost analysis. A thorough investigation is clearly complicated by the dynamics and uncertainties of various project activities.

EXHIBIT 13.2

REASONS TO MAKE OR BUY

REASONS TO MAKE	REASONS TO BUY
1. Lower production cost	1. Frees project team to deal with other important activities
2. More control over quality and time	2. Ability to utilize specialized suppliers
3. Lack of suitable suppliers	3. Flexibility in procurement
4. Obtain a customized item	4. Inadequate managerial or technical resources
5. Utilize project team's expertise and time	5. Inadequate capacity
6. Protect proprietary design or knowledge	6. Small volume requirements

OUTSOURCING ISSUES While outsourcing has gained in popularity, there are potential issues related to outsourcing. Some of these are relatively important with regard to the goal of projects:

- Loss of time control for completing project activities
- Lack of cost control for outsourced activities
- Gradual loss of special skills for doing some specific activities
- Loss of project focus and a potential conflict of interest
- Ineffective management as a result of complicated business interactions
- Loss of confidentiality and double outsourcing when a third party is used
- Sharing of proprietary knowledge that impacts competitive advantage

The concepts and techniques of project supply chain management possess strategic importance because of these potential issues related to outsourcing. Purchasing can contribute to the achievement of benefits such as higher product quality, shorter lead times, and lower costs. Project procurement strategies can change often and differ from corporate procurement strategies because of constraints, availability of critical resources, and specific project requirements that change dynamically. After making the make-or-buy decision, the project team proceeds to the next step of project outsourcing for selecting the right supplier and negotiating the contract.

The outputs of procurement planning also include documents and criteria for selecting a supplier, if a buy decision has been made. When multiple suppliers are available, selection standards such as total cost of ownership and risk also need to be developed.

When a buy decision is made, the client company is attempting to create a situation in which prospective contractor companies have the capability and motivation to provide useful and complete proposals that are easy to evaluate in order to determine which one best suits the client company's needs. The client company typically uses **procurement documents,** which are documents that define the requirements and contractual relationship between suppliers and customers of services and products used on a project.

Project procurement personnel need to understand the differences between types of requests so they use the correct one.

- **Request for Information (RFI)** is "a proposal requested from a potential seller or a service provider to determine what products and services are potentially available in the marketplace to meet a buyer's needs and to know the capability of a seller in terms of offerings and strengths of the seller."[5] An RFI is used to learn about the potential sellers and/or the products or services.
- **Request for Quotation (RFQ)** is a type of procurement document "used when discussions with bidders are not required (mainly when the specifications of a product or service are already known) and when price is the main or only factor in selecting the successful bidder."[6] An RFQ is used to compare prices from various vendors of standard items.
- **Request for Proposal (RFP)** is a type of procurement document used at "an early stage in a procurement process issuing an invitation for suppliers, often through a bidding process, to submit a proposal on a specific commodity or service."[7] An RFP is often used to compare different approaches for nonstandard items.

The client company creates evaluation criteria to define how they will evaluate and rank the proposals. Armed with these documents, the client company is now prepared to conduct the procurement.

13-3 Conduct Procurements

The second project procurement management process is to **conduct procurements,** which includes receiving seller responses, selecting a seller, and awarding a contract. Client firms need to decide which potential contractor companies they wish to solicit and then make sure those companies know about the potential project. Sometimes, firms develop a qualified sellers list and only allow listed companies to submit a proposal on the upcoming project. Other times, they advertise widely in hopes of attracting new contractors' interest. In either event, a formal request is normally sent out with hopes that competent firms will compete for the right to perform the project.

One Singapore company describes its project procurement process in Exhibit 13.3. The first part of the procurement process encompasses gathering of market intelligence, developing a procurement strategy, and developing a contract.

The *intelligence gathering* phase includes defining the scope for the procurement, analyzing the needs of the end user, and the articulation of upstream and downstream market forces. It is important to question whether the procurer has leverage or is beholden to the tight supply situation. A *strategy* is then developed and some parts are shared with "partner vendors" so that there is a clear understanding of the needs, available supply, and the satisfaction criteria of procurement. After understanding the total cost of procurement, a *Go to Market* position needs to be developed. The procurer needs to be armed with the best alternatives. The culmination of the strategy phase is to obtain clear mandates to negotiate. A *contract* is then developed. The contract should articulate clearly, without contradictory clauses, the legal aspects, technical requirements, and commercial terms.

These developments are the result of continuous dialogue between the procurer and prospective suppliers.

13-3a Sources for Potential Suppliers

Based on the nature of what is being requested in early procurement stages, the project team usually starts the selection process by establishing a robust list of potential suppliers. The following information sources are frequently used to identify these potential suppliers:

- Supplier websites
- Supplier information files
- Supplier catalogs

EXHIBIT 13.3

PROCURER, PROSPECTS, AND THE PROJECT MANAGER

INTELLIGENCE	STRATEGY	CONTRACTING
Scope	Statement	Legal
Needs	Analyses	Technical
Market forces	Go to Market direction	Commercial
	Alternatives	
	Mandates	

Source: Raji Sivaraman, M.S., PMI-ACP, PMP-2017

- Trade journals
- Phone directories
- Sales personnel
- Trade shows
- Professional organizations and conferences
- Electronic search engines
- Published information by local, state, and federal governments

13-3b Approaches Used When Evaluating Prospective Suppliers

Once potential contractors submit bids or proposals, the client company applies previously defined selection criteria to select one or more sellers who are qualified to perform the work and are acceptable as sellers. On some projects in which the services or materials are commodities, the selection decision is made mostly or entirely on price. On other projects, the client chooses the contractor on the basis of life cycle cost—that is, the cost to both purchase the item and use it for the entirety of its useful life. On still other projects, price is one of multiple considerations. With more complex projects, the client company may very well decide that one company is more capable than another on technical, managerial, financial, or experiential grounds. The evaluation criteria developed during the plan procurement process should guide this decision.

For example, a research study in the Middle East involving a range of public sector contracting agencies revealed that when a client selects a design-build contractor (one who supervises both the design and construction for a project with many other companies involved), several tangible and intangible selection factors are considered, as shown in Exhibit 13.4. In essence, the selection of a design-build contractor is chiefly guided by clients' business needs, functional requirements, and expectations of the outcome of the design-build process. Clients look for a sound business partner who is capable of and committed to delivering the design-build promise of producing better projects faster and at a reduced cost. The design-build contractor selection process is indeed twofold: one is process-related, focusing on project outcomes, and the other is organization-related, focusing on the actual abilities and qualities of the design-build contractor's organization.

After developing a comprehensive list of potential suppliers, the project team needs to evaluate each prospective supplier individually. The approaches and analyses can include the following:

- Supplier surveys that provide sufficient knowledge of the supplier to make a decision to include or exclude the firm from further consideration
- Financial condition analysis that reveals whether a supplier is clearly incapable of performing satisfactorily
- Third-party evaluators such as Dun and Bradstreet that can be hired for obtaining relevant information
- Facility visits to allow the project team to obtain firsthand information concerning the adequacy of the firm's technological capabilities, manufacturing or distribution capabilities, and managerial orientation
- Quality ability analysis that examines the potential supplier's quality capability
- Delivery ability analysis that estimates the supplier's capability to deliver the required product or services on time; backup solutions can also be considered

The analyses listed above should not necessarily be limited to potential first-tier suppliers. In some cases when second- or even third-tier suppliers are involved, the project team needs to evaluate all these suppliers as well. This proactive screening process

EXHIBIT 13.4

FACTORS TO CONSIDER WHEN SELECTING A DESIGN-BUILD CONTRACTOR

Component A: Process-related design-build contractor selection factors:

PRIORITY	FACTOR	DEFINITION
I	Shorten Duration	To reduce the overall project delivery time as compared to other project delivery methods
II	Reduce Cost	To reduce the overall project delivery cost as compared to other project delivery methods
III	Reduce Claims	To eliminate claims raised by contractors due to design errors or shortcomings
IV	Establish Cost	To fix project budget early on, long before completing detailed designs and specifications
V	Establish Schedule	To fix schedule of project benefits long before completing detailed designs and specifications
VI	Innovation	To benefit from the innovation opportunity created by designers and builders' interaction
VII	Reduce Coordination	To reduce client risk and effort of coordinating between contractors and designers

Component B: Organization-related design-build contractor selection factors:

TECHNICAL	MANAGERIAL	FINANCIAL	EXPERIENTIAL
Know-how	Brand	Financial strength	Design-build similar projects
Expertise	Culture	Marketability	Diversity
Plant/equipment	Trust/integrity	Stability	Resources
Specialism	Methodology	Audit reports	Reputation
Design capacity	Organization	Turnover	

Source: Adapted from Dr. Sherif Hashem, "*The Power of Design-Build: A Guide to Effective Design-Build Project Delivery Using the SAFEDB-Methodology*" (Business Expert Press: USA, August 2014).

usually generates a handful of potential suppliers with good standing. If the organization has a list of current qualified sellers, it can form the basis for new projects.

13-3c Supplier Selection

After one or more potential suppliers have passed the evaluation process, the selection process must begin. The project team now invites potential suppliers to submit bids or proposals. Procurement documents are used to solicit proposals from various vendors. The most common procurement document is the request for proposal (RFP). The RFP can be a foundation for the future working relationship between the buyer and the supplier. In fact, the proposal prepared by the vendor often becomes a part of the final contract, as an addendum or exhibit, between the supplier and the vendor. A request for proposal usually includes the following items:

- Purchasing overview
- Basic supplier requirements

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- Technical requirements
- Managerial requirements
- Pricing information
- Appendices

The basic supplier selection decision is a classic decision tree problem. This is a choice between alternatives under uncertainty. The outcome is concerned with both price and performance, including delivery time. Does the decision maker wish to trade a higher price against supply assurance under all circumstances? The difficulty in quantifying all consequences reinforces the need for sound judgment in key decisions.

Evaluation criteria are used to rate proposals and other supplier characteristics. The criteria can be objective or subjective, and they are often provided in the RFP. Typically, the most important evaluation criterion is price. Other important criteria include the vendor's technical capability, reputation, and so on. Exhibit 13.5 shows factors in addition to price that can be used in assessing suppliers.

The project team selects one or more sellers who are both qualified and acceptable as sellers. Many tools and techniques, including the following, can be used in the seller selection decision process:

- Weighting system
- Independent estimates
- Screening system
- Seller rating system
- Expert judgment
- Proposal evaluation techniques

The goal of selecting suppliers is to award a contract. A **contract** is "a mutually binding legal relationship obligating the seller to furnish supplies or services and the buyer to

EXHIBIT 13.5

FACTORS USED IN ASSESSING POTENTIAL SUPPLIERS

- Replenishment lead time: This is the lead time between placing an order and receiving the order, which can be translated into the required responsiveness for purchasing.
- On-time performance: This affects the variability of the lead time.
- Supply flexibility: It is the amount of variation in order quantity that a supplier can tolerate without letting other performance factors deteriorate.
- Delivery frequency and minimum lot size, which affect the size of each replenishment lot ordered by a firm.
- Supply quality: A worsening of supply quality increases the variability of the supply of components available to the firm.
- Inbound transportation cost: The total cost of using a supplier includes the inbound transportation cost of bringing materials in from the supplier.
- Information coordination capability affects the ability of a firm to match supply and demand.
- Design collaboration capability.
- Exchange rates, taxes, and duties can be quite significant for a firm with a global manufacturing and supply base.
- Supplier viability is the likelihood that the supplier will be around to fulfill the promises it makes. This consideration can be especially important if the supplier is providing mission-critical products for which it would be difficult to find a replacement. If a supplier has two key people who can each perform the necessary work, the second worker is sometimes considered to be "truck insurance" in case the first worker gets run over by a truck.

provide consideration for them."[8] A contract establishes a legal relationship between parties, and it is subject to remedy in the court system. The project organization can be a seller in dealing with the project owner or customer and a buyer in a more prevalent procurement setting. In many project management scenarios, the project manager must be aware of how a wide range of contracts is developed and executed. A procurement contract is awarded to each selected seller. The contract can be in the form of simple purchase order or a complex document detailing generic and specific conditions of the contract. The major components in a contract document generally include the following:

- Statement of work
- Schedule baseline
- Period of performance
- Roles and responsibility
- Pricing
- Payment terms
- Place of delivery
- Limitation of liability
- Incentives
- Penalties

13-4 Contract Types

Different types of contracts can be used as tools in planning acquisitions specified in the make-or-buy decision. Contracts differ by type with regard to how the risk is distributed and how the project is performed. The seven most common types of project procurement contracts are shown in Exhibit 13.6.

EXHIBIT 13.6

TYPES OF CONTRACTS

CONTRACT TYPE	COST RISK ABSORBED BY	APPROPRIATE WHEN
Firm-fixed-price	Seller	Costs are well known
Fixed-price-incentive-fee	Mostly seller	Costs are well known and buyer wants to maximize some performance aspect
Fixed-price-economic-price-adjustment	Both	Project may be long duration and inflation and commodity prices may fluctuate
Cost-plus-incentive-fee	Mostly buyer	Costs are not well known and buyer wants to maximize some performance aspect
Cost-plus-award-fee	Mostly buyer	Both parties agree most of fee is based upon buyer's opinion of seller performance on stated criteria
Cost-plus-fixed-fee	Buyer	Costs not well known
Time and material	Buyer	Cost rates known, volumes are unknown

13-4a Fixed-Price Contracts

A **fixed-price contract** is an agreement that binds the seller to perform the agreed-upon work for the agreed-upon money. The contract may also include an agreed-upon date for completion. The most common types of fixed-price contracts are firm-fixed-price (FFP), fixed-price-incentive-fee (FPIFD), and fixed-price-economic-price-adjustment (FP-EPA).

FIRM-FIXED-PRICE (FFP) CONTRACT The **firm-fixed-price contract** is a contract in which the seller has to complete the job for the agreed-upon amount of money regardless of the actual cost incurred. Any cost increase due to adverse performance is the responsibility of the seller, who is obligated to complete the effort. A simple form of a firm-fixed-price contract is a procurement order for a specified item to be delivered by a certain date for a specified price, such as a truckload of mulch delivered on the job site of 3110 Elm Street on May 15 for $300.

FIXED-PRICE-INCENTIVE-FEE (FPIF) CONTRACT The **fixed-price-incentive-fee contract** is a contract in which the price is fixed as defined by the contract, but the seller can earn an additional amount as incentive if the seller meets defined project metrics. An example is a contract for rebuilding a bridge for a fixed price of $1,250,000 with an incentive of an extra $3,000 for every day it is complete before the scheduled date of September 15. The buyer would like to have use of the bridge sooner, and the seller would like to earn a higher fee, so both have an incentive to finish the project early. Performance incentives can also include bonuses for better quality, more features, or anything else that the buyer wishes to maximize and is willing to pay for.

FIXED-PRICE-ECONOMIC-PRICE-ADJUSTMENT (FP-EPA) CONTRACT The **fixed-price-economic-price-adjustment contract** is a fixed-price contract with a clause to protect the seller from conditions such as inflation or commodity cost increases. An example is a contract that states the contractor will receive $400,000 to supply all of the

gravel for a project, but the price may be adjusted based upon market price for gravel at the dates when it is delivered.

Fixed-price contracts provide low risk for the buyer, since the buyer does not pay more than the fixed price regardless of how much the project actually costs the seller. Consequently, a seller bidding on a fixed-price project must develop accurate and complete cost estimates and include sufficient contingency costs. Certainly, overpricing should be avoided, as a competing contractor with a lower price might be selected. In case the seller does not have a clear understanding about the project scope, the next type of contract should be considered as an alternative.

Cost-reimbursable contracts, unlike fixed-price contracts, provide lower risk for the seller and higher risk for the buyer. They are generally more appropriate when it is difficult to estimate the project cost.

13-4b Cost-Reimbursable Contracts

Cost-reimbursable contracts are a type of contract in which the seller is reimbursed for the actual approved costs of completed work, plus a fee typically representing profit. The three variations of commonly used cost-reimbursement contracts are cost-plus-fixed-fee, cost-plus-award-fee, and cost-plus-incentive-fee.

COST-PLUS-FIXED-FEE (CPFF) CONTRACT

The **cost-plus-fixed-fee contract** is a type of contract in which the buyer reimburses the seller for all of the seller's allowable costs plus a fixed amount of profit (fee). An example is a research project in which all scientist hours spent on the project are paid along with a fee of $5,000 regardless of how many hours the scientist spent.

COST-PLUS-AWARD-FEE (CPAF) CONTRACT

The **cost-plus-award-fee contract** is a type of contract that involves payments to the seller for all allowed costs incurred for completed work, plus an award fee based on satisfying certain subjective performance objectives. An example is a development contract that pays the contractor $3,000,000 plus puts in escrow an award fee pool of $210,000, and an executive in the customer's organization has sole discretion regarding how much of the award fee pool is given based upon customer satisfaction criteria.

COST-PLUS-INCENTIVE-FEE (CPIF) CONTRACT

The **cost-plus-incentive-fee contract** is a type of contract in which the buyer reimburses the seller for the seller's allowable costs and pays the seller a fee if it meets defined performance criteria. These criteria can be for schedule, cost, and/or performance. An example of a schedule criterion is a contract for constructing a college dormitory that calls for completion by August 15 so it is ready for the fall semester. A cost criteria example is the buyer of a small house negotiating a total project cost of $150,000. A performance criteria example is when an auto company enters a contract with a supplier to develop a battery that can get 55 miles per gallon in a 3,000-pound car. In each of these cases, the contract can call for the seller to receive a bonus if it does better than the agreed-upon target and/or a penalty if it does worse. Both the buyer and the seller can benefit if performance criteria are met.

13-4c Time and Material (T&M) Contracts

Time and material contracts are hybrid contracts containing aspects of both cost-reimbursement and fixed-price contracts generally used when the deliverable is labor hours and/or amounts of materials. In this type of contract, the unit rate for each hour of labor or pound of material is set in the contract as it is practiced in a fixed-price contract. However,

the amount of work is not set, so the value of the contract can grow like a cost-reimbursement contract. The seller simply charges for the work to produce the product or service in the contract. This can be problematic if the time scheduled for production is greatly underestimated. This type of contract is used when the scope of the project work is ambiguous.

In choosing the right type of contract, the nature of the outsourced project activity influences the decision. The requirements that a buyer imposes on a seller, along with other planning considerations such as the degree of market competition and degree of risk, also determine which type of contract is used. The following items are frequently considered when selecting the right type of contract:

- Overall degree of cost and schedule risk
- Clarity about the scope of work
- Type and complexity of requirements
- Extent of price competition
- Cost and price analysis
- Urgency of the requirements
- Performance period
- Contractor's responsibility
- Contractor's accounting system
- Extent of subcontracting

One of the important factors to consider is the degree of risk for the seller and the buyer that each type of contract presents. Each of the contract types has risk attached to it. When considering different contracts, it must be clear who assumes the most risk—the buyer or the seller. Under normal conditions, the greatest risk to the buyer is when the cost-plus-fixed-fee contract is chosen. The contract with the greatest risk to the seller is the firm-fixed-price contract. Generally, the buyer and seller negotiate details of the contract risks and benefits that both parties can accept.

One risk management technique that is rapidly becoming popular for insuring large projects is the use of wrap-ups. A wrap-up, or owner-controlled insurance program (OCIP), is a single insurance policy providing coverage for all project participants, including the owner and all contractors and subcontractors. An OCIP can potentially reduce an owner's total project cost by 1 to 2 percent compared to traditional fragmented programs. Its major advantages include broader coverage, volume discounts, and reduced claims due to comprehensive loss-control programs. The type and complexity of the agreements may also necessitate assistance from legal specialists, buyers, and contracting experts.

13-5 Control Procurements

Control procurements include managing relationships between sellers and customers, monitoring contract performance, and making changes and corrections if needed. Both buyers and sellers administer contracts to make sure that the obligations set forth in the contract are met and to make sure neither party has any legal liability. Both must perform according to the contract terms. The seller creates performance reports, and the buyer reviews these reports to ensure that the performance of the seller satisfies the obligations of the contract.

13-6 Improving Project Supply Chains

Project supply chain performance can be improved by careful and innovative use of partnering, third-party involvement, lean purchasing, sourcing, logistics, and information.

Stephen Coburn/Shutterstock.com

13-6a Project Partnering and Collaboration

Companies are constantly in need of outsourcing or contracting significant segments of project work to other companies. The trend for the future suggests that more and more projects will involve working with people from different organizations in a partnering relationship. **Partnering** is "a long-term relationship between an owner and a contractor in which the contractor acts as a part of the owner's organization for certain functions."[9]

Research also finds that through strategic partnering, companies are more likely to access advanced technology, share risks, and improve project-based performance and relative competitiveness. This section extends the previous discussion of project procurement and contracting by focusing specifically on issues surrounding working with different suppliers to complete a project. The term *partnering* is used to describe this process. Partnering is a method for transforming contractual arrangements into a cohesive, collaborative project team with a single set of goals and established procedures for resolving disputes in a timely and cost-efficient manner. The single set of goals takes care of the customer requirements and the entire project instead of each individual organization. Exhibit 13.7 presents an excellent example of project partnering and collaboration in the international airport industry.

SOURCES OF CONFLICT DURING PROJECT PURCHASING In the procurement and purchasing environment, conflicts are inevitable. For example, many people envision the purchasing process as a type of zero-sum game, meaning what one party loses is what the other party gains. (The most common type of conflict is this: lower price means cost reduction for the buyer, but it also means revenue loss to the seller.) In

EXHIBIT 13.7

JORGE CHAVEZ INTERNATIONAL AIRPORT, LIMA, PERU

The location of Lima in the center of the west coast of South America presents an extended area of attraction, making the airport into a natural international hub. The proximity of Jorge Chavez International Airport (JCIA) to Port Callao, the principal port of Peru, offers the possibility of developing a sea/air plan in favor of external commerce.

LIMA AIRPORT PARTNERS

Fraport-Bechtel-Cosapi Consortium won the international public tender for the concession of the JCIA. With an equity contribution of $30 million, the consortium founded Lima Airport Partners (LAP). The three consortium partners each have impressive track records. Fraport AG operates the Frankfurt Airport, considered one of the largest in continental Europe. Fraport also provides other airport services such as handling and other commercial services. Fraport participates in more than 50 projects around the world. Bechtel is a private construction company founded in 1898. It has participated in more than 1,000 projects in 67 countries, of which 80 have been airport projects. Cosapi is a local construction company founded in 1960 with projects in South America. Currently, LAP's shareholders are Fraport AG, the International Finance Corporation (IFC), and the Fund for Investment in Infrastructure, Utilities and Natural Resources, managed by AC Capitales SAFI S.A.

LAP's objectives are to improve both facilities and operation of JCIA. The improved facilities will be transferred to the State of Peru. The concession term is 30 years with an option for a 10-year extension.

Source: Patricia Quiroz, Professor of Pontificia Universidad Catolica del Peru.

fact, many types of interest conflicts arise among different companies. For example, delays in construction are common and expensive, and litigation related to design and construction is rising.

Obvious conflicts of interest predispose owners and contractors to be suspicious of one another's motives and actions. Suspicion and mistrust prevent effective problem solving throughout the process. In taking care of each party's own interests, mistakes and problems are often hidden. When conflicts emerge, they often create costly delays as well as questionable responses simply because the information transferred may be distorted many times before it reaches the decision maker. The consequences, however, are avoidable from the beginning.

RESOLVING PROJECT PURCHASING CONFLICTS

One approach to resolving conflict is to use project partnering as an effective way to engage both the project owner and contractors. Project partnering naturally developed as people began to realize that the traditional win/lose adversarial relationship between owner and contractor degenerates into a costly lose/lose situation for all the parties involved. The systematic project supply chain management view goes beyond this traditional view to increase the baseline of trust and collaboration.

Ten key elements for effective project partnerships are shown in Exhibit 13.8.

MUTUAL GOALS IN PROJECT PARTNERSHIPS

Some common goals warrant a more supportive relationship. For example, both the buyer and seller would like to complete the project on time and safely. Both parties would prefer to avoid costly and time-consuming litigation. On the other hand, once the specified project can be finished on a faster and less-expensive basis, either party is in a better position of getting better operational rewards. Some of the many advantages for establishing a project partnership are shown in Exhibit 13.9.

EXHIBIT 13.8

Ten key elements of a successful partnership:

1. Recognition of the need for a partnership
2. Clear and agreed purpose and objectives
3. Commitment and ownership
4. Trust between partners
5. Create clear and robust partnership arrangements
6. Good communication with all partners
7. Mutual benefits for all partners
8. Conflict resolution and mediation
9. Systems to monitor, measure and learn
10. Outcomes that live on beyond the life of the partnership

Source: Sustainability Learning Guide: Successful Partnerships: https://www.lgnsw.org.au/files/imce-uploads/35/SLG_successful_partnerships.pdf, accessed April 24, 2017.

For example, Procter & Gamble (P&G) started using the Web to share information and streamline purchasing a few years ago. Ford used 900 virtual workspaces to design cars and hold meetings. In one project, Ford used digital conference rooms from eRoom to manage the formation of the auto industry e-marketplace Covisint.

EXHIBIT 13.9

ADVANTAGES OF PROJECT PARTNERSHIPS

ADVANTAGES TO BOTH PARTIES	ADVANTAGES TO CLIENTS	ADVANTAGES TO VENDORS
Shared motivation	More effectively managed risks	Clearly stated expected outcome
Flexibility	Reduced up-front project cost	Greater potential profit
Reduced administration of frequent bids	Potential of lower cost	More dependable stream of work
Improved project execution	Ability to focus on core capabilities	Opportunity to prove oneself
Ability to explore new technologies		
Improved communication		
Ability to make better decisions		
Improved resource utilization		

Source: Adapted from Tom Chaudhuri and Leigh Hardy, "Successful Management of Vendors in IT Projects," *PM Network* 15 (6) (June 2001): 48; and He Zhang and Peter C. Flynn, "Effectiveness of Alliances Between Operating Companies and Engineering Companies," *Project Management Journal* 34 (3) (September 2003): 49.

EXHIBIT 13.10

EFFECTIVE PROJECT PARTNERING APPROACHES
Organization-wide willingness to: • Use long-term perspective • Share power with partner • Trust partner • Adapt to partner • Go beyond contractual obligations Mutual commitment to: • Quality • Continuous improvement • Clearly understand partner • Ongoing relationship with partner Effective methods: • Openly share information • Develop contractual relationships • Develop interpersonal relationships • Resolve conflict

Lawyers from law firms and three automakers shared virtual rooms to haggle over contracts.

EFFECTIVE PROJECT PARTNERING APPROACHES Many differences exist between the way traditional project procurement unfolds and the way contemporary project procurement takes place in a partnering mode. Exhibit 13.10 lists some of the requirements of effective project partnering.

Many large Japanese manufacturers have found a middle ground between purchasing from a few suppliers and vertical integration. These manufacturers are often financial supporters of suppliers through ownership or loans. The supplier then becomes part of a company coalition known as a *keiretsu.* Members of the *keiretsu* are assured long-term relationships and are therefore expected to function as partners, providing technical expertise and stable quality production to the manufacturer. Members of the *keiretsu* can also have suppliers farther down the chain, making second- and even third-tier suppliers part of the coalition. Most partners value their membership and work hard to do their part. In the rare instance in which a partner consistently takes advantage of the situation, the partner is eventually dropped.

Companies can use different purchasing modes for specific purchasing items when dealing with large projects. For example, one major Chinese petroleum company used five purchasing models for multiple projects, which include purchasing mechanisms for strategic materials, full competitive products, limited resource products, nonstandard products, and existing long-term collaboration suppliers. Third-party inspection companies were hired to conduct on-site assessment and quality approval for the incoming materials of multiple projects at the same time. The integrated on-site warehousing management system streamlined the management process, reduced

unnecessary inventory to almost zero, and minimized the total investment of the projects.

SECURING COMMITMENT TO PARTNERING When developing a project supply chain partnership, a project manager may want to consider contractors with a mutual interest and expertise in partnerships. At the beginning, the owner needs to get the commitment of the top management of all firms involved. All the benefits of the partnership and how the partnership would work need to be described in detail. Team building is an effective approach for involving all the key players from different firms. Separate training sessions and workshops are offered to promote a collaborative spirit. One of the major goals of the team-building sessions is to establish a "we" as opposed to an "us and them" attitude among the different participants. A second objective of the sessions is to establish a mechanism in advance designed to ensure that this collaborative spirit is able to withstand the problems and setbacks that will invariably occur on the project. Some of the most significant mechanisms are as follows:

- Problem resolution—Solving problems at the lowest level of organizations and having an agreed-upon escalation procedure
- Continuous improvement—Endless process of waste elimination and cost reduction
- Joint assessment—Reviewing the partnering process jointly
- Persistent leadership—Displaying a collaborative response consistently

More project organizations are pursuing partnering relationships with each other. Project partnering represents a proactive way for managing many of the challenges associated with working with different organizations. The process usually starts with some agreed-upon procedures and provisions for dealing with problems and issues before they happen. One way is to design a contract with specific incentives and penalties. On the other hand, partnering is not just about relationship contracting. For example, although many companies may wish to develop company-wide policies and procedures for inter-firm conflict resolution, this method is less effective since each project and each company different. The partnering approach has to be dynamic to unite a wide variety of suppliers and contractors for some common goals that everyone cares about. Although the project purchasing relationship has been moved from short-term arrangements based on contracts to long-term relationships based on trust, this change is by no means universally applicable.

Partnering fosters a strong desire to contain costs when changes are necessary and leads to a team approach in resolving any financial and time consequences. In the next section, we discuss the integrated project supply chain management approach.

Partnering seeks to recast relations between actors in projects by promoting the use of collaborative, more open relationships. The integrated supply chain perspective further shifts traditional channel arrangements from loosely linked groups of independent businesses that buy and sell products or services to each other toward a managerially coordinated initiative to increase collaboration, customer satisfaction, overall efficiency, continuous improvement, and competitiveness. For example, in the construction industry, the construction supply chain (CSC) consists of all the construction partners such as client, designer, general contractor, subcontractor, supplier, and consultant. In fact, the CSC itself represents a concept of systematic coordination of relevant business activities within the supply chain.

13-6b Third Parties

In general, third parties can increase the supply chain performance effectively if they are able to aggregate supply chain assets or flows to a higher level than a firm can by itself. Third parties can use various mechanisms to grow the supply chain performance (e.g., reducing delivery time and cost), by aggregating:

- Capacity
- Inventory
- Transportation
- Warehousing
- Information
- Receivables
- Relationships

13-6c Lean Purchasing

Lean purchasing refers primarily to a manufacturing context and implementation of just-in-time (JIT) tools and techniques to ensure every step in the supply process adds value while various costs are kept at the minimum level. By reducing ordering cost for placing orders (e.g., the fixed part of the shipping cost), project organizations can use JIT for eliminating waste in ordering time and cost, which eventually results in timely completion of projects and customer satisfaction.

Doubtlessly, integrating SCM into project management helps project managers create win/win situations for all parties involved in the project supply chain as they become more efficient and effective. The specific supply chain techniques can help project managers make better trade-offs between project costs and time to create better customer satisfaction.

13-6d Sourcing

Sourcing encompasses all processes required for a firm to purchase goods from suppliers. Effective sourcing decisions thus have a significant impact on project performance. Good project sourcing decisions can improve project performance by aggregating orders, making procurement transactions more efficient, achieving design collaboration with suppliers, facilitating coordinated forecasting and planning with suppliers, and improving customer satisfaction.

13-6e Logistics

Logistics, in contrast to supply chain management, is the work required to move and position inventory throughout a supply chain. Supply chains use a combination of the following modes of transportation:

- Air
- Package carrier
- Truck
- Rail
- Water
- Pipeline
- Intermodal

The transportation cost a supply chain incurs is closely linked to the degree of responsiveness the supply chain aims to provide. Thus, decision makers must consider the trade-off between responsiveness and transportation cost when making the relevant logistics decisions. Moreover, the necessity of shipping speed needs to be considered, as noncritical project activities tend to have some slack.

13-6f Information

Information is also key to the success of project supply chain management because it enables management to make decisions over a broad scope that crosses both functions and firms. For instance, information sharing in many cases can allow the project supply chain to shorten the delivery time and, at the same time, offer better-quality products or services to meet the dynamic demand of a project. Information must have the following characteristics to be useful when making supply chain decisions:

- Accurate
- Accessible in a timely manner
- Of the right kind

Information is a key ingredient not just at each stage of the project supply chain but also within each phase of supply chain decision making. This is where IT comes into play. IT consists of the hardware, software, and people throughout a project supply chain that gather, analyze, and execute procurement actions based on information. In today's business world, IT-based information management is crucial to the performance of project supply chains simply because it provides the basis of decision making, which has profound impacts for every aspect of project management.

PMP/CAPM Study Ideas

Some of the questions you will see on the material covered in this chapter will be at least partly based on vocabulary. For example, there are several types of contracts, and some of their names are similar, but you need to completely understand the difference between terms such as *cost-plus-award-fee* and *cost-plus-incentive-fee*, as well as when each type of contract may be used and how each type of contract divides risk between buyer and seller.

Likewise, similar terms are used in the seller selection process, and you will need to know the difference between a Request for Information (RFI), Request for Quotation (RFQ), and Request for Proposal (RFP) and to apply that knowledge to a variety of questions/problems.

Summary

More and more companies are seeking cooperative relationships with each other to compete in today's demanding marketplace. Project supply chain management represents a set of proactive responses to many challenges created by people from different organizations working together on one-time projects. By identifying the project needs and wants, project organizations start with assessing the need to outsource part of the project work. Contracting is commonly used to specify and manage supplier–buyer relationships. Purchasing details such as scope, deliverables, and quality expectations are legally enforced in the contract. As such, project teams take great care in selecting a specific and attainable contract to meet customer delivery expectations and internal profitability goals. However, project supply chain management is not just about contracting. Partnering and coordinating purchasing across all supplier stages allow a firm to maximize economies of scale in purchasing and also to reduce transaction costs.

Key Terms Consistent with PMI Standards and Guides

supply chain management, 427
owner, 427
general contractor, 427
subcontractor, 427
make-or-buy decisions, 428
plan procurement management, 429
procurement management plan, 429
procurement statements of work, 429
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lean purchasing, 445
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Chapter Review Questions

1. Do small businesses often outsource project work? Why or why not?
2. Name the three processes that make up project procurement management.
3. In supply chain management, what are some other names for the seller? What are some other names for the buyer?
4. List three functional areas that are frequently outsourced by business organizations.
5. What is the difference between a request for quotation (RFQ) and a request for proposal (RFP)?
6. After an organization has developed a list of potential suppliers, how should the organization evaluate each supplier individually?
7. What are four potential information sources that organizations can use to identify potential sellers?
8. Describe two methods that can be used to evaluate potential suppliers.
9. What items are generally included in a request for proposal?
10. In a fixed-price contract, who assumes the greatest level of risk?
11. What type of contract is good to use if it is necessary for both parties to share the risk?
12. In what type of contract does the buyer assume the greatest level of risk?
13. What is the name of a single insurance policy that is used to provide coverage for all project participants?
14. What is meant by *logistics* and how does it relate to project management?
15. _____ is a method for transforming contractual arrangements into a cohesive, collaborative project team with a single set of goals and established procedures for resolving disputes.

Discussion Questions

1. Why does the project team require a project scope statement prior to planning procurements?
2. List three reasons an organization might choose to make a product or service in-house and three reasons why an organization might choose to buy or outsource the work.
3. Should activities on the critical path be outsourced? Why or why not?
4. Which of the three competitive advantages do you think companies are most willing to outsource for? List any examples you can think of.
5. Your company is hoping to outsource some of its work constructing a new development of condominiums. What would you use as selection criteria to narrow down your list of potential sellers?

6. You decide to board your dog at the vet's office while you are on vacation and sign papers saying you will pay $25 per day plus $15 for a bath every third day. What type of contract have you entered into?
7. What would be your top two considerations when selecting a type of contract to enter into?
8. Describe three differences between a partnering relationship and a traditional seller–buyer arrangement.
9. What are some potential issues related to outsourcing? How could you mitigate these issues?
10. You are the project manager in charge of renovating a large apartment building, and your team has decided to outsource the installation of a new septic system. Do you put out an RFQ or RFP to interested contractors? Why?

PMBOK® Guide Questions

1. The Project Procurement Knowledge Area includes all of the following processes *except*:
   a. plan procurement management
   b. conduct procurements
   c. close procurements
   d. control procurements
2. In order to plan for procurements, the project team uses a project document that includes a list of deliverables, acceptance criteria, project assumptions and constraints, and a description of the product, service or result. This document is called the _____.
   a. work breakdown structure (WBS)
   b. project charter
   c. project contract
   d. project scope statement
3. One output of the Plan Procurement Management process is the _____, a document that describes the item to be procured "in sufficient detail to allow prospective sellers to determine if they are capable of providing the products, services, or results."
   a. request for proposal
   b. procurement statement of work
   c. scope statement
   d. procurement management plan
4. Which of the following contracts is riskiest for a buyer?
   a. time and material
   b. cost reimbursable
   c. firm-fixed-price
   d. fixed-price-economic-price-adjustment
5. A _____ analysis is a technique that results in a decision about whether particular work can best be accomplished by the project team or should be purchased from external sources.
   a. make-or-buy
   b. SWOT
   c. sensitivity
   d. vendor
6. Which contract type puts the most risk on the seller?
   a. time and material
   b. cost reimbursable
   c. firm-fixed-price
   d. fixed-price-economic-price-adjustment
7. What is a hybrid type of contract that is often used for staff augmentation or any outside support in which a precise statement of work cannot be defined, and which often includes a not-to-exceed value and time limit to prevent unlimited cost growth?
   a. time and material
   b. cost reimbursable
   c. fixed price
   d. incentive fee
8. The type of procurement document that might be used to request prices for standard products or services is called a(n) _____.
   a. request for proposal (RFP)
   b. request for information (RFI)
   c. invitation for negotiation (IFN)
   d. request for quotation (RFQ)
9. During which of the following processes is evaluation criteria developed, in order to evaluate potential sellers?
   a. plan procurement
   b. conduct procurement
   c. control procurement
   d. plan communication management
10. Procurement performance reviews, contract change control system, payment systems, and

performance reporting are all tools and techniques for which procurement process?
a. plan procurement management
b. conduct procurements
c. close project
d. control procurements

Exercises

Find a story in your local newspaper about a project that is about to start. For that project, answer each of the following questions and justify your answers:

1. Using the ideas in Exhibit 13.2, speculate on what activities, supplies, or services could be contracted out.
2. Create a request for information for one portion of the project work that could be contracted out.
3. Using ideas from Exhibits 13.4 and 13.5, determine criteria you would use to select sellers for the portion of contract work under consideration.
4. Determine what type of contract you would use for this work and explain why.
5. Describe the extent to which any partnering makes sense for this project. What are the challenges and benefits to this partnering? What would prevent any further partnering?

INTEGRATED EXAMPLE PROJECTS

SUBURBAN HOMES CONSTRUCTION PROJECT

A well-known aspect of the construction industry is that it is a fragmented industry with a large share of working people engaged with it. Due to its nature of operations and fluctuations in demand, the construction industry thrives on hiring contractors and subcontractors on an as-needed basis. Likewise, one can find multiple sources of suppliers nationwide for all the hardware items such as windows, doors, drywall, doorknobs, and HVAC equipment. Suburban Homes, as an organization, realizes the importance of long-term partnership with various suppliers and contractors and the many benefits of such a partnership. Suburban Homes is planning to revisit their existing partnerships with various suppliers and contractors because competition is rising and profit margins are declining. Suburban Homes is looking for partners and suppliers to improve profits and increase customer satisfaction. Suburban Homes developed a set of criteria to select partners for construction work and supply of materials:

- Collaboration
- Reliability
- Value engineering (higher quality at a competitive price)
- Performance
- Trust
- Transparency in commercial deals and communication

With its ambitious plan of expanding its business to several southern states and its vision to deliver high-quality construction that adheres to local, state, and federal standards as well as exceed industrial standards for quality, Suburban Homes is willing to identify, negotiate, and partner with competent and reliable suppliers and contractors. Adam Smith entrusted you with the task to develop a procurement and supply chain management plan. For this purpose, you were asked to do the following tasks:

Tasks to Complete

- Assess the current market situation.
- Identify prospective partners for supply of materials and construction work.
- Select an appropriate type of contract for each supplier (it may not be same for everyone).
- Assess risks associated with each contract.
- Develop contract terms and conditions.
- Perform qualitative assessment to prioritize risks.
- Develop a procurement policy.

CASA DE PAZ DEVELOPMENT PROJECT

Casa de Paz has multiple supply chain issues. Some questions to answer include the following:

1. Will Casa de Paz rent or buy a building? If renting, how much can they help pay for needed upgrades? How can they partner with a potential landlord for the best long-term goals of each?
2. What kind of organizations can Casa de Paz partner with for professional services such as nursing, English as a Second Language, occupational readiness, counseling, and so forth?
3. What kind of partnership can they establish in the religious and nonprofit communities? What should they look for in potential partners?

Semester Project Instructions

Using the ideas in Exhibit 13.2, determine what activities, supplies, or services needed on your example project could be contracted out. Create a request for information for one portion of the project work that could be contracted out. Using ideas from Exhibits 13.4 and 13.5, determine criteria you would use to select sellers for the portion of contract work under consideration. Determine what type of contract you would use for this work and tell why. Describe the extent to which you are partnering on your example project. Describe the extent to which any other person or group may be partnering on the project. What are the challenges and benefits to any partnering that is occurring? What is preventing any further partnering?

PROJECT MANAGEMENT *IN ACTION*

Implications for Project Management in a Networked Organization Model

What Is a Networked Organization?

In a small organization, it is quickly recognized that you cannot do it all. You need to develop a business model where you leverage the strengths and expertise of your core team, while partnering and networking with specialized organizations and experts where you build trusted alliances and long-term relationships.

Our company is a project management training and consulting firm. We have seven people on our core team. These individuals are critical to the success of the company. They perform the "essential functions" required to run the business—primarily operations such as accounting, legal, contracting, sales, and project management. Functions we do not have to do ourselves are outsourced to experts such as human resources (we have seven employees), information technology (we had seven computers), fulfillment (packing and shipping training materials), marketing (branding and social media), and independent contractors (hired as expert trainers and consultants under contract with the firm

As a seven-person company, we must have a high-performance team and a solid network of business partners who are considered part of our team, but not part of our payroll.

The Challenges

Running a business with a number of external partners has its challenges. Do they understand our business to be a key contributor? Will they have time for our projects while they are working with other organizations? Will they be working with competitors while they are servicing us?

In addition, so that we could better service our worldwide clients with local providers, we decided to

globalize the company. This added another element of complexity—time zones, language and cultural differences, and in-country laws for contracting their services.

Our Approach

1. Establish a common PM Methodology—Since our company uses PMI's *Guide to the Project Management Body of Knowledge* (PMBOK® Guide) as a foundation, our global partners also use the PMBOK Guide, translated in their local language. This created a common terminology for all of us, which helped discussions and accelerated problem solving.
2. Have a central point of contact—Communications is key. As the chief operating officer (COO), my role is to be the "go-to" person for all business partners. It is crucial to establish an element of trust and transparency, especially when negotiating and executing contracts.
3. Establish a Quality Management System—We became ISO 9001 certified. This enables us to help our business partners be accountable for the delivering of our products and services under our brand name. To accelerate doing business together, one of the ISO processes is establishing and documenting "shared expectations" with each business partner. Not only does this include the specific details about services being delivered, but also the financial aspects of procurement, payments, and fulfilling various types of contracts. ISO also gives us a competitive advantage in the marketplace.
4. Invite strategic partners into the business—In our networked organization, we call our outside experts "business partners" or "strategic alliances." They are not vendors. They are critical to the success of our business and are invited to attend our strategic planning sessions and business planning meetings. If they are involved in a project, they attend the project status meetings and participate on project teams. They are key to our success.

It is amazing what seven people in an organization can do. With the right partners, the right resources, the right contracts, and the right relationships, we can make an international footprint as a leading project management training and consulting firm.

Source: Connie Plowman, PMP, Chief Operating Officer (retired), PMI Eric Jenett, Project Management Excellence Award Recipient.

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CHAPTER 14

Determining Project Progress and Results

CHAPTER OBJECTIVES

After completing this chapter, you should be able to:

CORE OBJECTIVES:

- Develop and demonstrate use of a change control system.
- Demonstrate how to monitor and control project risks with various resolution strategies.
- Create and present a project progress report.

BEHAVIORAL OBJECTIVES:

- Describe the importance of formal reporting and communications.
- Demonstrate negotiating skills.
- Manage conflicts during the project execution

TECHNICAL OBJECTIVES:

- Describe project quality control tools, including how and when to use each.
- Calculate current project schedule and budget progress, and predict future progress, using earned value analysis.
- Document project progress using MS Project.

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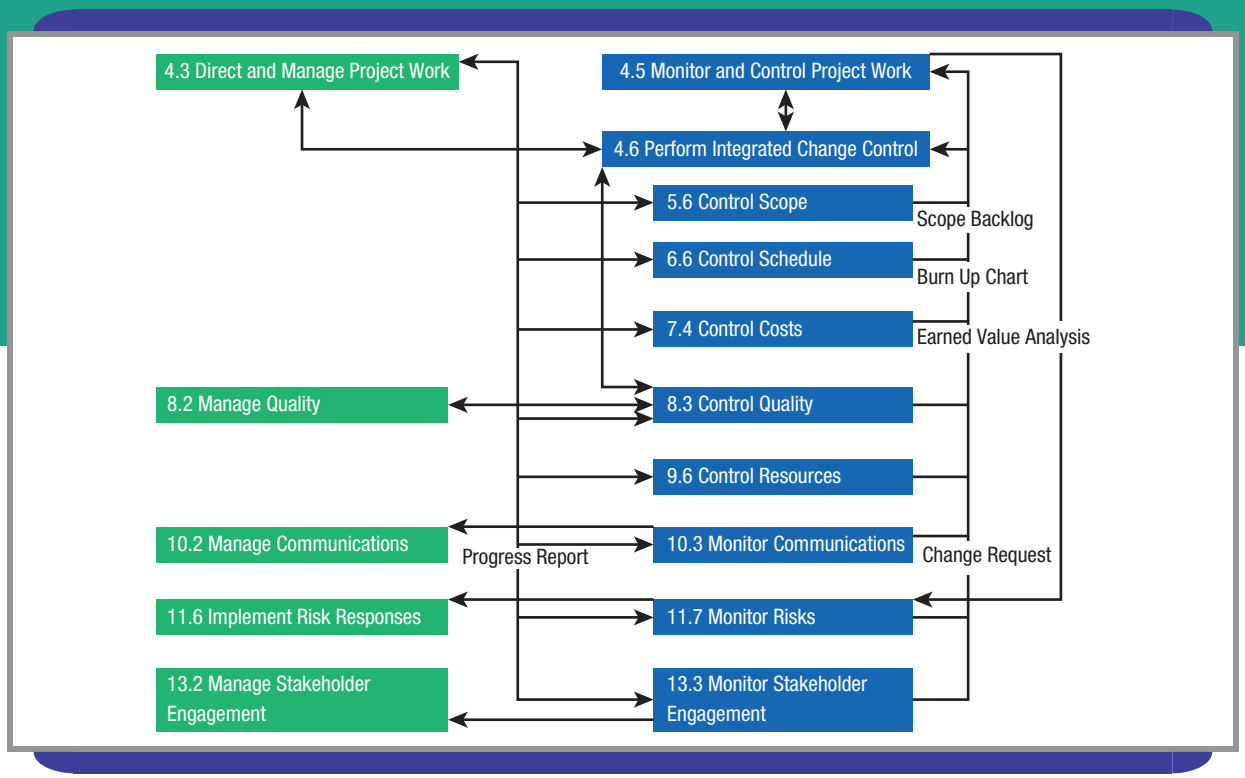
The fundamental reason for determining project progress and results comes down to one thing—*presenting actionable, decision-making information to project leaders.*

A major U.S. electric utility company is continuously faced with the daunting task of managing over 1,200 simultaneous projects in all phases of planning, execution, and completion over a geographic area consisting of five states. These projects are supported by over 40 departments within the utility and hundreds of external contractors and equipment suppliers. Over 85 percent of these projects take place over multiple years. There are over 15,000 activities tracked for active projects every month. Today, many of these projects are related to SmartGrid efforts to fundamentally change the way the electric utility system delivers power to homes, schools, and businesses.

This utility regularly sets the standard for its industry each year by completing over 90 percent of its projects on time and utilizing its annual project budget within just a few percentage points. How is this accomplished?

By identifying and collecting just the right amount of financial, scheduling, resource, and risk management data, and by focusing intently on turning raw data into actionable information for the groups leading and supporting the



PMBOK® GUIDE

Topics:

- Direct and manage project work
- Monitor and control project work
- Perform integrated change control
- Monitor risks
- Manage communications
- Monitor communications
- Manage quality
- Control quality
- Control scope
- Control schedule
- Control costs

CHAPTER OUTPUTS

- Progress report
- Scope backlog
- Burndown chart
- Earned value analysis
- Change request

projects, the utility's project controls staff can continuously find and highlight the information that requires leadership attention and project team action.

With the large number of projects being managed, the focus on individual projects decreases and management of the entire group of projects as a portfolio becomes paramount. The actionable information presented highlights significant issues for individual projects, but more important, forecasts trends over the entire portfolio and extended spans of time, helping turn earned-value statistics into meaningful strategies.

Presenting valuable decision-making data to the multiple resource and leadership groups required to support a project provides the critical linkage between the feedback of raw data and the ability to successfully control a single project or an entire multiyear portfolio. Project data collection and management present the opportunity to simultaneously manage an organization's "profit, people, and planet" objectives in an optimal way.

As you move forward with this chapter and your own projects, consider the use and impact of the project information that needs to be collected. What are the key factors for your project—financial, environmental, resource management, scheduling, risk identification, stakeholder management, or others? Who needs the project progress data, and exactly what do they need to know to make good decisions and successfully achieve organizational objectives?

Identifying, collecting, managing, and presenting data that allow you to control critical aspects of your projects are fundamental elements of project success.

—Paul Kling, director—project management and controls, Power Delivery Engineering, Duke Energy

The word *determine* in the context of "determine project progress and results" has multiple meanings. While each offers a slightly different perspective, collectively, they help a project manager understand what she needs to do to ensure that her project

is progressing adequately and will yield the intended results in the end. *Determine* can mean the following:

- To give direction to or decide the course of
- To be the cause of, to influence, or to regulate
- To limit in scope
- To reach a decision
- To come to a conclusion or resolution[1]

Project managers, in the course of planning, give direction to a project. Many projects also require replanning due to any number of causes. Project managers sometimes can influence only how work is accomplished (when people do not report to them), but they may be able to regulate or demand the work to be accomplished at a certain time or in a specific manner. To be successful in influencing and regulating project work, the project manager needs to consider the stakeholder priorities and communications needs, as discovered in Chapter 6, and use those to design the monitoring and control mechanisms described in this chapter. Many stakeholders on projects attempt to persuade the project manager and team to deliver more scope, but one important role of the project manager is to jealously guard the agreed-upon scope. Throughout a project, decisions will be made. In such instances, the project manager can do one of the following:

- Personally make these decisions
- Be part of a group that makes decisions
- Delegate decisions to others
- Facilitate the process by which each decision is made

Often, project managers need to follow up to ensure that decisions are made and then carried out. Finally, the project manager is responsible for making sure that the project is satisfactorily completed.

14-1 Project Balanced Scorecard Approach

To successfully accomplish all five aspects of project determination (direct, regulate, limit, decide, and conclude) in managing project progress, a project manager can think in terms of a balanced scorecard approach. The concept behind a balanced scorecard is that an organization needs to be evaluated from the perspectives of customer, internal business, financial, and growth and innovation. If one considers a project as a temporary organization, the same perspectives make sense when monitoring and controlling a project. Exhibit 14.1 shows a project balanced scorecard approach to project determination.

When a project manager seeks to monitor and control a project, different critical aspects are often interrelated, and thus, their impacts on each other must be considered. For example, a proposed change may impact the scope, quality, schedule, and/or cost. However, to understand project control, one must consider each aspect individually before assessing the impact on all other factors. This chapter begins with the project manager controlling internal project issues. The next major section of this chapter deals with the customer-related issues of quality and scope. The final sections deal with the financial issues of resources, schedule, and cost. The project manager can utilize a number of tools to manage schedule overloads and conflicts and to reprioritize the work. Earned value and project scheduling software such as MS Project can prove to be useful to manage these issues. Growth and innovation include issues of participant development covered in Chapter 5 and managing project knowledge covered in Chapter 15.

EXHIBIT 14.1

BALANCED SCORECARD APPROACH TO PROJECT DETERMINATION

INTERNAL PROJECT	CUSTOMER	FINANCIAL
Direct and manage project work	Manage quality	Control resources
Monitor and control project work	Control quality	Control schedule
Perform integrated change control	Control scope	Control costs
Implement risk responses		
Monitor risks		
Manage communication		
Monitor communication		

Source: Adapted from Kevin Devine, Timothy J. Kloppenborg, and Priscilla O'Clock, "Project Measurement and Success: A Balanced Scorecard Approach," *Journal of Healthcare Finance* 36 (4) (2010): 38–50.

14-2 Internal Project Issues

While all aspects of a project are important and interrelated when determining progress and results, a logical starting place is with the project work that needs to be accomplished. Closely related are the risks that may impede the work and adequate communication. Collectively, these form the project's internal issues. These issues can be envisioned as the project's nerve center. Problems in any of them travel to all other project areas just as nerves in a body carry information throughout. When dealing with this project nerve center, project managers direct and manage project work; monitor and control the project work; perform integrated change control; implement risk responses monitor project risks; and manage and monitor communications.

14-2a Direct and Manage Project Work

Directing and managing project work is performing the work as defined in various components of the project management plan, including approved changes with an intent to accomplish project objectives. When project managers authorize project work, they should empower others to the extent possible, yet control them to the extent necessary. It should be clear who is allowed to authorize each portion of work to commence. The project management plan identifies work to be accomplished, but the project manager or her appointee must tell someone when it is time to perform the work. Often, spending limits are intertwined with work authorization (e.g., "*Please perform this activity and do not spend more than $X on it. Report back to me for approval if you need to spend more.*").

The work to be performed can come from one of several sources. The primary source is the work package level of the work breakdown structure. However, approved corrective actions, preventive actions, and defect repairs may also trigger work to be authorized.

When directing project work, trade-offs are often present both between projects and other work within the project itself. Organizations often have many projects and a variety of other work that must all be accomplished. Some work is of higher priority than other work. A project manager needs to understand where her work fits in the priority. If her project is relatively low in priority, she may have trouble getting people and resources to perform the project-related activities as per the planned schedule. In a case

like that, the project manager and sponsor should have open and transparent communications so the sponsor can either help the project manager secure the resources needed or understand that the project could be delayed.

Projects often are resource-constrained or time-constrained. In resource-constrained projects, the project is limited by budget constraints. In this case, the project schedule gets extended. When a project is time-constrained or its completion date is nonnegotiable, organizations may have to expend more resources to complete the project, and project cost is likely to exceed the planned cost. In both the resource- and time-constrained projects, project scope is often not compromised. However, one should remember that the project manager should have some leeway with one of the three constraints. If all the three constraints (cost, time, and scope) are fixed, it is unlikely that the project manager and the team will be successful in completing the project within time, on budget, and with the promised scope and acceptable quality.

As the project progresses, are there changing priorities that impact project importance? Remember, any proposed change to the project scope, quality, schedule, or budget needs to be processed through the integrated change control system described later in this chapter.

Projects are undertaken with scope goals and with constraints on cost, schedule, and quality. Exhibit 14.2 gives an example of Tatro, Inc., dealing with project trade-offs.

Well-developed project charters, effective stakeholder management, and clear communications help the project manager make sensible trade-off decisions. Sometimes, an owner representative works closely with the project manager to make these decisions. Skills an owner representative can use when working closely with a project manager to make these trade-off decisions effectively are shown in Exhibit 14.3.

14-2b Monitor and Control Project Work

Monitoring and controlling project work includes a series of activities such as identifying work packages for tracking, reviewing, and documenting the progress to ensure that the project execution meets performance objectives as defined in the project plan. The term **monitor** refers to reviewing the progress and capturing project performance data with reference to the project plan; developing performance measures; and communicating performance information. **Control** means assessing actual performance obtained from monitoring a work element and comparing it with planned performance, determining variances, analyzing trends to identify and implement process improvements, evaluating possible alternatives, and finally, recommending appropriate corrective action as needed.

A **variance** is a measurable departure from a planned baseline or expected value. Variance is often measured in quantitative terms, but qualitative measures cannot be

EXHIBIT 14.2

PROJECT TRADE-OFF DECISIONS AT TATRO, INC.

Tatro, Inc., is a company that describes itself as a designer, builder, and caretaker of fine landscaping. It has both commercial and private (homeowner) clients. Landscaping projects for private homes often cost well over $100,000. Homeowners who contract for landscaping projects of this magnitude are ultra-successful people who will not change their mind once they decide they want something special. These clients tend to focus closely on the process of a project. They wish to have polite, skilled workers with no interruptions. The reason they wish to have the project completed is to create a "wow factor." Therefore, they will rarely compromise at all on either scope or quality, but they will often compromise on the necessary cost and schedule.

Source: Chris Tetrault, president, Tatro, Inc. Reprinted with permission.

EXHIBIT 14.3

USEFUL OWNER REPRESENTATIVE SKILLS IN PROJECT TRADE-OFF DECISION MAKING

Partnership	Building trust
	Improving relations
	Collaborating
	Creating alliances
	Assuring quality
Management	Planning
	Managing change
	Aligning resources
Leadership	Communicating
	Team building
Technical	Project management
	Knowledge of criteria

Source: Adapted from Denis R. Petersen and E. Lile Murphree, Jr., "The Impact of Owner Representatives in a Design-Build Construction Environment," *Project Management Journal* 35 (3) (September 2004): 35–36.

ruled out. Monitoring and controlling activities allow a project manager to keep an eye on many project activities that can indicate how well the project performance is progressing. This prepares her to act if necessary to get the project back on track. The most difficult part of monitoring and controlling is figuring out what metrics to keep, what to measure, and how to report the results to various decision makers as necessary.

Monitoring and controlling are not activities that are done only once. Monitoring and controlling activities occur along with project execution. Monitoring and controlling are a continuous, overarching part of an entire project's life cycle, from project initiation through project closing. Since the purpose of monitoring and controlling project work is to be able to take corrective action, these activities need to be timely. In fact, the reverse of an old adage is in order. Instead of shooting the messenger when there is bad news, reward the messenger if the message is delivered quickly enough to bring the project back into control and at low cost.

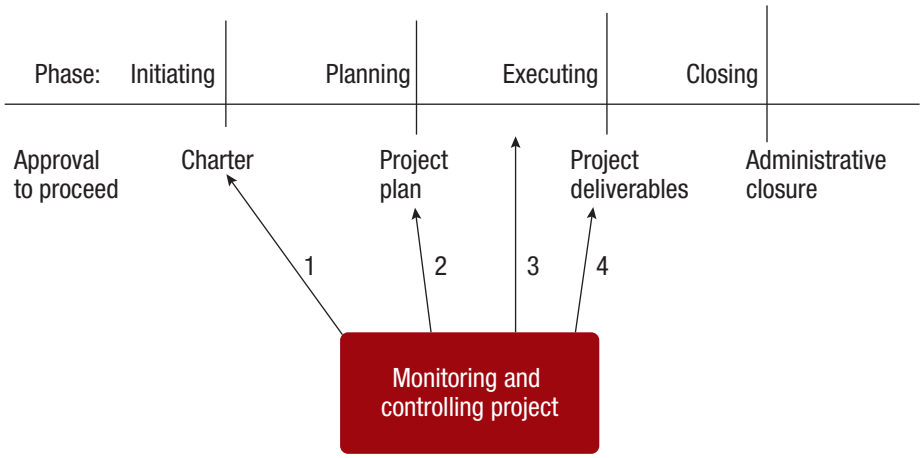
To the extent possible, letting people self-control their work adds to their enthusiasm. In other words, make them responsible and accountable by empowering people and delegating the work. That said, the project manager is ultimately accountable for all of the project results and needs to develop a sense for how much control is necessary, given the work and the person performing it.

TYPES OF PROJECT CONTROL

While this section deals with monitoring and controlling project work, the remainder of this chapter deals with monitoring and controlling each of the other project management knowledge areas. Two types of control are used extensively on projects and both compare actual performance against the project plan. One type is steering control, in which the work is compared to the plan on a continual basis to see if progress is equal to, better than, or worse than the project plan. Adjustments can be made as often as necessary. The second type of control is go/no-go control. Go/no-go control requires a project manager to receive approval to continue.

EXHIBIT 14.4

RESULTS OF MONITORING AND CONTROLLING A PROJECT



This control is often used at milestones (such as those developed in the project charter) or when someone needs to determine if a key deliverable is acceptable or not. If it is acceptable, the project continues as planned. If not, either the work needs to be redone or the project could even be cancelled. For both types of control, resulting change requests can include corrective actions, preventive actions, or defect repair.

The results of monitoring and controlling project work, schedule, budget, risks, or anything else can range from minor to major, depending on how close the actual progress is to the plan. This can be seen in Exhibit 14.4.

Depending on the extent to which actual progress performance varies from planned performance, the results of monitoring and controlling activities can suggest anything from modifying the charter to transferring project deliverables as planned. Some of the monitoring and controlling decisions are listed below:

1. If the actual progress is very different from the original intent, perhaps the project charter needs to be revisited to ensure that the project still makes sense.
2. If progress is somewhat different from what was planned but the charter is still a good guide, perhaps the project plan needs to be adjusted.
3. If the project plan is still a useful guide, perhaps minor adjustments need to be made in day-to-day instructions within the project executing stage.
4. Finally, if the results indicate the customer is ready to accept the project deliverables, perhaps it is time to proceed into the project closing stage.

PERFORM INTEGRATED CHANGE CONTROL George and John are new project managers fresh out of college. Both are approached by internal customers of their projects (managers of departments where the project deliverables will be used). Their customers tell them what a fantastic job the two of them are doing. The customers then say, "This is great! Could you add these couple of little improvements to it? Then it would be even more valuable to me." George, wanting to please his customer, says, "Yes, we can add that little bit." John's immediate answer is, "Let's see what impact that might have on the schedule, budget, quality, and project team. I will be happy to consider it, but

I want to be sure to deliver the project results we promised on time and on budget." George, in his eagerness to please the customer, made a classic mistake. Many great projects have been derailed because someone stroked the ego of a project manager who then agreed to changes without understanding their impact.

Perform integrated change control is reviewing all change proposals, estimating their impact on project goals wherever appropriate, approving or declining changes, and managing changes to deliverables, schedules, budgets, and the project management plan. **Change control** is a process wherein change proposals to various project planning elements are acknowledged, formally documented, and either approved or declined after review. Change control includes considering the impact of any change, deciding whether to agree to the change, and then documenting and managing that change. An observant project manager will ensure that changes that were not approved are not somehow slipped in anyway by a stakeholder who does not take no for an answer. Proposed changes are documented in a change request such as the one shown in Exhibit 7.14.

The decision to approve the proposed change needs to be made by the appropriate person or group responsible for it. Generally, if the proposed change requires a modification to the project charter (or contract for an external project), then the sponsor and/or customer would decide. If the change does not rise to that level, often a project manager is empowered to make the decision. Some organizations use a **change control board**, which consists of a formal group authorized and responsible for reviewing, evaluating, approving, delaying, or rejecting any changes to any aspect of the project plan by following a formal communication method of documenting the decision process. The change control board often consists of the project manager, sponsor, project core team, and perhaps other key stakeholders. Since some changes have far-reaching impacts, it is often wise to include people with diverse knowledge and skills on the change review board.

Change is a reality on virtually all projects. While we cannot predict or plan what changes will occur, we can plan for how we will deal with those changes. Some projects are easier than others to plan, especially the later phases of the project. If the planning team can plan most details at the outset, change control may be the primary method they use for handling change. On other projects, where it is difficult to plan the later phases or parts in detail until results from the early parts of the project are known, change control is still used, but it is not enough. What is also used in these cases is the rolling wave planning described in Chapter 9. The early parts of the project are planned in detail, and the later parts are planned in less detail until later when additional detail is added. Often, a detailed plan for the following section of the project is required before being allowed to proceed. Agile projects are planned in a rolling wave fashion.

14-2c Monitoring Project Risk

During project planning, the project team normally develops a risk management plan that is used to guide risk monitoring and response activities. They also normally create a risk register to record each identified risk, its priority, potential causes, and potential responses. The risk management plan and risk register are used to monitor and implement responses to project risks and to resolve them when they occur.

Monitor risks is the process of adhering to the risk response plan of tracking identified risks, identifying new risks, monitoring residual risks, and evaluating the effectiveness of the risk response process throughout the project. On some projects, the majority of risk events that materialize are ones that the project team has previously identified. Efforts needed on these risks largely include tracking the identified risks, executing the response plans, and evaluating their effectiveness. Project managers know it is

wise to consider multiple responses to a given risk. This is true both because some risks cannot be fully handled with just one strategy and because the first strategy may not always be the best strategy.

On other projects, however, many unanticipated risks may materialize. This could be partly due to poor or incomplete risk planning. It could also be partly due to events that would have been so unlikely that the team could not have been expected to plan for them. In either event, specific contingency plans may not be in place to deal with these risks. Identifying these new risks is vital—and the sooner the better. Two categories of project management methods can help to deal with previously unidentified risks. First, the project team in planning may recognize that unknown risks may surface, and they may add a contingency reserve of time, budget, and/or other resources to cover these unknowns. Good project management practice suggests a need for this. The amount of cost and budget reserves that are included can vary extensively based upon the customer's perception of risk and the type of project that is involved. Competitive pressures often dictate a lower limit on reserves than project managers may prefer.

The second category of project management methods includes a number of good practices that project managers often employ anyway. These practices can be classified according to whether the project team has full, partial, or no control over the events, as shown in Exhibit 14.5. Note especially the second column, which deals with risks partially within a project manager's control. A project manager cannot completely control many situations, but by using good leadership and ethics, the project manager can certainly help create a situation in which others want to help the project.

14-2d Implement Risk Responses

Implement risk responses is the process where when a risk event occurs or is quite likely to occur soon, the person assigned to that risk executes the strategy identified in

EXHIBIT 14.5

RISK EVENT RESOLUTION STRATEGIES

RISKS WITHIN PROJECT CONTROL	RISKS PARTIALLY WITHIN PROJECT CONTROL	RISKS OUTSIDE PROJECT CONTROL
Understand and control WBS	Establish limits to customer expectations	Understand project context and environment
Closely monitor and control activity progress	Build relationships by understanding project from client's perspective	Actively monitor project environment
Closely manage all project changes	Use honesty in managing client expectations	Understand willingness or reluctance of stakeholders to agree to changes
Document all change requests	Work with client to reprioritize cost, schedule, scope, and/or quality	
Increase overtime to stay on schedule	Carefully escalate problems	
Isolate problems and reschedule other activities	Build team commitment and enthusiasm	
Research challenging issues early		

Source: Adapted from Hazel Taylor, "Risk Management and Problem Resolution Strategies for IT Projects: Prescription and Practice," *Project Management Journal* 37 (5) (December 2006): 55–60.

the risk management plan. Exhibit 11.12 outlines the most typical strategies with examples of each. One core team member should be assigned to each risk. That person should be alert to any trigger condition that suggests the risk event may happen and be prepared to implement the response strategy quickly. Possible outcomes of implementing a risk response include updates to the risk register, approved change orders, and perhaps lessons learned so that both this project and future projects may avoid that same risk event in the future.

14-2e Manage Communications

Manage communications as defined in Chapter 6 is all the work connected with the project communications plan, starting with planning for it; generating it; organizing and sharing it; and, finally, storing and disposing of it. This includes determining project information needs and establishing an information system as described in Chapter 6. Then, while the project is under way, the project manager and team need to determine any additional information needs that were not already uncovered, collect information on executed work and work in progress, and then report progress to all stakeholders.

COLLECT INFORMATION ON EXECUTED WORK AND WORK IN PROGRESS

Project managers gather data on the work they have authorized so they can understand the progress being made. This information is necessary for scheduling additional work, for understanding how the project is doing with respect to the schedule, and for quality purposes. A project manager may try to gather data to answer the following typical questions:

- How well is this particular activity proceeding in terms of time and budget?
- How well is the entire project proceeding in terms of time and budget?
- How much more money will need to be spent to finish?
- To what extent does the quality of this work meet requirements?
- How many hours of human resources have we used to complete this activity, compared to how much we estimated?
- What methods have we used that are worth repeating?
- What methods have we used that need to be improved before we do that type of work again?
- What evidence supports the answers to the above questions?

REPORT PERFORMANCE

Performance reporting includes gathering **work performance data** and using it to create work performance information and reports. Work performance data are the actual and raw observations and measurements during execution of project activities. **Work performance information** is the performance data collected from these processes, analyzed in context, and then integrated, considering relations across areas. **Work performance reports** are the compilation of work performance information in some physical or electronic form that are presented as project documents intended to generate awareness, discussions, decision making or other suitable actions.

Performance can be reported either at fixed time intervals or at key project milestones. Detailed progress can be reported informally but frequently within the project team and to functional managers who control resources—perhaps weekly or even daily on a project with critical time pressure. More general progress may be reported formally but on a less frequent basis to sponsors, senior management, and clients—perhaps semiweekly or monthly. If regular reports and meetings already exist within the parent organization that can serve for performance reporting vehicles for a project, they can

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substitute for these reports. On the other hand, if your project needs additional or different meetings and reports, then develop and use those as well.

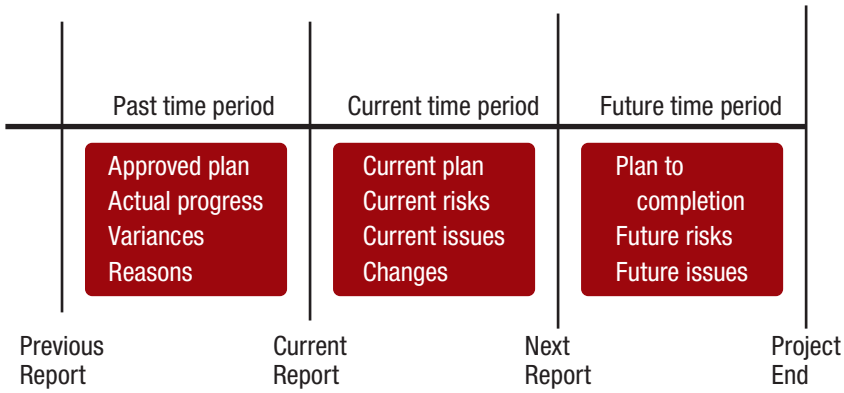
Progress reporting within the project team and to functional managers who control resources is often done in the form of meetings. The emphasis should be on specifics. Each team member can report for each deliverable for which he is responsible: the target date, status, and what other work or information on which progress depends. Once all the deliverables have been reported, the project team can update the risk register and issues log. Recommended changes that are within the project manager's discretion are either approved or rejected and then documented. Recommended changes beyond the project manager's discretion are formally sent to the sponsor or change control board for consideration. Approved changes become part of the project plan with activities, responsibilities, and timing assigned. Consequently, the project baseline will be updated. Finally, progress reporting meetings are a great time to capture lessons learned.

Performance reporting to sponsors, management, and clients can be in the form of either meetings or reports. Think in terms of three time horizons, as shown in Exhibit 14.6. It is often helpful to establish an agenda for progress report meetings based upon what sponsors wish to know concerning each of these three time horizons.

1. Past time period—The first time horizon is the immediate period between your last report and now. When looking back like this, it is important to be able to state what was planned to be accomplished during that time and what actually was accomplished. Any variance or difference between the approved plan and actual performance, along with reasons for the variance, should also be part of the retrospective portion of performance reporting.
2. Current time period—The second time horizon is from now until the next performance report is due: What work is to be accomplished during this time period (current plan)? What risks and issues are foreseen? Finally, what changes need to be approved?

EXHIBIT 14.6

TIME HORIZONS FOR PROJECT PERFORMANCE



3. Future time period—The third time horizon is after the next reporting period. Sponsors especially want to know what future risks and issues are envisioned because they may be able to head some problems off before they grow. Remember the concept of rolling wave planning—the plan for the later part of the project might still be evolving, but what is known about it right now?

14-2f Monitor Communications

Monitor communications is monitoring and controlling communications throughout the project life cycle to make certain that the information needs of all the project stakeholders are met. The project manager and core team often discuss whether the project communications are following the plan, how effective they are, and how to improve their effectiveness.

AGILE

Self-directed teams on agile projects are largely empowered to decide what work to do and when to do it, consistent with the prioritizing of deliverables by the product owner.

On Agile projects, change is expected, and the only part that is planned in detail at the outset is the first iteration. Subsequent iterations are planned in a rolling wave fashion. Within an iteration, there is great reluctance to change. Conducted well, agile projects may have less risk because communication is so frequent and specific; because during each iteration, the team needs to demonstrate that the project deliverables perform correctly; and because it is common practice to maintain a visible, monitored, prioritized risk list.

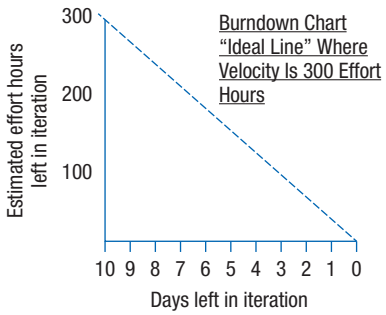
Communication is frequent and rapid on agile projects. Often, a directional indicator showing that things are getting better or worse in some manner is more valuable than a more detailed and polished report. Teams generally display highly visible information registers so everyone concerned can tell in a transparent manner how the project is proceeding.

Progress report meetings are held every morning as brief (15 minutes) standup meetings. Each core team member discusses the previous day as the past time period and today as the current time period. The more distant future is generally not discussed in these meetings.

Documentation often starts very tersely and becomes more complete as the deliverables are better understood. Progressively more complete working product is the primary measure of progress.

EXHIBIT 14.7

BURNDOWN CHART WITH IDEAL LINE



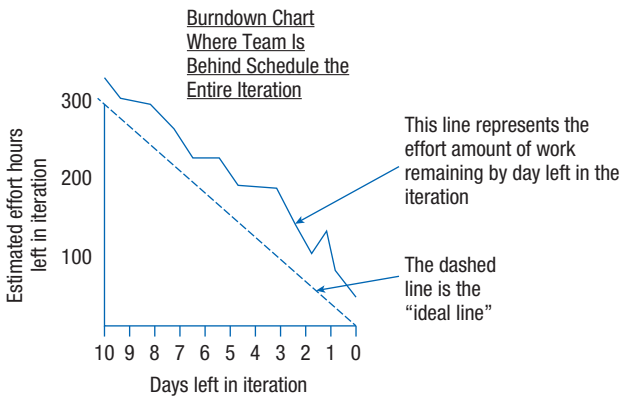
Agile projects often use a Burndown Chart to show the amount of work remaining. A Burndown Chart is useful to Scrum Masters as it projects how close to plan the team is within a given time box—that is, it is a graphical representation of work effort remaining in an iteration (or similar) versus the days left in an iteration.

The vertical axis is typically the number of effort hours remaining in an iteration. The horizontal axis identifies how many days are left in an iteration. Exhibit 14.7 displays a straight line, which is called the ideal line. It depicts a team with a velocity of 300 effort hours and 10 days of iterations.

The way this works is that each day, the members of the Scrum Team let the Scrum Master know how many effort hours of work they have left to complete for the current iteration. Velocity, which is used to draw the ideal line, is determined by tracking the team's historical progress. Exhibit 14.8 displays a Burndown Chart with the team constantly behind schedule.

EXHIBIT 14.8

BURNDOWN CHART WHERE TEAM IS BEHIND SCHEDULE THE ENTIRE ITERATION



Source: Brain Vanderjack PMP, MBA, CSM, SAFe Certified

14-3 Customer Issues

The second major perspective included in a balanced scorecard approach to project control is that of the customer. Customers need the deliverables of the project. They want the results to be useful (quality) and complete (scope).

14-3a Manage and Control Quality

As previously defined in Chapter 12, **manage quality** is the process of using and improving the quality plan and policy to perform tasks that will most likely lead to creating project outputs to customers' satisfaction. This forward-looking, broad management process (often known as quality assurance), both ensures that work is performed correctly and that key stakeholders are convinced that the work is performed correctly.

Also as previously defined in Chapter 12, **control quality** is "the activities … used to verify that deliverables are of acceptable quality and that they are complete and correct. Examples of quality control activities include inspection, deliverable peer reviews, and the testing process."[2] This backward-looking, detailed set of reactive technical activities verifies whether specific project deliverables meet their quality standards.

QUALITY MANAGEMENT AND CONTROL TOOLS

A variety of quality management and control tools can be used effectively on projects. Some of the most common tools and their primary uses on projects are shown in Exhibit 14.9.

The following discussion presents a small example of a project process that is used to demonstrate a few of the project quality tools. A straightforward presentation of each tool is demonstrated. Multiple variations exist for some of the tools, and an interested student can find more detailed examples and instructions in a statistics or quality textbook.

Flow Chart A flow chart is a tool that project managers use as they begin to control quality. Flow charts can be used to show any level of detail from the overall flow of an entire project (such as a network diagram of the project schedule) down to very specific details of a critical process. Flow charts show clearly where a process starts and ends. A box shows each step in the process. Arrows show the direction in which information, money, or physical things flow. Exhibit 14.10 is a flow chart of the process of estimating project cost.

This is a high-level flow chart of the process. Perhaps the project team looks at this and realizes labor cost estimates are unreliable. They might decide they need more detailed understanding of this step. One method would be to create a more detailed flow chart of just that step. Another method is to gather some data using a check sheet such as the one shown in Exhibit 14.11.

Check Sheet Check sheets are customized for each application. Decide exactly what data will be useful in understanding, controlling, and improving a process, and create a form to collect that information. It is helpful to also collect the date or time when each event happened and notes regarding the impact or any special circumstances. When creating categories on a check sheet, it is wise to have a category titled "other" because many times, a problem comes from an unexpected source.

Pareto Chart Once a check sheet is used, the gathered data can be displayed on an analysis tool such as the Pareto chart shown in Exhibit 14.12. The purpose of the Pareto chart is to quickly understand the primary sources of a problem using the 80/20 rule, wherein 80 percent of defects often come from only about 20 percent of all the sources.

EXHIBIT 14.9

PROJECT MANAGEMENT AND QUALITY TOOLS

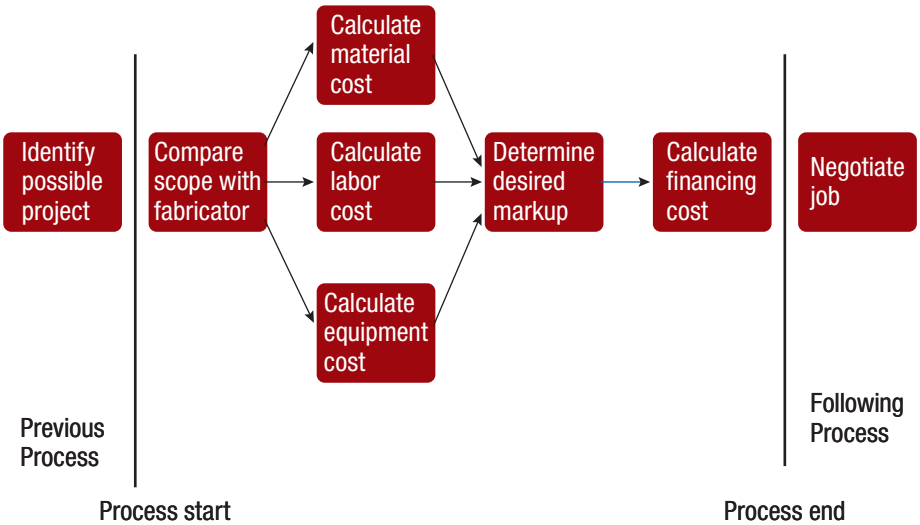
TOOL	CHAPTER	DESCRIPTION
Charter	3	High-level agreement to start project describing authority, scope, expectations, and resources
Lesson learned	3 and 15	Knowledge from experience captured and shared
Stakeholder analysis	6	Identification and prioritization of stakeholder desires
Communication management plan	6	Document that guides and assigns responsibility for communication with stakeholders
Voice of the customer	7	Captured desired benefits and features in customer's own words
Brainstorming	7	Quick generation of many ideas to identify gaps, issues, roadblocks, or potential solutions
Quality metrics	7	Crisp definition of what and how to measure specific performance
Project risk review	11	Thorough document review to uncover risks
Root cause analysis	11	Technique to discover underlying reason for problem
Cause and effect diagram	11	A visual outline, often resembling a fish skeleton, used to identify and organize possible causes of a stated outcome
Supplier, input, process, output, customer (SIPOC)	12	High-level view of process and stakeholders
Quality audit	12	Structured process to ensure project activities comply with organizational policies
Benchmarking	12	Identifying and analyzing best practices for improvement ideas
Flow chart	14	A visual model used to show inputs, flow of work, and outputs and to identify possible data collection points for process improvement
Check sheet	14	A simple, structured form used to gather and organize data for analysis
Pareto chart	14	A vertical bar graph used to identify and plot problems or defects in descending order of frequency or cost
Histogram	14	A vertical bar chart used to show the average, extent of variation, and shape of measurements recorded for a process variable
Run chart	14	A special type of scatter diagram in which one variable is time, used to see how the other variable changes over time
Control chart	14	A run chart with process average and control limits used to distinguish between common and special causes of variation

Note that, in this example, the error of using an incorrect scope shows the highest cost impact by far. Therefore, that is probably the first place the project team looks for improvements.

Cause-and-Effect Diagram Exhibit 14.13 shows how the largest bar on the Pareto chart often becomes the head of the fish on the cause-and-effect diagram—the result that the project team tries to improve.

EXHIBIT 14.10

ESTIMATING PROJECT COST FLOW CHART



The cause-and-effect diagram (also commonly known as the fishbone diagram, because it resembles a fish skeleton, and the Ishikawa diagram, named after its developer) is constructed with each "big bone" representing a category of possible causes. For example, in Exhibit 14.13, one of the possible categories is "deliverable design," meaning that maybe something about the design of the project's deliverables contributed to problems with the "head of the fish"—in this case, using incorrect scope to estimate the labor cost. Once categories of possible causes are identified, the project team brainstorms ideas with the goal of identifying as many potential causes as possible. Once the

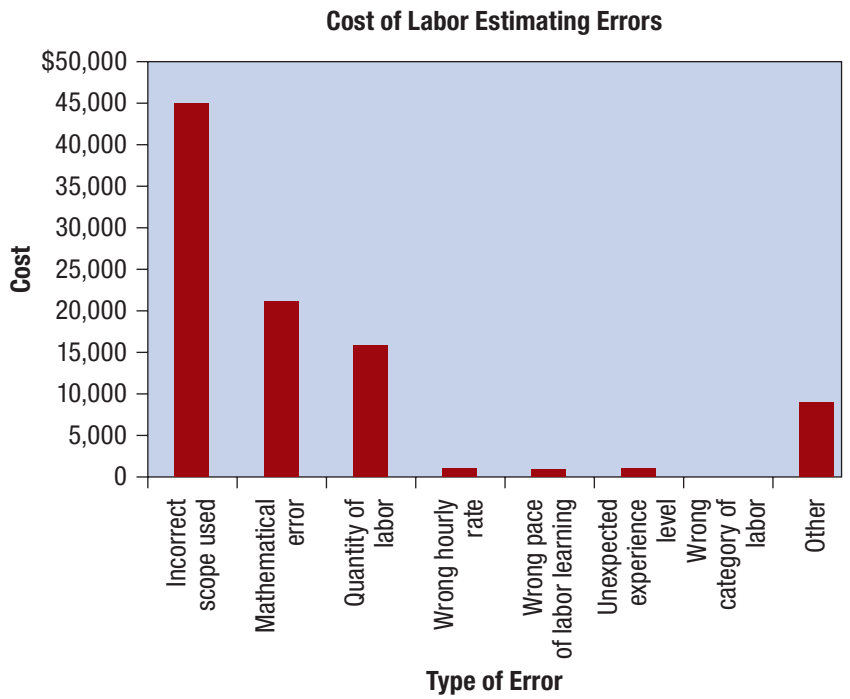
EXHIBIT 14.11

CHECK SHEET FOR LABOR COST ESTIMATING

LABOR COST ISSUE	DOLLAR IMPACT	DATE DISCOVERED	ACTION TAKEN
Incorrect scope used			
Category of labor			
Quantity of labor			
Hourly rate			
Pace of labor learning			
Unexpected experience level			
Mathematical error			
Other (be specific)			

EXHIBIT 14.12

PARETO CHART OF LABOR ESTIMATING PROCESS PROBLEMS



team can think of no additional possible causes, they decide to test one or more possible causes to see if they actually have an impact. Testing can be done by gathering more data on the project as it is currently operating. Alternatively, a project team can test a new method and then collect data on it.

EXHIBIT 14.13

PARETO CHART CAUSE AND EFFECT RELATIONSHIP

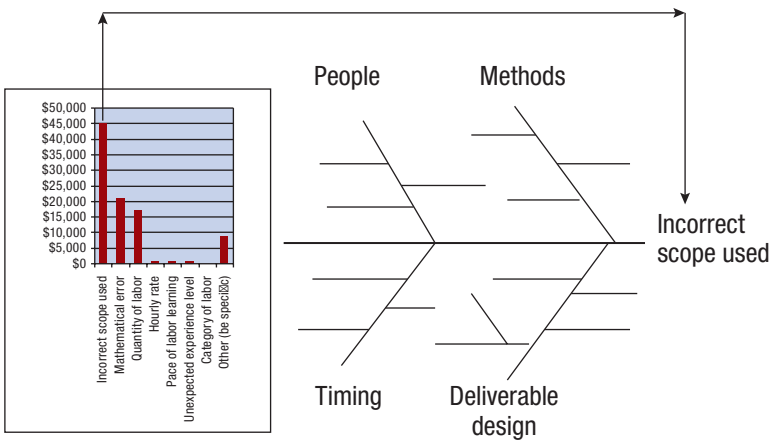
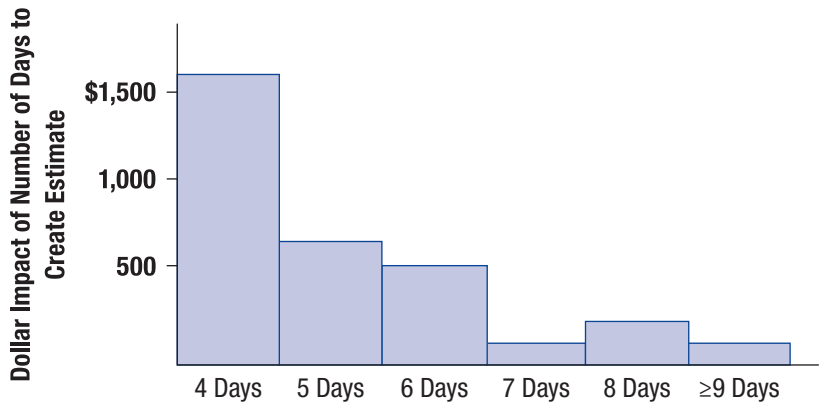


EXHIBIT 14.14

HISTOGRAM OF IMPACT OF NUMBER OF DAYS TO CREATE ESTIMATE



Histogram Once the additional data are gathered, they can be analyzed using a histogram, run chart, and/or control chart. For example, if one of the potential causes of using incorrect scope is that the client demands the cost estimate within four days of job notification (that is, within the timing category), perhaps the charts would appear as shown in Exhibit 14.14, Exhibit 14.15, or Exhibit 14.16.

A project manager can interpret several things from a histogram such as the one shown in Exhibit 14.14. First, if nothing unusual is happening, a normal or bell-shaped

EXHIBIT 14.15

RUN CHART EXAMPLE

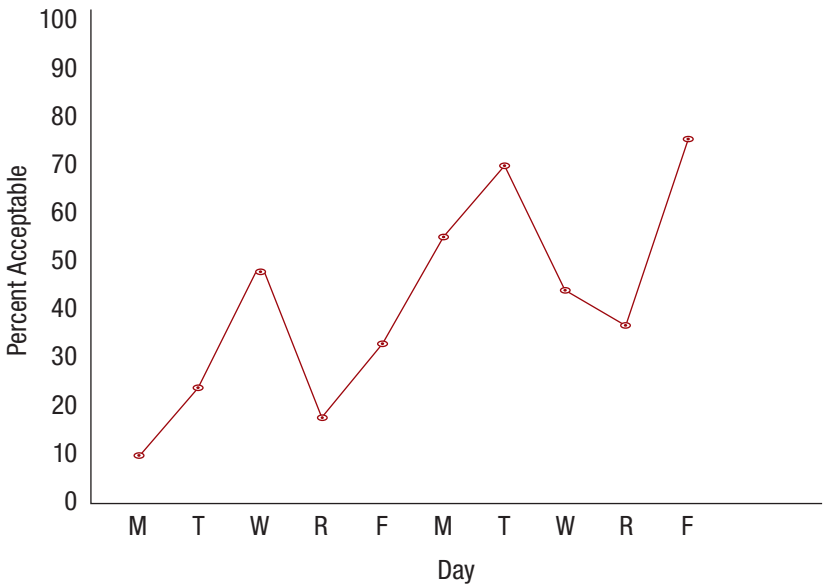
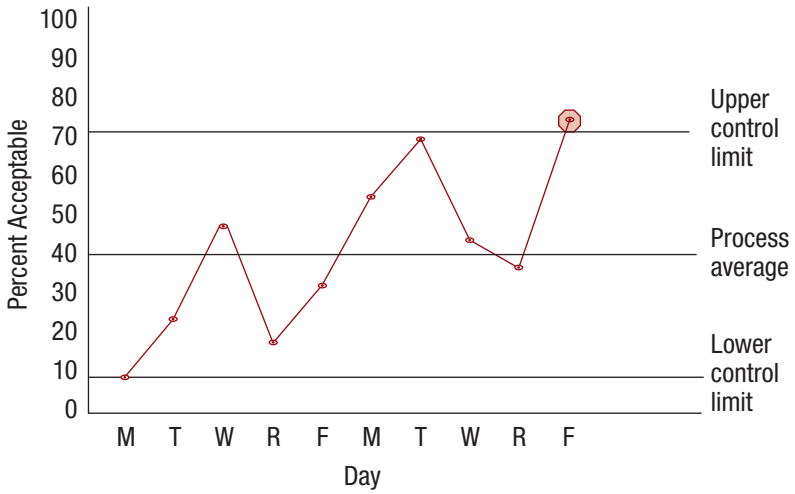


EXHIBIT 14.16

CONTROL CHART EXAMPLE



curve might be expected. However, this histogram is highly skewed, with much more impact happening when the client demands an estimate within four days. When the client demands the estimate in four days, the impact is approximately $1,600. When comparing that to the total impact of about $15,000 for using the wrong scope, this error appears to explain only a bit more than 10 percent of the total problem. It might be worth changing this, but most of the problem will still exist. Therefore, changing this factor alone does not solve the entire problem.

Run Chart Perhaps the project team wants to see how one specific aspect of the work process may change over time. If they collect data for two weeks on a daily basis and show them on a run chart such as the one in Exhibit 14.15, they could determine trends in how the process is changing over time.

The team could look for three types of variation. First, is there a trend either up or down? In this example, there is an upward trend. Second, is there a repeating pattern, such as a low every Monday or a high every Wednesday? In this case, it is too early to tell. Both Tuesdays are up from Mondays, and both Thursdays are low, but day of week does not seem like the major source of variation. The third type of variation is abrupt changes, such as either a single point far higher or lower than the others or all of the points suddenly being much higher or lower than previous points. The question teams ask when trying to find this variation is: "How big of a change is big enough to count?"

Control Chart Quality control charts are helpful in answering this question. Exhibit 14.16 displays the same data on a control chart with a process average and control limits shown. This chart shows the final point above the upper control limit. This means the variation is enough that it is not likely to have happened purely by chance. Something is causing the variation—some sort of special cause.

When considering any of these quality control tools, remember that it is easy to get lost in the details, but the purpose of quality control is to make sure the agreed-upon scope and quality are met per the project charter.

Dmitry Kalinovsky/Shutterstock.com

14-3b Control Scope

Control scope is the act of closely monitoring the project and product scope status and only allowing necessary changes to the scope baseline. Ideally, project managers and teams practice scope control proactively. They attempt to understand what might cause changes to either the product scope (the features of the project deliverables) or the project scope (the work that must be done to create the deliverables). Once a project team discovers something that may cause a need to change the scope, their first effort is typically to head it off. It is easiest if the stakeholders can still be satisfied and project objectives can be met without changing the scope. However, many times, it may be necessary to make a scope change. A **scope change** is any change to the project work activities or deliverable. When the scope changes, the project cost and/or schedule also need to change. For this reason, proposed scope changes are processed through the integrated change control system to determine what impact each might have on other critical aspects of the project goals. Some scope changes start as proposed changes to cost or schedule, just as some changes to cost or schedule start as proposed scope changes.

As with any type of proposed change, one must have a scope baseline in order to understand scope changes; that is, the approved scope definition and work breakdown structure must be clearly understood. Only then can the project team determine how big a proposed scope change is, what impact it will have, and how to best manage it.

Variance analysis is the process of determining both the cause and the amount of difference between planned and actual performance. Variance analysis includes determining how large the difference is between the actual and planned scope (or schedule or budget), the reasons for the difference, and whether any action is necessary to resolve it. For scope variances, the action can include updating the scope definition and work breakdown structure.

AGILE

Quality is enhanced on agile projects by having the appropriate team members resolve issues quickly. Success of the product is predicted by having team members, including the product owner, use the product before users do.

14-4 Financial Issues

Cost control is obviously a financial issue. Cost, schedule, and scope are often so closely intertwined that they are monitored and controlled simultaneously, and a change in one of them impacts the others. The amount of resources of all kinds needed to perform the project has a direct impact on cost, so we also cover controlling resources here.

14-4a Control Resources

Control resources is a process by which all of the physical resources needed to perform the project are planned and monitored, and changes are made if needed. This occurs throughout the life of the project. Obviously, if needed resources are late, the project can be delayed. If needed resources are in short supply, the cost and schedule might both be impacted unfavorably. Project managers need to look ahead at potential trends, be willing to proactively solve problems, and work cooperatively with a myriad of stakeholders to ensure the needed resources are available when required.

14-4b Control Schedule and Costs

Schedule and cost control are very similar in concept to control. The project manager should start with the approved cost and schedule baseline. Next, the current status of the schedule and cost should be determined.

If the schedule or budget has changed by at least a previously agreed amount, changes should be formally recommended and managed through the integrated change control system to ensure that any impacts on other areas are considered. Cost control often has one additional consideration—that is, ensuring that no more money is spent than the authorized amount. This may force other changes on the project, such as delaying the schedule or reducing part of the project scope. While many methods exist for controlling cost and schedule, the two discussed in this chapter are two of the most common: earned value management and project scheduling software such as MS Project.

Very often, the project manager must work with his or her company's finance department or CFO to get the proper data on accounts payable, accounts receivable, and other information. The project may require the help of someone skilled at financial software. If the project manager is not personally adept at using such software, the finance department representative might be included in the project team either as a core team member or in SME capacity.

14-4c Earned Value Management for Controlling Schedule and Costs

Earned value management is "a disciplined, structured, objective, and quantitative method to integrate technical work scope, cost, and schedule objectives into a single cohesive contract baseline plan called a Performance Measurement Baseline for tracking contract performance."[3] Earned value allows a project team to understand the project's progress in terms of cost and schedule as well as to make predictions concerning the project's schedule and cost control until the project's conclusion. Earned value is used as a decision-making tool. The project manager can quickly assess how the project is doing according to the baseline plan and whether the project will end without major cost and/or schedule overruns. The earned value data presents a snapshot of the status

of his or her project at a given point in time. It is valid only for the day that the cost and schedule progresses are measured.

When interpreting earned value management, cost and schedule must be considered independently. A project can be either ahead or behind the planned schedule and either over or under the planned budget. Second, all earned value terms deal with one of two time frames. Each represents either status as of the last date that project data were gathered or a prediction for the end of the project. Exhibit 14.17 lists 11 questions and answers that introduce all of the earned value management terms.

Exhibit 14.18 uses an example to show each of the earned value management terms. Currently known values for the example are stated, followed by their definitions. Variances, indexes, and estimates are next defined, and calculations for the example are shown.

CURRENTLY KNOWN VALUES

In this example, the first several items are provided:

PV = $250,000, EV = $200,000, AC = $400,000, and BAC = $750,000

Each of these terms also has a formal definition.

Planned value (PV) is "the approved value of the work to be completed in a given time. It is the value that should have been earned as per the schedule."[4] In our example, we expected to spend $250,000 for the work we planned to have accomplished by now.

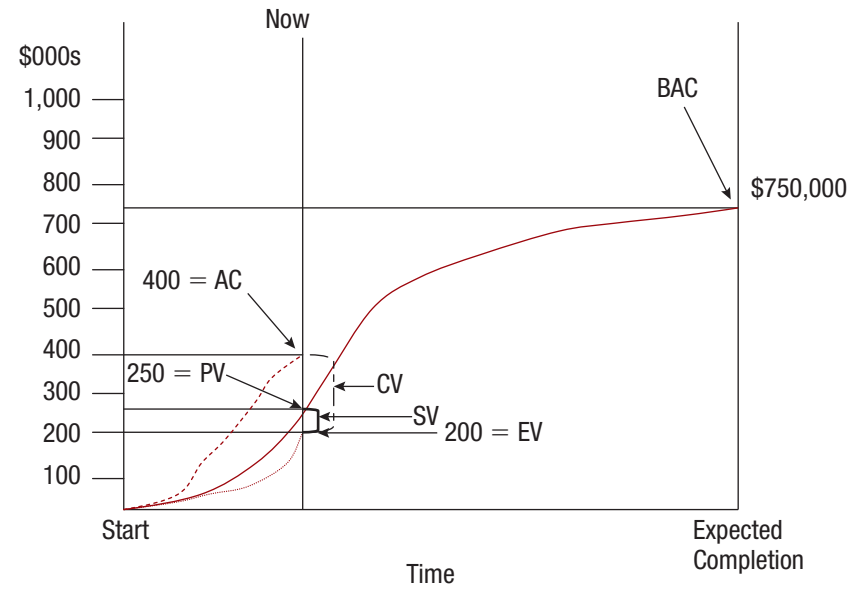
EXHIBIT 14.17

EARNED VALUE MANAGEMENT TERMS

QUESTION	TIMING	ANSWER	ACRONYM
How much work *should be done?*	Now	Planned value	**PV**
How much work *is* done?	Now	Earned value	**EV**
How much did *the* "is done" work cost?	Now	Actual cost	**AC**
How much was the total project *supposed to* cost?	**End**	Budget at completion	BAC
How much *is* the project schedule ahead or behind?	Now	Schedule variance	**SV**
How much *is* the project over or under budget?	Now	Cost variance	**CV**
How efficient is the project *so far* with its schedule?	Now	Schedule performance index	SPI
How efficient is the project *so far* with its budget?	Now	Cost performance index	CPI
How much more do we expect to spend to finish the project?	**End**	Estimate to complete	**ETC**
What do we now think the total project will cost?	**End**	Estimate at completion	EAC
How efficient do we need to be to finish on budget?	**End**	To-complete performance index	TCPI

EXHIBIT 14.18

EARNED VALUE MANAGEMENT EXAMPLE



Earned value (EV) is the value of the work actually completed to date. In our example, the work that has been completed is worth $200,000.

Actual cost (AC) is the total of costs incurred in accomplishing work on the activity during a given period. In our example, we owe $400,000 for the work that has been completed.

Budget at completion (BAC) is the total amount budgeted for the entire project. In this example, our approved budget for the entire project is $750,000. Now that we know these four pieces of information, we can calculate answers to all of the remaining questions listed in Exhibit 14.16.

VARIANCES **Schedule variance (SV)** is the difference between the earned value (EV) and the planned value (PV), and it denotes schedule performance. In our example, it is calculated as $200,000 − $250,000 = −$50,000. We know we are behind schedule because the variation is negative (unfavorable):

$$\mathbf{SV = EV - PV}$$

Cost variance (CV) is the difference between earned value (EV) and actual cost (AC), which reflects cost performance. In our example, it is calculated as $200,000 − $400,000 = −$200,000. We know we are over budget because the variation is negative (unfavorable):

$$\mathbf{CV = EV - AC}$$

The two variances help us understand, in dollar terms, how poorly or well we are performing on cost and schedule. In this example, we are performing poorly in terms of

both cost and schedule. These are commonly used indicators. However, some people prefer to use efficiency measures to understand in percentage terms how well or poorly the project is performing.

INDEXES **Schedule performance index (SPI)** is a schedule performance measure expressed as the ratio of earned value (EV) to planned value (PV). In our example, it is calculated by \$200,000/\$250,000 = 80%. We know our project is behind schedule because we only accomplished 80 percent of what we planned:

$$\textbf{SPI} = \textbf{EV}/\textbf{PV}$$

With performance indexes, 100 percent means right on plan, less than 100 percent means less efficient than planned, and over 100 percent means more efficient than planned.

Cost performance index (CPI) is a cost performance measure expressed as the ratio of earned value (EV) to actual cost (AC). In our example, it is calculated by \$200,000/\$400,000 = 50%. We know our project is over budget because we have only received \$0.50 worth of results for every dollar we have spent:

$$\textbf{CPI} = \textbf{EV}/\textbf{AC}$$

Now that we understand how we have performed so far (poorly in our example), it is time to forecast how we will perform for the remainder of the project. The simplest way to estimate future performance is to predict that the past performance trend will continue. The following calculations are based upon that assumption. There are projects, however, that may have unusual circumstances in the early stages that are not likely to be repeated later. In those instances, the project manager and sponsor need to use judgment to determine if the original estimates for the remaining work or some other method of estimating it are better predictors. In each case, an estimate is made for the remaining work and added to the actual cost of work completed to provide the overall estimate. We will use the two most common methods of estimating the remaining work.

ESTIMATES **Estimate to complete (ETC)** is the expected budget required to complete all the remaining project work. In our example, if we predict that our future performance will have the same efficiency as our past performance, it is calculated by: (BAC − EV)/CPI = (\$750,000 − \$200,000)/50% = \$1,100,000:

$$\textbf{First method (Work to date is good estimate of future) ETC} = (\textbf{BAC} - \textbf{EV})/\textbf{CPI}$$

Unless we improve upon our efficiency, we can expect to pay more for the remaining project work than we originally expected to pay for the entire project!

The second method of calculating the ETC is to believe that the original plan is a better predictor than the work to date (maybe because of unusual circumstances that are unlikely to continue). This method is calculated by budget at completion (BAC) − EV = \$750,000 − 200,000 = \$550,000:

$$\textbf{Second method (original plan is good estimate of future) ETC} = \textbf{BAC} - \textbf{EV}$$

Estimate at completion (EAC) is the total cost of completing all the project work expressed as the sum of actual cost to date and the estimate to complete. In our example, if we believe our efficiency to date is a good predictor of the future, it is calculated by \$400,000 + \$1,100,000 = \$1,500,000. On the other hand, if we believe what happened

so far will not be repeated and our original plan is good for the remaining work, it is calculated by \$400,000 + \$550,000 = \$950,000:

$$\mathbf{EAC} = \mathbf{AC} + \mathbf{ETC}$$

Because our cost efficiency is only half of our plan (as we learned from our CPI), unless we become more efficient, we can expect to pay double our original estimate! Even if we match our original plan for the rest of the project, we will still be over the budget in the end. Perhaps our sponsor still wants to know what it would take for us to finish on budget.

The **to-complete performance index (TCPI)** is a measure of the cost performance required to complete the remaining project work within the remaining budget. This is the ratio of the remaining work to the remaining budget and on our example is calculated as (\$750,000 − \$200,000)/(\$750,000 − \$400,000) = 157%. That means that so far, our cost efficiency as measured by our CPI is 50% and we need to suddenly raise it to 157% for the remainder of the project to complete on budget!

$$\mathbf{TCPI} = (\mathbf{BAC} - \mathbf{EV})/(\mathbf{BAC} - \mathbf{AC})$$

Each term in earned value management helps project managers understand a bit more about their project's performance. Collectively, the earned value management terms give project managers insight for monitoring and controlling project cost and schedule. In addition to and often in conjunction with earned value management, many project managers use scheduling software to help control their projects.

14-5 Using MS Project to Monitor and Control Projects

When used to its fullest, MS Project can be a powerful tool for monitoring and controlling the project schedule, cost, and resources. Once a project has entered into the execution phase, the job of the project manager shifts primarily to tracking the project to see if it is executing according to plan. To understand how MS Project assists in this regard, it is helpful for the project manager to understand the following:

1. What makes a schedule useful
2. How MS Project recalculates the schedule based upon reported and inputted actuals
3. The current and future impacts of time and cost variances

Once these concepts are understood, the project manager can use MS Project to update the schedule in a step-by-step fashion.

14-5a What Makes a Schedule Useful?

To properly control a project, the project manager must provide useful status reports, produce accurate assignment dates, take timely corrective actions, and make other necessary management decisions. This is difficult or impossible to do well without a sufficiently useful schedule. To be useful, three sets of schedule data must exist for comparison purposes. Each set includes dates, duration, work, and cost (along with any approved changes). The three sets are as follows:

1. The Baseline Set (sometimes called the planned schedule)
   a. This set is the original stakeholder-approved scheduled values (as discussed in Chapter 12).
   b. Data includes the *Baseline Start, Baseline Finish, Baseline Duration, Baseline Work*, and *Baseline Cost*.

2. The Actual Set (sometimes called the performance data)
   a. This set is what actually happens during project execution as reported by the resources assigned to project tasks.
   b. Data includes the *Actual Start, Actual Finish, Actual Duration, Actual Work*, and *Actual Cost*.
3. The Scheduled Set
   a. This set is the future estimated time and costs and is calculated by MS Project.
   b. Data includes the *Start, Finish, Duration, Work*, and *Cost*.
   c. Values are continuously recalculated during project execution as tasks and estimates are entered, as the project network is defined, as resources are assigned and balanced, and as actual execution data is entered.

14-5b How MS Project Recalculates the Schedule Based on Reported Actuals

As actual data is entered into a task's *Actual* field, MS Project copies that data into the task's *Scheduled* field, replacing the estimated values. MS Project then recalculates the schedule for future tasks based on a combination of what actually happened and the estimates of the remaining tasks.

14-5c Current and Future Impacts of Time and Cost Variance

With the three sets of data, comparisons can be made between any two of the sets. This is useful in understanding future impacts of various issues, such as:

- Time and cost performance variances from baseline
- Critical path changes
- Resource allocation issues
- Emerging risks
- Remaining contingency and management reserves
- The impacts of proposed changes

14-5d Define the Performance Update Process

The performance update process is simply the project manager updating actual project data as the project is executed. The update process is defined by the project manager informing the project team on who needs to report, what information is needed in each report, and when each report needs to be submitted. The following guidelines will help the project manager keep the schedule updated and accurate.

WHO REPORTS? All team members and suppliers assigned to tasks that were scheduled during the past reporting period need to report. Also, any resource wanting to change the estimate of a soon-to-be-starting task needs to report the new estimate.

WHAT IS REPORTED? Actual Start, Actual Finish, Actual Duration Complete, and Estimated Remaining Duration are reported. The sooner the project manager learns of variances from estimates, the sooner he or she can take corrective action, making Estimated Remaining Duration and Actual Finish among the most important values to update accurately.

WHEN TO REPORT? The project manager determines what day of the week resources will report performance ("Status Date" or "As of Date"), as well as the frequency. The Status Date is usually driven by the date of stakeholder review meetings and the time

needed to make adjustments before that meeting. The project manager wants to walk into that meeting with the most accurate and up-to-date status information as possible.

14-5e Steps to Update the Project Schedule

The process of updating the project schedule in MS Project includes six steps as described below. Please note: for the purposes of this chapter's tutorial, a simplified version of the running Suburban Park Homes example has been used.

STEP 1: ACQUIRE THE PERFORMANCE DATA Performance data is duration-based data. From each resource assignment, collect the date when the task started, how much duration has been completed, how much duration remains, and the actual finish date (if the task has been finished).

STEP 2: SET THE STATUS DATE (AS OF) The Status Date, or "as of" date, is the date the project manager sets for the team to report on the progress of the project. To be useful, the Status Date must be updated every time the project manager requires performance data reported.

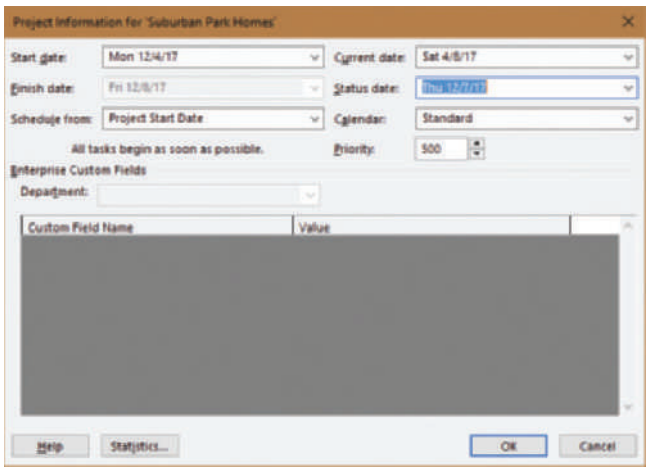
1. Click the **Project Tab>>Properties Group>>Project Information**
2. Click the "**Status date**" drop-down
3. Set status date to **12/7/17** (as shown in Exhibit 14.19)
4. Click **OK**

STEP 3: DISPLAY THE STATUS DATE LINE ON THE GANTT CHART Displaying a Status Date line on the Gantt chart provides a visual cue as to how much of the work has been completed for each task (once the update data is entered).

1. Click the **Task Tab>>View Group>>Gantt Chart**
2. **Right-click** on the right pane>>select **Gridlines**

EXHIBIT 14.19

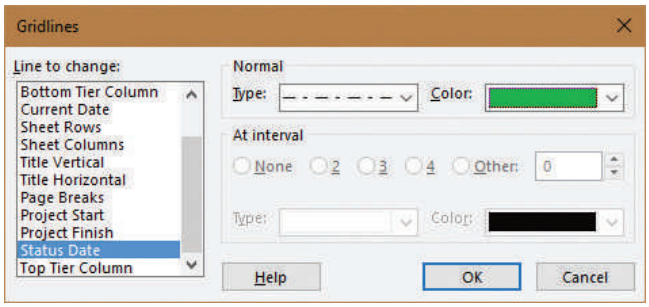
DISPLAY STATUS DATE LINE



Source: Microsoft product screenshots reprinted with permission from Microsoft Corporation.

EXHIBIT 14.20

SET THE STATUS DATE (AS OF)



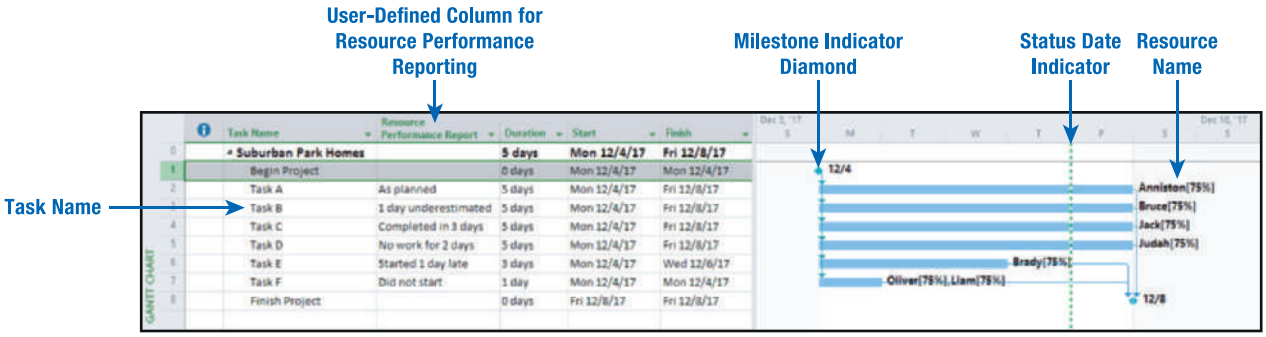
Source: Microsoft product screenshots reprinted with permission from Microsoft Corporation.

3. In the "Line to change list", select **Status Date** (as shown in Exhibit 14.20)
4. In the "Normal" box, choose **dashed dotted line**; choose **Green** for the color
5. Click **OK**

STEP 4: ENTER THE DURATION-BASED PERFORMANCE DATA Exhibit 14.21 shows a simplified Suburban Park Homes project schedule in the Gantt Chart View with resource assigned tasks A–F (Task IDs two through seven) and beginning and end milestones (Task IDs one and eight). To the right of the Task Name column, a user-defined text column has been inserted (**Right click>>Insert Column>>type a heading name**) to record the performance report from the assigned resource(s). The Status Date is end of day on Thursday December 7, 2017 (denoted by the vertical dashed line in the right side pane of the Gantt view). Resources have been assigned to each task and are denoted by the resource name in the right-side pane. Updating reported performance data for each task is demonstrated in the next steps.

EXHIBIT 14.21

SCHEDULE BEFORE ANY ACTUALS ARE APPLIED



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Anniston reports Task A's performance was as scheduled through the end of day on Thursday (remember that Thursday, December 7 is the Status Date).

1. Click **Task A** in the Gantt chart
2. Click the **Task Tab>>Schedule Group>>**click **Mark on Track**
3. Notice a dark progress bar line appears in the Gantt bar through the end of day on Thursday (the Status Date)

Bruce reports Task B's performance as scheduled, but the estimated remaining duration is two days instead of one.

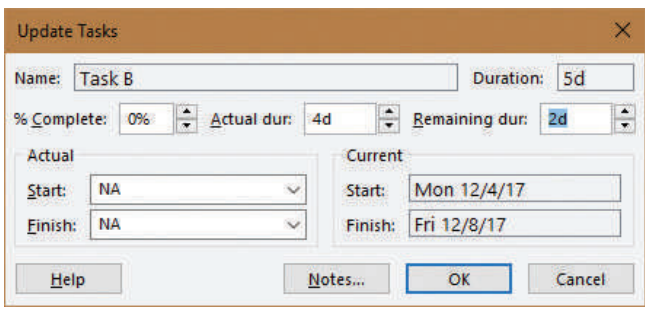
1. Click **Task B**
2. Click the **Task Tab>>Schedule Group>>**click the **Mark on Track drop-down>>**click **Update Tasks**
3. In the Update Tasks dialog:
   a. Actual dur: **enter "4d"**
   b. Remaining dur: **enter "2d"** as shown in Exhibit 14.22.
4. Click **OK**
5. Notice Task B's duration has updated to six days and extends through the end of day Monday, as shown in Exhibit 14.23

Jack reports that Task C finished two days early.

1. Click Task C
2. Click the **Task Tab>>Schedule Group>>**click the **Mark on Track drop-down>>**click **Update Tasks**
3. In the Update Tasks dialog:
   a. Actual dur: **enter "3d"**
   b. Remaining dur: **enter "0d"**
4. Click **OK**
5. Notice in Exhibit 14.24 that Task C's duration is now three days and the activity is marked complete (as denoted by a checkmark in the Indicators column)

EXHIBIT 14.22

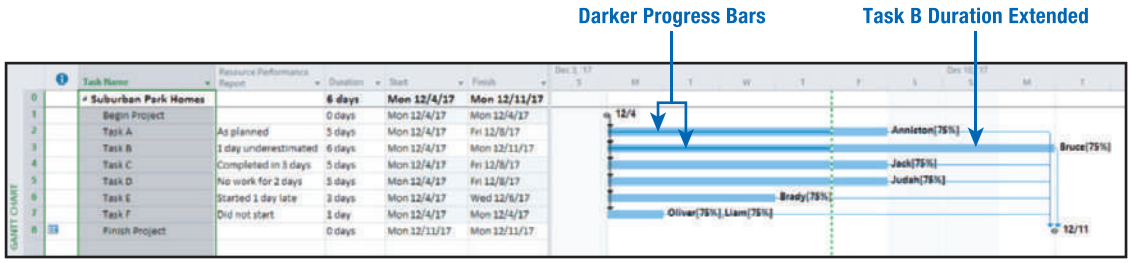
UPDATE TASKS DIALOG BOX



Source: Microsoft product screenshots reprinted with permission from Microsoft Corporation.

EXHIBIT 14.23

GANTT CHART VIEW WITH ACTIVITIES A AND B UPDATED



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Judah reports that no work was done for two of the five days on Task D.

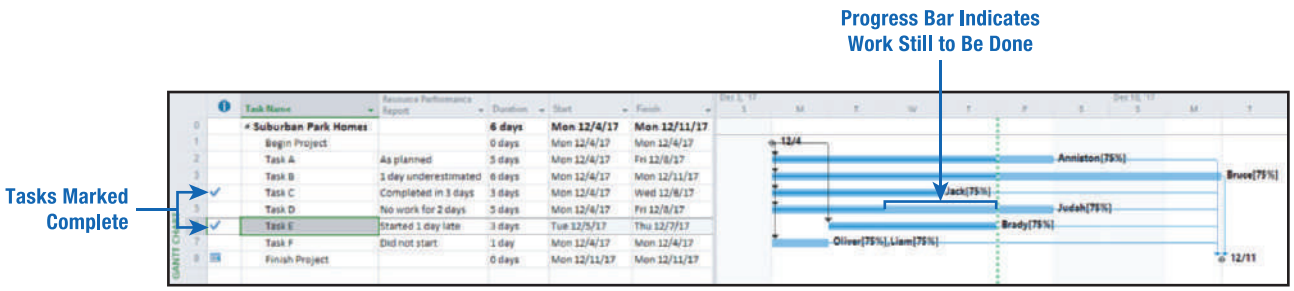
1. Click Task D
2. Click the **Task Tab>>Schedule Group**>>click the **Mark on Track drop-down**>>click **Update Tasks**
3. In the Update Tasks dialog:
   a. Actual dur: **enter "2d"**
   b. Remaining dur: **enter "3d"**
4. Click **OK**
5. Notice Task D's dark progress bar indicates there is still work scheduled for Wednesday and Thursday

Brady reports that Task E started one day late.

1. Click Task E
2. Click the **Task Tab>>Schedule Group**>>click the **Mark on Track drop-down**>>click **Update Tasks**

EXHIBIT 14.24

GANTT CHART VIEW WITH ACTUALS APPLIED TO ACTIVITIES A THROUGH E



Source: Microsoft product screenshots reprinted with permission from Microsoft Corporation.

3. In the Update Tasks dialog:
   a. Actual Start: **enter "12/5/17"**
   b. Actual dur: **enter "3d"**
   c. Remaining dur: **enter "0d"**
4. Click **OK**
5. Notice that Task E is marked complete

Oliver and Liam report that no work was done on Task F. This update will be addressed in the next step.

STEP 5: RESCHEDULE REMAINING WORK Both tasks D and F still have work scheduled for dates prior to the Status date. This work must be moved to start no earlier than the day following the Status Date.

1. Click Task D
2. Click the **Project Tab>>Status Group>>**click **Update Project**
3. In the Update Project dialog, click "**Reschedule uncompleted work to start after:"**
4. Enter the Status Date if not already entered as shown in Exhibit 14.25
5. Click on **Selected tasks**
6. Click **OK**
7. Repeat these steps for Task F

As seen in Exhibit 14.26, Task D is now split with the completed work showing on Monday and Tuesday, and the remaining work rescheduled to resume on Friday. If a more likely date to resume work is not Friday, the Gantt bar can be dragged to the likely date.

Task F is also scheduled to resume on Friday. When all of a task is rescheduled, a "start-no-earlier" constraint is automatically applied. That constraint can be modified to select a more likely resume date. Ignoring unfinished work that is scheduled earlier than the Status Date is a risky practice.

STEP 6: REVISE FUTURE ESTIMATES The most accurate estimates are made just before a task gets started. Therefore, at any status meeting, it's a good practice to ask project team members if they believe the estimates for any of their upcoming tasks need updating.

EXHIBIT 14.25

RESCHEDULING WORK ON A GANTT CHART

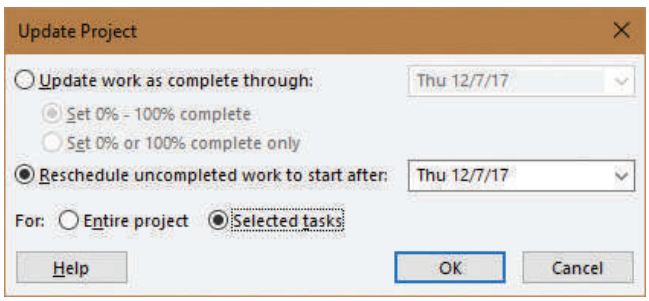


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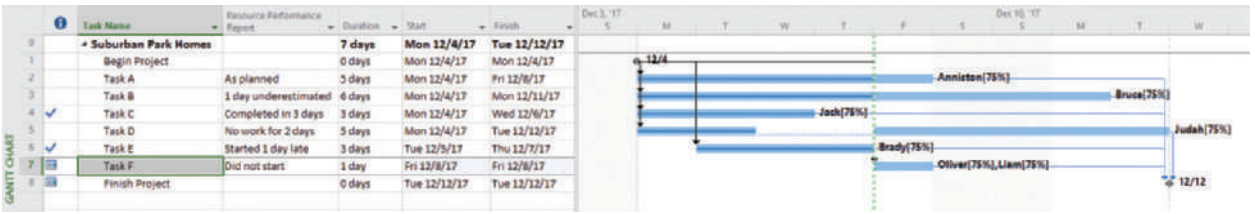
EXHIBIT 14.26

GANTT CHART WITH COMPLETED WORK RESCHEDULED



14-6 Replanning If Necessary

Sometimes it becomes necessary to replan a project. The project manager can use the integrated change control system to understand the impact the proposed changes may have and to secure approval to make the change. The changes are then reflected in a revised plan. The schedule, cost, and resource changes can be shown on an updated MS Project schedule. Other changes can be reflected in risk register updates or issues log updates. Two questions still exist regarding replanning: "What kinds of changes might be made in response to the problems?" and "Does the approval for a change need to be escalated to higher management?"

Changes a project manager may need to recommend include reassigning activities to different workers, splitting activities so at least some work can get started, reordering activities so they may be accomplished sooner, borrowing or acquiring additional resources, reducing scope, and so on. Many of these types of change can help a project get back on track; however, make sure the appropriate stakeholders agree with the changes because many times, a change that improves one aspect of a project degrades another.

Consider that people at each level in an organization have the ability to make specific decisions and are generally allowed a certain amount of time to deal with a problem before notifying a superior. Whoever makes the decision is still expected to document it appropriately. If a very minor problem occurs on a project, perhaps a team member can make the decision regarding how to handle it. A bit larger problem may fall in the domain of the project manager. Large decisions may go to the sponsor, and really critical decisions may be sent to the leadership of the parent organization. Escalation answers the question of what kinds of decisions are submitted to a higher level and how much time the lower-level person gets before raising the problem. A person who escalates minor decisions, or even major decisions very quickly, gives the impression of being weak and indecisive. However, a person who does not escalate important decisions or who takes so long to escalate them that the problem has worsened, exhibits poor judgment.

AGILE

Replanning is conducted for each release and each iteration in agile. Within an iteration, once the replanning is complete, very little additional change is allowed.

PMP/CAPM Study Ideas

You can expect to see several questions using Earned Value Management (EVM) on either the CAPM or PMP, and you will not be provided with the formulas. We recommend that you memorize all of the following formulas and write them down on the blank paper you are provided as soon as you enter the testing room so you can refer to them throughout the test:

$$\textbf{CV (cost variance)} = \textbf{EV} - \textbf{AC}$$
$$\textbf{SV (schedule variance)} = \textbf{EV} - \textbf{PV}$$
$$\textbf{CPI (cost performance index)} = \textbf{EV}/\textbf{AC}$$
$$\textbf{SPI (schedule performance index)} = \textbf{EV}/\textbf{PV}$$
$$\textbf{ETC (estimate to complete)} = (\textbf{BAC} - \textbf{EV})/\textbf{CPI} = \textbf{BAC} - \textbf{EV}$$
$$\textbf{EAC (estimate at completion)} = \textbf{AC} + \textbf{ETC}$$
$$\textbf{TCPI (To - complete performance index)} = (\textbf{BAC} - \textbf{EV})/(\textbf{BAC} - \textbf{AC})$$

You will need to apply these formulas for the test, so refer back to section 14-4c of this book to review abbreviations, when to use each formula, and how to interpret the results. In addition to EVM, you can expect at least a few questions pertaining to the *Integrated Change Control* process. Remember that once the project management plan is approved and you have a baseline, any proposed change to schedule, budget, or scope needs to go through the change control process.

Summary

For a project manager to effectively determine that the desired project progress is being made and results are being delivered, a multitude of things need to be monitored and controlled. Many of these are interdependent, so a project manager needs to understand how changes in one area might impact another area.

Project managers need to monitor and control the actual work of the project or the activities. This entails observing the work as it is executed and making adjustments as needed. Any adjustments that may have a sizable impact must be processed through the project's integrated change control process. Each potential change is proposed, approved or disapproved, and documented, and the approved changes are implemented. A risk register is maintained to keep track of active risks, whether the risk events transpire, and how they are handled. New risks are added as they are discovered, and no-longer-relevant risks are retired.

Project managers also need to control the various aspects of the project that are subject to potential trade-offs—namely, scope, quality, cost, and schedule. When controlling these, the project manager looks for variances—that is, any difference between what was planned and what has actually happened. The project manager also seeks to understand how a change in any one area will impact the others. Several tools exist for helping project managers with this control. Many quality tools are widely used when seeking to understand what the quality level is, where problems may exist, what the root causes are for problems, and how to improve the project processes so the problems do not reoccur. Sponsors and other stakeholders want to understand progress made on the project, current plans, and what might derail the project. Regular progress meetings and reports serve this purpose. Earned value management and MS Project are both quite helpful in understanding, documenting, and improving upon cost and schedule progress.

Key Terms Consistent with PMI Standards and Guides

direct and manage project work, 459
monitor and control project work, 460
monitor, 460
control, 460

variance, 460
perform integrated change control, 463
change control, 463
change control board, 463
monitor risk, 463
implement risk responses, 464
manage communications, 465
work performance data, 465
work performance information, 465
work performance reports, 465
monitor communications, 467
manage quality, 469
control quality, 469
control scope, 475
scope change, 475
variance analysis, 475
control resources, 476
earned value management, 476
planned value (PV), 477
earned value (EV), 478
actual cost (AC), 478
budget at completion (BAC), 478
schedule variance (SV), 478
cost variance (CV), 478
schedule performance index (SPI), 479
cost performance index (CPI), 479
estimate to complete (ETC), 479
estimate at completion (EAC), 479
to-complete performance index, 480

Chapter Review Questions

1. What five aspects of project success are evaluated in the balanced scorecard approach?
2. Give three categories of internal project issues and an example of each.
3. In addition to the WBS, what might trigger project work to be authorized and performed?
4. What is an advantage of letting workers self-control their work?
5. What are two types of control frequently used on projects?
6. What members of the project team should serve on the change control board?
7. What is the difference between work performance data and work performance information?
8. Which time periods are discussed in Agile project progress meetings?
9. What three sets of data should a project manager have after completing a project audit?
10. Give some examples of times in the project lifecycle when an inspection might be especially useful.
11. Why is prevention preferable to inspection?
12. What is the difference between an attribute and a variable?
13. The highest bar on a Pareto chart often becomes the "head of the fish" in the _____.
14. What three types of variation should one look for in a Run Chart?
15. How does one calculate schedule variance?
16. What does cost performance index (CPI) measure?
17. What should your initial response be if a customer asks for a change to your project?
18. What is the main purpose of monitoring and controlling a project?
19. Describe the purpose of using an integrated change control system.
20. Describe the three time horizons for project performance reporting, what should be reported in each, and why.

Discussion Questions

1. Describe how a project manager can determine project progress for each element in the project balanced scorecard.
2. In your opinion, under what conditions should the sponsor approve a project change, and when is it okay for the project manager to authorize a change? Give an example of each.
3. Give specific examples of risks on a project that are within the team's control, partially within the team's control, and outside the team's control. Tell how you would deal with each.
4. As project manager, what would be your reaction to learning that, as of the last audit, your project's SPI was and your CPI was Why?

5. What is the difference between efficiency and effectiveness? Give an example of something that is one but not the other.
6. In your own words, what is the difference between Manage Quality and Control Quality on a project?
7. List and give an example of when to use each of the seven project quality control tools described in this chapter.
8. Give an example of a common cause and a special cause, and describe how you would address each.
9. If you were sponsoring a project, would you want to be updated in terms of cost and schedule variance or cost and schedule performance indexes? Why?
10. When it comes to monitoring progress, which parts of Microsoft Project schedule do you find most useful? Why?

PMBOK® Guide Questions

1. In regard to Project Work, which activity refers to "reviewing the progress and capturing project performance data with reference to the project plan, developing performance measures, and communicating performance information?"
   a. controlling
   b. monitoring
   c. executing
   d. managing
2. Juan is a project manager for a project that has been baselined and is now under way. When a customer approaches Juan and asks him to increase the project's scope, Juan's response should be to _____.
   a. comply with the customer's request if it seems reasonable
   b. determine the schedule performance index (SPI)
   c. perform integrated change control
   d. calculate the Estimate to Complete (ETC)
3. Which of the following formulas represents the schedule performance index (SPI)?
   a. EV/PV
   b. EV − PV
   c. EV − AC
   d. EV/AC
4. If your sponsor asks for an estimate as to how much more money your team needs to complete all project work as scheduled, which of the following formulas might you use?
   a. BAC − EAC
   b. EV/PV
   c. (BAC − EV)/CPI
   d. (BAC − EV)/(EAC − AC)
5. What is the final step in the *Perform Integrated Change Control* process?
   a. Review Change Proposals
   b. Manage changes to deliverables and Project Management Plan
   c. Estimate impact of proposed changes on project goals
   d. Approve or Decline change requests
6. Which quality control tool is a special type of vertical bar chart that is used to identify the primary (vital few) sources that are responsible for causing most of a problem's effects, often referred to as the 80/20 rule?
   a. Ishikawa diagram
   b. Pareto diagram
   c. Control chart
   d. Force field analysis
7. Which quality control tool is sometimes referred to as a "fishbone diagram" because it places a problem statement at the head of the fishbone and uses each "big bone" in the fish's skeleton as a category of probable cause, in order to determine the root cause of the problem?
   a. Ishikawa diagram
   b. Pareto diagram
   c. Control chart
   d. Force field analysis
8. Good project management practice suggests a need to include a _____ within the cost baseline in order to cover identified risks that are accepted, and for which responses have been developed.
   a. contingency reserve
   b. project buffer
   c. control account
   d. management reserve
9. The "methodology that combines scope, schedule, and resource measurements to assess project performance and progress" is called _____.
   a. cost management (CM)

b. funding limit reconciliation
c. triple constraint management
d. earned value management (EVM)

10. The "ToComplete Performance Index" (TCPI) is a measure of the cost performance required in order to finish the outstanding work within the remaining budget. The formula for this index is _____.
a. BAC − EAC
b. AC + BAC − EV
c. EV/AC
d. (BAC − EV)/(BAC − AC)

Exercises

1. Use the following information to answer parts a through h. Describe what the results of each calculation mean to you as a project manager. What do you propose to do?

$$PV = \$500{,}000$$
$$EV = \$350{,}000$$
$$AC = \$550{,}000$$
$$BAC = \$1{,}200{,}000$$

a. Schedule variance (SV)
b. Cost variance (CV)
c. Schedule performance index (SPI)
d. Cost performance index (CPI)
e. Estimate to complete (ETC—first method)
f. Estimate to complete (ETC—second method)
g. Estimate at completion (EAC)
h. To-complete performance index (TCPI)

2. Use the following information to answer parts a through h. Describe what the results of each calculation mean to you as a project manager. What do you propose to do?

$$PV = \$25{,}000$$
$$EV = \$30{,}000$$
$$AC = \$29{,}000$$
$$BAC = \$1{,}000{,}000$$

a. Schedule variance (SV)
b. Cost variance (CV)
c. Schedule performance index (SPI)
d. Cost performance index (CPI)
e. Estimate to complete (ETC—first method)
f. Estimate to complete (ETC—second method)
g. Estimate at completion (EAC)
h. To-complete performance index (TCPI)

3. A project manager has just learned that the schedule performance index (SPI) for his project is 85 percent. The calculation of the cost performance index (CPI) is 107 percent. How would you describe this project both in terms of budget and schedule?

4. Document the flow of a project work process. Be sure to identify the starting and ending points.
5. Create a check sheet to gather data regarding a step in the process flow chart you constructed in Exercise 4 above.
6. For a cost savings project, you have captured data that show the following costs: delays between operations = $900; broken/missing tools = $1,200; water losses = $3,700; poor seals = $1,500; other = $2,000. Construct a Pareto chart. What would your next course of action be?
7. For a productivity improvement project, you discover the most frequent cause of delays in receiving payment is incorrect invoices. Construct a fishbone diagram to identify possible reasons for this problem. What action do you recommend with the results of your fishbone diagram?
8. Using the data below, construct a run chart to visualize how the number of customer complaints is changing over time. Describe what you find in terms of trends, repeating patterns, and/or outliers.

Date	Day	Complaints
1	Mon	14
2	Tue	17
3	Wed	11
4	Thu	12
5	Fri	21
8	Mon	15
9	Tue	21
10	Wed	19
11	Thu	22
12	Fri	23

Date	Day	Complaints
15	Mon	27
16	Tue	11
17	Wed	29
18	Thu	31
19	Fri	35

9. Using the data below, construct a schedule in MS Project. Show where the project is ahead and/or behind schedule. Be specific. Which activities did the best? Which had the most problems?

Planned Start	Planned Finish	Actual Start	Actual Finish
8/31	9/5	8/31	9/5
8/25	9/8	8/25	9/8
9/5	9/8	9/5	9/8
8/25	9/2	8/26	9/3
8/26	8/27	8/28	8/29
8/25	9/8	8/28	9/8
8/25	9/6	8/29	9/6
8/25	9/1	8/29	9/6
9/1	9/2	9/5	9/11
9/1	9/6	9/5	9/11
9/1	9/8	9/6	9/14
9/8	9/15	9/13	9/22
8/25	10/26	8/31	10/31
8/25	9/16	8/31	9/23
9/16	9/29	9/23	10/9
9/16	9/19	9/23	9/25
9/20	9/28	9/30	10/6
9/20	9/21	9/30	10/21
9/22	9/28	10/3	10/28
9/16	9/27	9/26	10/27
9/16	9/20	9/27	10/10
9/21	9/26	10/6	10/16
9/28	10/6	10/15	11/6
9/28	10/5	10/22	11/5
10/7	10/10	11/7	11/20

10. Find a company (or other organization) that has a reputation for excellence in some aspect of project work. Benchmark their methods and determine how you can use the results to help your team improve.

11. Create a process improvement plan using the DMAIC model in Exhibit 4.9 to improve a project work process either for your own project or for another one.

INTEGRATED EXAMPLE PROJECTS

SUBURBAN HOMES CONSTRUCTION PROJECT

The project monitoring and controlling phase is where most of the resources are employed for project execution, and it is essential that the project execution happen strictly according to the project plan. Projects often experience changes during the execution because everything cannot be anticipated. However, Suburban Homes has an excellent track record of completing projects on time and within the budget and delivering its products to the customer's satisfaction.

With its plans to expand operations to other states, Suburban Homes is acutely aware of its inadequacies in new working environments and with new stakeholders. Specifically, it is more concerned with risk management, change management, quality expectations, and communication issues.

Suburban Homes has requested to review and modify its existing project management practices and processes. They want to use your comprehensive understanding of the

importance of project baselines for scope, cost, and schedule. They also want to use your knowledge of project control, progress reports—including earned value analysis—the importance of communications, and change control. Specifically, you are requested to develop templates and checklists to do the following:

- Develop a communication (formal and informal) plan with details about frequency, intended receivers, and medium of communication
- Review and modify the change management plan
- Monitor risks and develop a risk response plan
- Revise the quality assurance plan and incorporate new quality control tools and techniques

CASA DE PAZ DEVELOPMENT PROJECT

As with many development projects managed in a largely agile fashion, Casa de Paz has proceeded in unexpected ways. The board voted to negotiate a one-year lease on the target building without a commitment to do substantial work on it. The negotiated agreement included an option to extend the lease for up to five years with a negotiated agreement on the amount of money spent on upgrades that Casa de Paz would pay and what the owner would pay. This allows for the further development of the community for the target population that Casa de Paz will ultimately serve, without sinking large amounts of cash into a building that may not be suitable. It means that Casa de Paz will continue with most other aspects of the project, including developments such as the following:

- Programs
- Strategic partnerships
- Community building
- Website
- Fundraising
- Volunteers

This approach lessens risk because large commitments are not being made until more people are engaged and more is understood. It also allows for further board and working group development so the people side of the infrastructure will be able to communicate effectively and handle the increased demands when the building opens. It also recognizes that the primary goal is to help abused Latina women and their children develop self-sufficiency. Meetings and outreach can serve many more families than the few who can be served more intensively through the residency program.

Semester Project Instructions

For your semester project, complete the following at a minimum:

1. Document the change requests and their disposition (if you have had any changes proposed to your project).
2. Identify any changes to your risk register with new risks added and/or old ones removed.
3. Show any quality tools you have used and explain how you interpret and act upon the results from them.
4. Show your progress updates on MS Project.
5. If you are tracking cost on your project, show the most current status of the 10 earned value management terms.
6. Create one key deliverable for your project. This should be one deliverable that your sponsor asked your team to create when you wrote the charter. Gather information regarding your process of creating the deliverable.
7. Describe trade-off issues on your project. These can include trade-offs between the needs of your sponsor's organization, the project, and your project

team. The trade-offs can also be within the project objectives and constraints of scope, quality, time, cost, other resources, and stakeholder satisfaction.

8. Show the information you have collected using the information retrieval and distribution system you set up (introduced in Chapter 6).

PROJECT MANAGEMENT *IN ACTION*

Controlling, Monitoring, and Reporting Projects at a Major Medical Center

The Emergency Medicine Division of Cincinnati Children's Hospital Medical Center typically has a large number of active quality improvement projects that require effective control, monitoring, and reporting. Division leadership aims for three levels of effective monitoring and control and reporting:

1. Team-level monitoring: Self-monitoring progress against process and outcome measures at daily, weekly, or monthly intervals.
2. Division-level monitoring: Main outcome and select process measures reported to division leaders who can then guide and support teams as needed.
3. Institutional-level monitoring: Main outcome measure progress followed and presented along with other projects to institutional leadership and other stakeholder groups.

An essential part of effective monitoring is the development of a well-defined aim. Each aim is associated with a primary outcome measure and is supported by process measures. For the division's strategic flow project, the primary aim was a reduction in the length of stay for patients and was supported by process measures representing specific intervals of this time, such as time from arrival in the department to being seen by a physician and time from being able to leave the department to actually leaving.

Team-Level Monitoring

Team-level monitoring functions in slightly different ways from those of the other two levels. On the ground, the feedback loop for evaluating tests needs to be nimble and timely. Rather than using a single outcome measure to gauge progress, teams utilize a number of process measures, the collection of which typically represents the main identified outcome measure of a given project. Process measures are tracked frequently as the teams conduct tests within the system and during the course of a project are often displayed in daily, weekly, and monthly formats. Ad hoc analysis supplements these measures, particularly for tests that are run for discrete periods of time.

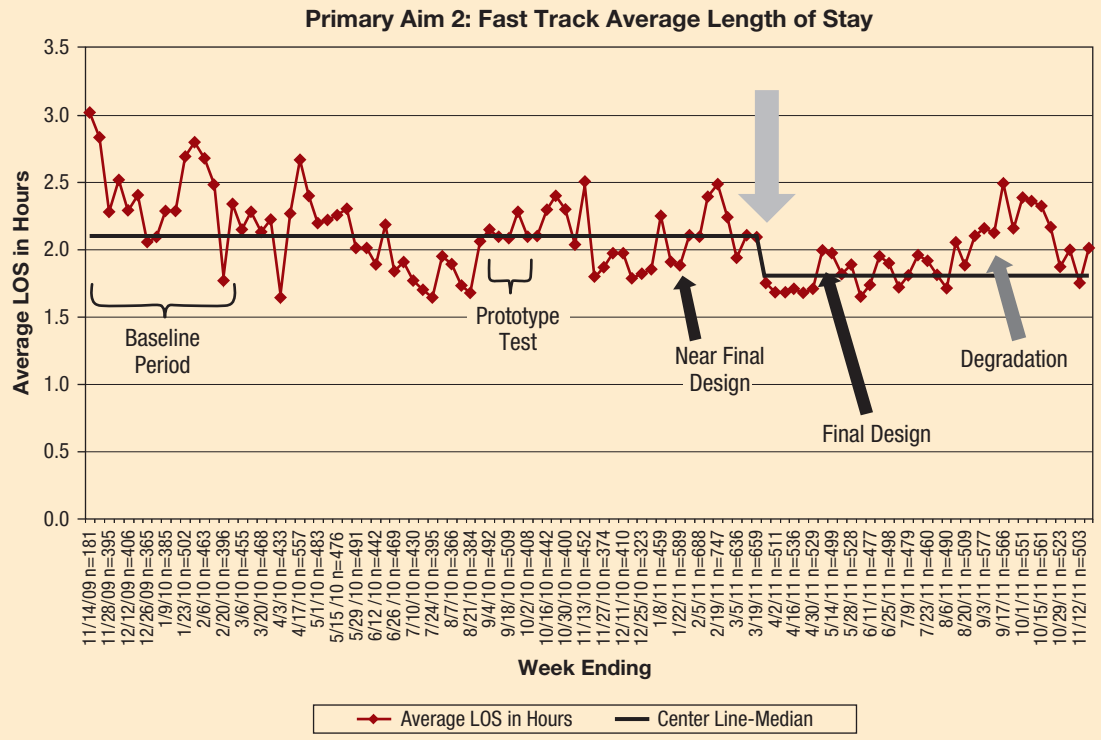
At this level, changes are tested for short periods of time. Individual tests are evaluated using process measures; often, the daily variants of the measure or ad hoc analysis are employed, particularly in the first three to six months of a project or during intensive periods of testing. Teams meet weekly and discuss tests, adapting, adopting, or abandoning tests as they are evaluated. Weekly charts are used to minimize the noise of day-to-day variance, and teams monitor these over time. Monthly charts are used to view larger trends over time and are more important in months six through twelve as changes are implemented and systems experience this change for longer periods of time. An example measure used by a team is shown in Exhibit 14.27.

Division-Level Monitoring

Individual teams organize work into 90-day blocks for planning, execution, and reporting purposes. Teams formally report after each 90-day cycle to a group of senior leaders using a preestablished reporting template. Team presentations typically last 20 minutes and include data reporting in the form of annotated run charts for all key performance measures. Teams share special challenges and seek guidance on issues blocking progress. Teams also share goals, work plans, and predictions of key

EXHIBIT 14.27

EXAMPLE MEASURE USED BY TEAMS FOR ONGOING MONITORING



Source: James M. Anderson Center for Health System Excellence.

measure progress for the next 90-day cycle. A formal leadership letter follows each team presentation summarizing key discussion points and action items.

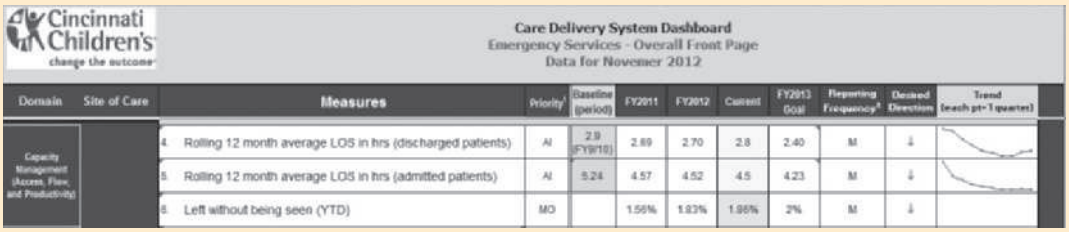
High-Level Reporting Structure and Management (Macro)

At the highest level, individual team progress is displayed on a department-wide dashboard. Aggregating each individual measure across all projects, this dashboard is designed to provide visibility to department leads, institutional stakeholders, and hospital leadership on the progress of projects. Historical data for measures, along with current performance, yearly goals, and immediate past quarterly performance, are indicated. High-level trend lines are provided, and links to individual charts are embedded within the dashboard itself. A dashboard example is shown in Exhibit 14.28.

The intent of this dashboard is to provide hospital leadership with a high-level view of recent progress on individual projects. Reporting at this level occurs monthly to department leadership and three times a year to institutional leadership. Feedback from these groups is given to teams depending on progress.

EXHIBIT 14.28

EXAMPLE OF HIGH-LEVEL DASHBOARD REPORT TEMPLATE



Cincinnati Children's
change the outcome

Care Delivery System Dashboard
Emergency Services - Overall Front Page
Data for Novemer 2012

Domain	Site of Care	Measures	Priority[1]	Baseline (period)	FY2011	FY2012	Current	FY2013 Goal	Reporting Frequency[2]	Desired Direction	Trend (each pt= 1 quarter)
Capacity Management (Access, Flow, and Productivity)		4. Rolling 12 month average LOS in hrs (discharged patients)	AI	2.9 (FY9/10)	2.89	2.70	2.8	2.40	M	↓	
		5. Rolling 12 month average LOS in hrs (admitted patients)	AI	5.24	4.57	4.52	4.5	4.23	M	↓	
		6. Left without being seen (YTD)	MO		1.56%	1.93%	1.98%	2%	M	↓	

Source: Michael Buncher and Kartik Varadarajan, Cincinnati Children's Hospital, Division of Emergency Medicine.

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CHAPTER 15

Finishing the Project and Realizing the Benefits

CHAPTER OBJECTIVES

After completing this chapter, you should be able to:

CORE OBJECTIVES:

- Describe how to determine when a project should be terminated early and the process for terminating a project in normal completion time.
- Describe the importance of the project closing activities and how to perform them.
- Create and present a transition plan for the project, including a plan for ongoing support and sharing lessons learned.
- Capture and share project lessons learned.

BEHAVIORAL OBJECTIVES:

- Secure customer feedback and acceptance of the project.
- Assist senior management in managing talent and managing resources for upcoming projects.

TECHNICAL OBJECTIVES:

- Close your projects administratively using MS Project.

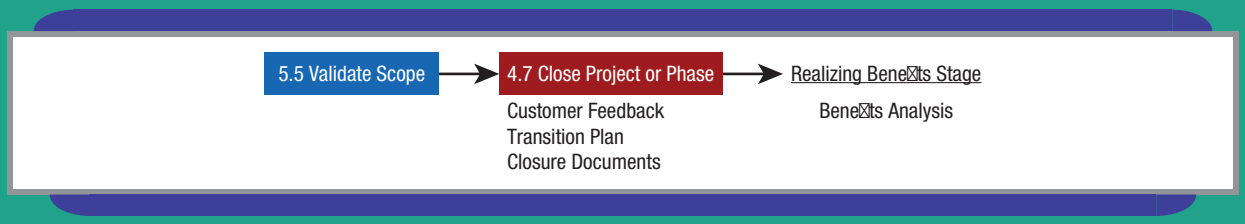
Liliyana Vynogradova/Shutterstock.com

After managing a number of projects to successful completion, it wasn't until I was overseeing a project in Trinidad and Tobago that I fully realized the importance of the project team celebrating its success.

Trinidad and Tobago is the southernmost Caribbean island, seven miles off the coast of Venezuela. The client company, Trinmar Limited, was formed as a joint venture between Texaco and Petrotrin, wholly owned by the government. Texaco had recently sold its equity share in Trinmar, leaving state-owned Petrotrin to produce 35,000 to 40,000 barrels of oil per day.

Many of the rigs Trinmar inherited were over 25 years old and declining in production. In addition to building a new organization and strategy, Trinmar faced the difficult decision of whether to upgrade the existing rigs or invest in building new rigs.

Our consulting team quickly identified over 80 potential projects. Working closely with the executive team, we were able to facilitate a portfolio optimization process to establish the strategic criteria and help Trinmar evaluate, prioritize, and make decisions regarding each project. The company invested in only a few new capital projects, while focusing on monthly well output and proactive preventative maintenance, resulting in an overall increase in production.



PMBOK® GUIDE

Topics:

- Validate scope
- Close project or phase

CHAPTER OUTPUTS

- Customer feedback
- Transition plan
- Closure documents
- Benefits analysis

Flying in from Miami to discuss the final steps of the project closing process, I was greeted at the airport by the company driver offering a gift bag. Inside was a polo shirt with a company logo and a card.

The day was spent in semiformal meetings with company executives and the portfolio team. We presented and discussed the culmination of customer reviews that had been conducted throughout the project—customer feedback, areas for improvement, lessons learned, project results, and approval of the final deliverables.

The evening had a much different tone, with live music, local delicacies, and drinks flowing freely. All company executives and their spouses were joined by everyone associated with the project. Several team members brought relatives, including cousins. Partway into the evening, the CEO stood and made an announcement, describing the project success and complimenting our partnership. He personally recognized everyone associated with the project. Each team member received an award of accomplishment and had their picture taken with the CEO Before he left, the CEO pulled me aside and said, "Mr. Miller, on behalf of our company and country, we sincerely thank you for hosting us with this generous celebration."

When I arrived back at the hotel early the next morning after settling the evening's bill, I saw the gift bag and finally opened the card. It read "Mr. Bruce Miller cordially invites you and your guest to join us in a celebration of our project success."

It was only later that I was sheepishly advised by one of my fellow consultants that he had offered to have our company sponsor the celebration and did not have the chance to tell me in advance. But the true impact of the celebration—reflected in the sincere joy and pride of the project team members as they received the sincere thanks of their CEO—had already proven the value of the event.

—Bruce Miller, PMP, managing partner, Xavier Leadership Center, Xavier University

Projects are often started with great enthusiasm. They serve as vehicles to accomplish important organizational objectives. Many things happen during the course of a project that may impact its success. Regardless of the level of success achieved by the project, going out on a strong note is good for everyone involved.

When purchasing a new home, buyers and a builder's representative do a "walk-through" to inspect the finished product and discuss mechanical functions and features of the home.

Project completion is either pleasant and predictable or unpleasant and unexpected. In the first case, the project team successfully meets project goals. In the second case, reasons could be different: performance is inadequate, the project deliverable may no longer be needed, or project constraints such as time or cost prevent the team from completing the project.

Blend Images/Superstock

A project moves into the closing stage when its customers validate that the scope is complete and accept the project deliverables. A project can close as planned or be terminated early. In either event, closing activities include securing customer feedback and approval, planning and conducting a smooth transition of project deliverables to a client or into ongoing operations, capturing and sharing lessons learned, performing administrative closure, celebrating success, and providing ongoing support.

15-1 Validate Scope

Validate scope is formally accepting the completed project deliverables. Stakeholders validate that scope is complete with interim deliverables throughout the project and with final deliverables near the end. When the stakeholders formally accept the final project deliverables, the project completes the executing stage and proceeds into the closing and realizing stages. To illustrate, imagine you have contracted with a construction company to build a new home. Before you close on the house, you want to make sure the house has been properly finished and a certification of occupancy is obtained. Therefore, the common practice is to have a "walk-through," where as a customer you literally walk through the house with a representative from the building company. The representative points out features and describes how things work. You try light switches, look at the finish, and consider all of the things you wanted (and agreed to pay for) in the house. Often, a few little things are not yet finished, and these can form a "punch list" of items to complete. The **punch list** is the list of "work items that are identified during a final inspection that need to be completed."

If the punch list is small enough, as a customer you agree to formally take possession of the house subject to the contractor finishing the punch list items. Once you formally agree the work is complete and agree to take possession, the house becomes an accepted deliverable.

However, if there are major concerns and/or a long punch list, you may decide not to formally accept the house until certain things are complete. Most projects are like this: The customer only formally accepts the deliverables once he or she is convinced they will work as planned. At that point, the buyer provides the seller with a formal written acceptance, and the project transitions from the executing stage to the closing stage.

Project managers need to ensure that all work on their project has been successfully completed. They can refer to the charter, scope statement, WBS, schedule, and all communications plans to verify that everything they committed to do is actually done. Many organizations also use project closeout checklists that itemize typical project activities and/or deliverables. These can be used to assign responsibility to each item concerning project closeout. An example of a project closeout checklist is shown in Exhibit 15.1.

15-2 Terminate Projects Early

Ideally, all projects continue until successful conclusion, with all deliverables meeting specifications and pleasing customers. However, this is not always the case. Sometimes, a project is terminated before its normal completion. Early termination can be the result of mutual agreement between the contractor and buyer, because one of the parties has defaulted (for cause), or for convenience of the buyer.

MUTUAL AGREEMENTS

On some projects, by closeout, not all of the deliverables are completed. Remaining deliverables need to be integrated into another project, stopped altogether, or continued as a lesser project or a further phase of the finishing project. If both parties agree to stop the project before its planned completion, a negotiated settlement may take place. If some of the deliverables or documentation is not completed, the project manager may need to negotiate with the customer. Perhaps the customer would rather have most of the capability now rather than all of it later. The project team may have made a larger-than-expected breakthrough in one area and can negotiate with the customer to deliver more in that area and less in another. Ideally, both parties agree what deliverables or partial deliverables go to the buyer and what compensation goes to the seller, and any outstanding issues are resolved. If agreement cannot be reached by direct negotiations, either courts or alternative dispute resolution can be used to reach a settlement. Perhaps it is in all parties' best interest to finish the project as is and part as friends.

TERMINATIONS FOR DEFAULT

Terminations for default occur for projects executed externally and often result from a problem with the project's cost, schedule, or performance. A buyer can also decide to terminate a project early because he or she has lost confidence in the contractor who is performing the project. Good project management practices consistently applied throughout the project can lessen the chance of early termination for cause by managing stakeholder expectations and by delivering what customers want on spec, on time, and on budget.

TERMINATIONS FOR CONVENIENCE OF BUYER

Projects can also be cancelled for the convenience of the buyer. This can happen through no fault of the contractor. Sometimes, the buyer faces unexpected difficulties or changing priorities. If a customer's needs change, it might decide that the resources assigned to a project could be more profitably applied to a different project. If a customer decides to terminate a project for

EXHIBIT 15.1

EXAMPLE PROJECT CLOSEOUT CHECKLIST

Project Name: Closeout Date:

Project Team:

Project Manager:

Sponsor:

Item	Who	Target Date	Completion Date
Final Certificate of Occupancy			
Punch List Complete			
Notice of Punch List Completion			
Certificate of Substantial Completion			
Utilities Transferred to Owner			
Notice to Owner on Insurance			
Facility Manual			
As-Built Drawings			
Attach Job Files to Database			
Update Projects Database			
Final Retainage Billing			
Release of Subcontractor Retainage			
Complete Subcontractor Evaluations			
Team Close-Out Meeting			
Send Out Owner Survey			
Bond Release			
Estimating Feedback Cost Report			

Approved for Closeout:

Project Manager	Sponsor	Vice President–Construction

convenience, it invokes a contract clause. This clause normally stipulates that the contractor is reimbursed for the money it has spent up to that point and the customer takes ownership of the deliverables in whatever form they currently exist. Internal projects can also be terminated if organizational priorities change.

Project managers can pursue two avenues to possibly head off early termination. First, a project manager who has been serious about managing stakeholder relationships may be able to find other stakeholders in the customer organization or elsewhere who can provide some funds to keep the project viable—even if the scope has to be reduced. Second, the project manager can look internally to find ways of continuing with the project, but at lower cost.

Project managers serve as the strongest advocates for their projects throughout the project's life. Considering that most projects face many challenges, this unwavering support is often critical to project success. However, when a project is no longer needed or no longer viable, project managers owe honest and timely communication to their parent organization. Project managers need to present the facts of project progress and make recommendations for early termination if they feel it is warranted.

If a decision is made to terminate a project early, the project manager is obligated to communicate this decision to his or her team quickly and honestly. Let the team know as soon as possible and tell them exactly why the decision was made. Care must be taken to ensure that no unjust blame is placed on anyone. It is absolutely unethical to have reputations and careers suffer for a termination in which the impacted party was not at fault. Once a decision is made and communicated to terminate a project early, much of the remaining work is similar to that of a project that is completed as planned.

15-3 Close Project

As stated in Chapter 1, closing a project entails finalizing all activities needed to finish the project. The remainder of this chapter details what a project team does when finishing a project on time. Customers are asked both to accept the project deliverables and to provide feedback. Lessons learned are captured and shared. Contracts are closed. Participants are reassigned and rewarded. Reports are created and archived. Success is celebrated, and the project team ensures that customers receive the ongoing support they need to successfully use the project deliverables.

A few key challenges arise at the end of projects. One is to keep the right workers engaged until project completion. Some of the final activities are administrative. Often, new projects are starting up that are more exciting and cause distraction.

15-3a Write Transition Plan

A project manager may decide to create a **transition plan** to help the customer to use the project deliverables successfully. Project transition plans are a sort of instruction manual on how the customer should use the project deliverables once the project team has completed its work.

The reason a project is performed is that some person or organization needs the resulting deliverables. Some project deliverables are created by one group and turned over to another group. Sometimes the group performing the project also uses the results or deliverables. In either case, a transition plan can ensure that all responsibilities are considered and all deliverables—whether complete or not—are handed over with appropriate documentation to the people who will use them. If any activities remain incomplete when the deliverables are transitioned, they should be itemized, and responsibility for each should be clearly identified. For example, if a home buyer wanted to close on a house before everything is complete, a punch list of remaining items would be determined, and the contractor would agree to complete them. A transition plan helps to ensure the following:

- Quality problems are avoided during the transition.
- The project deliverables transition into their service or operational role.
- The needed maintenance, upgrades, and training take place.

15-3b Knowledge Management

The fourth area identified in using the balanced scorecard approach to controlling and improving projects is growth and innovation. While the portion of this pertaining to team development is covered in Chapter 5, the portion concerning knowledge management is covered here. Knowledge management should occur throughout the project life, but it may become most apparent as a project comes to an end. Project customers, whether internal or external to a company, can provide valuable feedback concerning both the project process and results. Ask them what they think! Exhibit 15.2 is a simple form for asking project customers for their opinions.

CAPTURE LESSONS LEARNED **Lessons learned** are the useful knowledge gained by project team members as they perform a project and then reflect on both the process of

EXHIBIT 15.2

PROJECT CUSTOMER FEEDBACK FORM

Customer: _____ Date: _____

	Rating	Importance (Rank order 1= most important)
1. How would you rate the quality of our deliverables?	1 Poor Avg. 5 Excellent	☐
2. How well did we control schedule?	1 Poor Avg. 5 Excellent	☐
3. How well did we control budget?	1 Poor Avg. 5 Excellent	☐
4. How would you rate stakeholder relationships?	1 Poor Avg. 5 Excellent	☐
5. How effective were our communications?	1 Poor Avg. 5 Excellent	☐
6. Overall, how would you rate your satisfaction?	1 Poor Avg. 5 Excellent	
7. How can we improve?	_____ _____	

doing the work and the results that transpired. Lessons can include what worked well that the project team members think should be copied and/or adapted for use on future work. Lessons can also include areas for which a different method may yield better results. Furthermore, information about mistakes and what went wrong should be captured to avoid repeating them again. The project meeting Plus-Delta evaluation template shown in Exhibit 6.14 is an example of capturing lessons learned at the end of a project meeting. Lessons can also be captured at milestones and at the end of a project. On long-duration projects, it is often better to capture lessons frequently because people may not remember clearly what happened months previously. Therefore, the best project managers capture lessons learned early and often. A project manager may wish to capture lessons learned first from the core project team and then from all of the stakeholders.

The first step in capturing end-of-the-project lessons learned is for the project manager to send an e-mail asking the participants to identify major project issues. Then, the actual meeting begins with each participant writing his or her top issues on a flip chart or other workspace where everyone can see them. Once all participants have listed their top issues, the entire group can vote on the top five (or perhaps top ten on a large project). Then the project manager can go through one top issue at a time by asking leading questions to determine what went wrong and how it might be avoided in future projects.

Likewise, the participants can list significant successes on the project and discuss factors that contributed to each. They can then ask what practices can be used to re-create similar successes on future projects.

Some organizations use a standard form for capturing project lessons learned, such as the one shown in Exhibit 15.3.

DISSEMINATE AND USE LESSONS LEARNED The process of capturing and discussing lessons learned is valuable learning for the participants. However, for the remainder of the organization to capitalize on those lessons, a method must be established for documenting and sharing the lessons. More organizations effectively collect lessons learned than effectively disseminate and use them. One problem is deciding how to store the lessons so all workers in a company can easily access them. Some companies have created databases, shared folders, or wikis for this purpose. Many companies that do a good job with lessons learned have one person assigned to "own" and be responsible for designing and maintaining the lessons-learned database. Every project team that collects lessons then sends the new lessons to this "owner," who compares the new lessons with existing lessons and decides whether to modify, combine, or add the lessons and to possibly remove an old lesson. Thus, the database only grows when unique and useful new lessons are added. Another idea some companies use is to have the person who submitted each lesson list her cell phone number and e-mail so another person considering the lesson can contact her to ask questions. This is especially helpful because it is hard to document all tacit knowledge, and even if a person did so, the lessons would be so long, many people would not take the time to read them.

Coding each lesson by factors such as the type of project, stage in project life cycle or project phase, issue it concerns, and project knowledge area helps future project teams when they search for new lessons to apply. Many organizations find that it is helpful to have a limited number of categories and have each lesson stored according to the category in which it is best suited. The ten *PMBOK® Guide* knowledge areas can be a useful starting point when determining useful categories. Exhibit 15.4 shows thirteen categories used by a company along with two or three lessons in each category.

Another problem is that most people are busy and do not seek lessons learned just for fun. One way to overcome this is for sponsors to sign charters only if lessons from other recently completed projects are included. That forces project teams to consider what lessons they can use.

EXHIBIT 15.3

LESSONS-LEARNED PROJECT CLOSING DOCUMENT

D.D.Williamson
World Leader in Caramel Color

Project Number:
Closing Date:

PROJECT CLOSING DOCUMENT:

As your project comes to a close, please capture continuous improvements, lessons learned and issues to consider for future projects. Please focus on the positive aspects that would help other teams in the future and you would like to see done again (+) and on things that could be changed/improved upon in the future (Δ). These learnings will be entered into a database for future reference to help all associates.

Criteria	Plan	Actual	Learnings (+/Δ)
Outcome • Future state achieved? • Success measure (attach graph/data)			
Schedule • Milestones • Completion			
Cost (Cap Ex)			
Hours required: • Project Manager • Sponsor • Core team members • SMEs			

Risks and Countermeasures	
Anticipated	Unanticipated

Communication Plan Implementation	
What worked well (+)	What did not work (Δ)

Other Learnings	
What worked well (+)	What did not work (Δ)

Source: Elaine Gravatte, D. D. Williamson.

Another effective way to transfer lessons is to assign roles to people. One person in the organization can serve as process owner with responsibility to continue to improve that particular work process regardless of what project it is performed on. Also, every project team member can have an additional role as improvement team member.

One of the challenges in using lessons-learned information is that most people are busy. One way to overcome this issue is for sponsors to sign the project charter only if lessons

EXHIBIT 15.4

LESSONS-LEARNED EXAMPLE	
ACCOUNTABILITY:	Use formal accountability and measurement systems down to the individual performance level. Ensure all team members have clearly defined roles and responsibilities.
BUY-IN AND COMMITMENT:	It is helpful when directors attend project meetings. Be sure sponsor secures buy-in from other executives. Involve people with decision-making authority early in the project.
COMMUNICATION:	Develop and follow a communications management plan to develop trust. Communication about change needs to be ongoing. Communication needs to be early and ongoing with all key audiences and stakeholders.
COMPLEXITY:	Many projects are multifaceted and involve numerous trade-offs that need to be managed. Project manager should attend some client meetings and sponsor should attend some team meetings to ensure integration.
CULTURE AND CHANGE:	Lean concepts challenge the organization's culture for data collection and transparency. Commitment to transparency and change is needed prior to project initiation. Educating leaders in change management strategies helps them deal with resistance.
EXPECTATIONS:	Set and state clear expectations. Define and stay within scope. Manage expectations of sponsor, stakeholders, customers, and project team.
MEETINGS:	Team members will be prepared with previous meeting minutes, agenda, and project updates. End a meeting with clear action items and due dates for each team member. Plan meetings in advance to make them more efficient.
PLANNING:	Have well-defined roles and responsibilities. Scale planning at the appropriate level of detail. Expect many revisions.
PROCESS IMPROVEMENT:	Always discuss what we could have done better. Keep working to sustain results on completed projects. Investigate feedback provided to assure it is understood and utilized as appropriate.
PROJECT TEAM:	Listen to and respect input from all team members. Let each team member be responsible for setting his or her own timetable to the extent possible. Determine in advance how project team will make decisions.
SCOPE:	Define success early. Be specific about scope. Manage scope creep.
SPONSOR SUPPORT:	Sponsors and other leaders need to publicly endorse the project and remove barriers. Speak candidly and informally to your sponsor in addition to formal reports. Obtain sponsor's signature on charter before proceeding.
STAKEHOLDERS:	Invite key stakeholders to specific meetings. Be sensitive to the political climate within your client's organization. Be open to constructive criticism and other input from stakeholders.

from other recently completed projects are considered and relevant aspects are included. Some lessons learned are more effectively transferred by informal means such as conversations, unscheduled meetings, or having a project team member also serve as a team member on another project. An organization that seriously uses a lessons-learned process makes continual improvements in its project management processes and develops an organizational learning culture. The best lessons learned are only of value if they are used!

Closure of a project entails ensuring that all work has been accomplished, all resources have been reassigned, and all documentation is complete. The project manager and team can review the project charter, WBS, and schedule to make sure that everything that was promised was delivered. They can review the issues log and risk register to ensure all items on both of them have been addressed. They can review the communications plan to check that all documentation was created. The customer feedback and scope verification should also be reviewed to verify that the customers thought everything was accomplished.

However, closure activities can take place during the project execution as well. Many of the quality assurance activities fall in that category. Also, the project team can review the communications plan to check that all documentation was created and used as mandated, which brings a closure to the project communication plan.

15-3c Create the Closeout Report

Many organizations have formal procedures for closeout reports and archiving project records. The **closeout report** usually includes a summary status of the project that can be gleaned from progress reports. The closeout report also normally includes lessons learned. Finally, the closeout report often contains a review of the project's original justification. Did the project accomplish what it was originally approved to do? This is an important question because many projects change along the line. The exact timing, costs, and deliverables may have changed, but did the project still accomplish its goals? Finally, the project manager needs to ensure that the records are in a workable format and stored in a manner that will allow others in the organization easy access for lessons learned, financial audits, or other uses.

Organizations often create templates for closeout reports such as the one in Exhibit 15.5. See the Project Management in Action feature at the end of this chapter for more ideas on how to effectively capture, share, and use lessons learned.

EXHIBIT 15.5

CLOSEOUT REPORT TEMPLATE

This deliverable, required for each small project, contains the project charter, the original work breakdown structure, summary of weekly progress reports, and client feedback summary.

PROJECT SUMMARY REPORT FOR PROJECT _____			
TASK OR ITEM DESCRIPTION	SATISFACTORY	UNSATISFACTORY	COMMENTS
A. Project charter updated and included			
B. Original WBS included			
C. Weekly progress report summary included			
D. Client feedback summary included			

Knowledge management is hugely important on agile projects. At the end of every two- to four-week iteration, a ceremony (meeting) called a retrospective is held to determine what worked well and what can be improved with an eye toward improving the current project, not just future projects. As with many organizations, if asked what worked well and what did not, many team members initially do not have much to offer. Therefore, many scrum masters (project managers) will use gimmicks and jokes to liven the mood and truly get team members to share and even joke about what happened. That way, not only do good ideas surface but because most team members discussed them, there also is widespread buy-in.

15-4 Post-Project Activities

15-4a Reassign Workers

Project managers owe the members of their team timely updates for their personnel records, honest recommendations, help securing their next assignments, and rapid notification of any issues. Wise project managers know it is not only ethical to treat their members well, but if a project manager also develops a reputation for taking good care of team members, it becomes much easier to recruit team members for future projects. Helping good workers secure follow-on work is one of the most important things a project manager must do near the end of a project. Many of these workers will be eager to work again for that project manager and will share their good experience with others in the organization.

It is important to understand aspirations and recognize individual strengths of all the project team members to recommend future project assignments. Ideally, it would be immensely beneficial for organizations when individual aspirations and professional goals are aligned with project objectives. The project manager plays an important role in advising senior management and support in meeting this issue of strategic importance.

15-4b Celebrate Success and Reward Participants

The successful conclusion of a project should be celebrated for many reasons. Perhaps one way to understand the many reasons is to utilize a play on the very word *celebrate:*

Challenge
Energize
Limit
Exert
Believe
Recognize
Acknowledge
Transition
Ease Stress

When people are reminded of their recent accomplishments, they realize they just met a large **challeng**e and are motivated to undertake new challenges. The team members are frequently **energized** to finish the last few administrative chores so they can move on to another project. By recognizing their accomplishments, they are now ready to say "the project is over; we will **limit** any additional work on this project." The team members exert themselves to finish the last few items. Celebrations can persuade members to believe they can do just a bit more than they might otherwise think is possible.

racorn/Shutterstock.com

Celebrations are excellent times to **recognize** and **acknowledge** both effort and results. Celebrations mark **transition** points as people leave one project and move on to another. Finally, celebrations of success **ease** the stress of working hard for a prolonged period of time trying to accomplish a project.

When a primary project deliverable is quite visible, such as a new building, celebrating right at the project site makes sense. People feel success partly just by observing the deliverable. When the project deliverables are less visible, project managers can still create ceremonial deliverables to demonstrate the project results. Project managers may be able to use specially packaged software, oversized checks, posters of thanks from customers, or other creative means of visualizing project results.

15-4c Provide Ongoing Support

Ultimately, a project manager should ensure that customers can effectively use the project deliverables. This may include providing ongoing support in the forms of training, change management, and/or other services. A transition plan can guide this support. Project managers aim to create useful project deliverables on time and on budget. They want to turn those deliverables over to capable, satisfied customers who will directly provide more project work in the future and who will enthusiastically tell others how pleased they are.

15-4d Ensure Project Benefits Are Realized

Many organizations insist that project managers follow up with customers weeks or months after the project deliverables are in use. One of the most important measures of project success is how well the customers can use the project deliverables. When considering the full impact of the project results, project managers are encouraged to consider use by direct customers and other stakeholders (people), and also how the results

contribute to the other parts of the triple bottom line—profit for the parent company and sustainability of the planet.

15-5 Using MS Project for Project Closure

15-5a Creating Project Progress Reports

As your project executes and eventually enters into the closing phase, there are likely to be multiple occasions where you must generate project reports to share with stakeholders. Often, organizations have existing templates, web portals, or other specific methods they want used to report project data. If not, you can quickly create customized or prebuilt (canned) reports within MS Project to share with project stakeholders. Using the simplified Suburban Park Homes project from Chapter 14, the following will demonstrate how to create a canned project report. However, you can easily create these reports with any MS Project file.

CREATE A CUSTOMIZABLE CANNED REPORT Although the **Report Tab** gives the project manager the option to create a new report from scratch (**Report Tab>>View Reports Group>>New Report**), it also contains a variety of canned reports from which to choose, including Resources, Costs, and In-Progress reports. There are also several Dashboard style reports that provide overviews of the project, for example, the "Project Overview" in Exhibit 15.6 and "Cost Overview" in Exhibit 15.7. The variety of canned reports, and the ability to customize them once generated, greatly reduces the need for the project manager to struggle with creating a new report from scratch. To create a Project Overview report like the one in Exhibit 15.6, do the following:

1. Click the **Report Tab>>View Reports Group>>Dashboards>>Project Overview**

Once generated, the elements of the report can be manipulated and customized. Element position can be changed by clicking and dragging to different areas of the report, and fonts, colors, shading, and effects can be altered by double-clicking elements to open

EXHIBIT 15.6

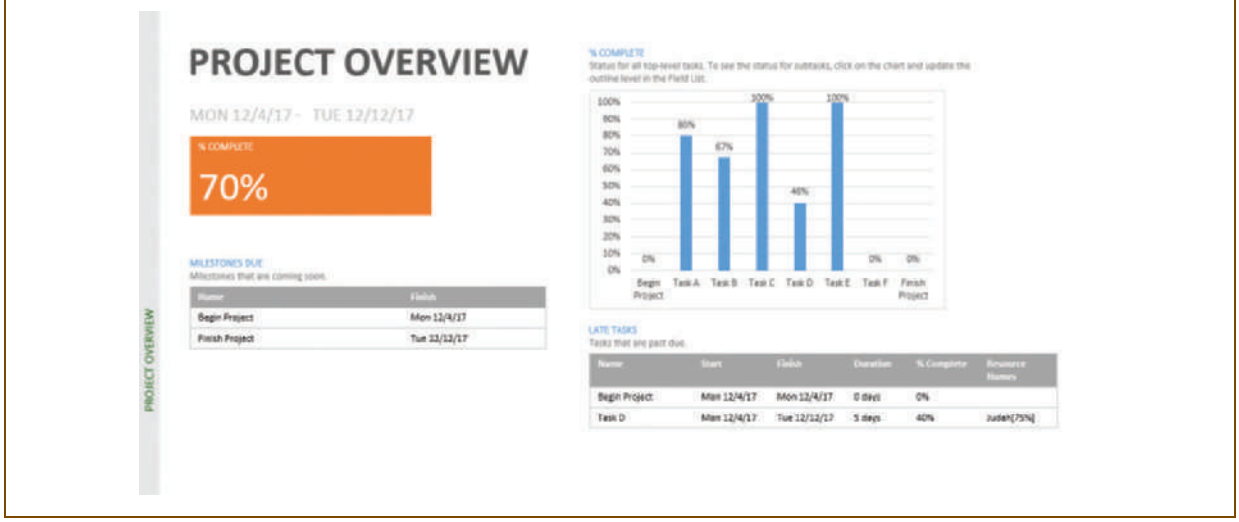
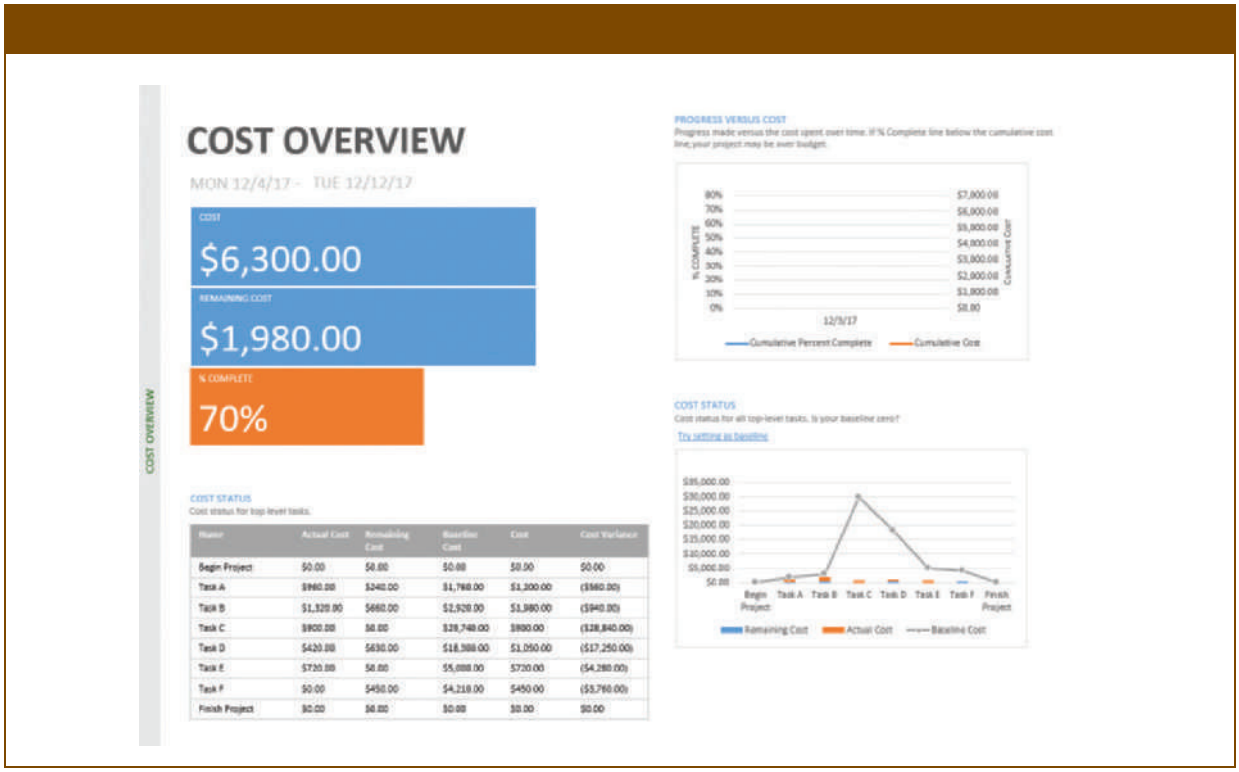


EXHIBIT 15.7



formatting panels. In addition, images from a file can be added to the report if desired. Formatting techniques and image insertion follow the same conventions as other Microsoft Office applications. Many of the controls for formatting can also be accessed from the **Design Tab** once the report is active on-screen.

SHARING REPORTS Once the report is formatted to your specification, it can be printed or saved as a PDF and published to e-mail, a web portal, or other location. MS Project has native support for sharing to e-mail or MS SharePoint in the **File>>Share** menu options, as seen in Exhibit 15.8.

EXPORT A REPORT TO MS EXCEL MS Project can also export a variety of reports to MS Excel. The following steps will create a customizable report, as seen in Exhibit 15.9:

1. Click the **Report Tab>>Export Group >>Visual Reports**
2. Click the **Resource Summary Tab**>> select **Resource Remaining Work Report**
3. Click **View**
4. The report will build and then open in MS Excel (where is can be customized and distributed)
5. Click **Close** to close the Visual Reports dialog (Exhibit 15.10) in MS Project

15-5b Archiving Project Work

Just as software such as MS Project can be useful in planning, managing, and reporting on a project, it also can be useful when closing out a project and leveraging the benefits

EXHIBIT 15.8

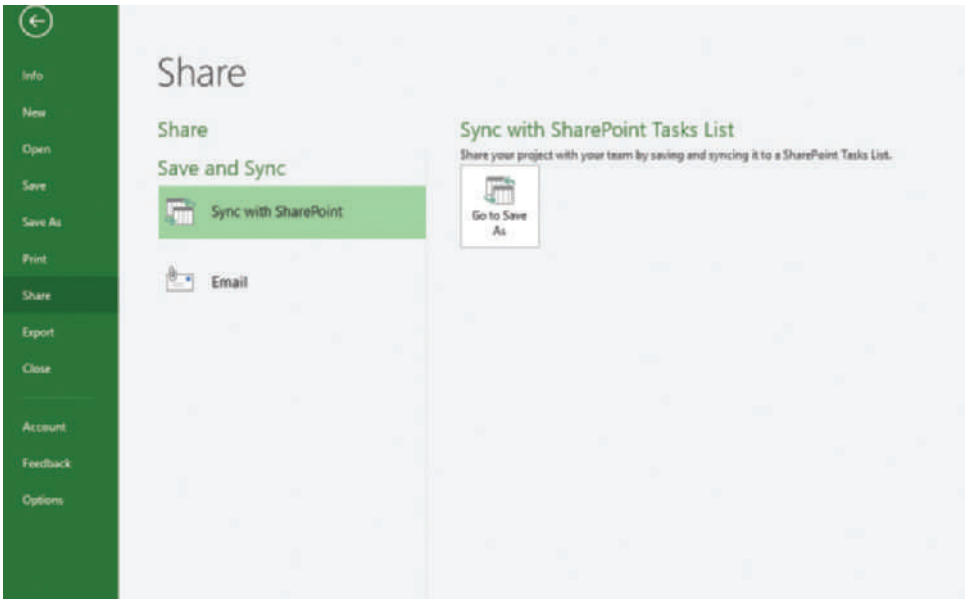


EXHIBIT 15.9

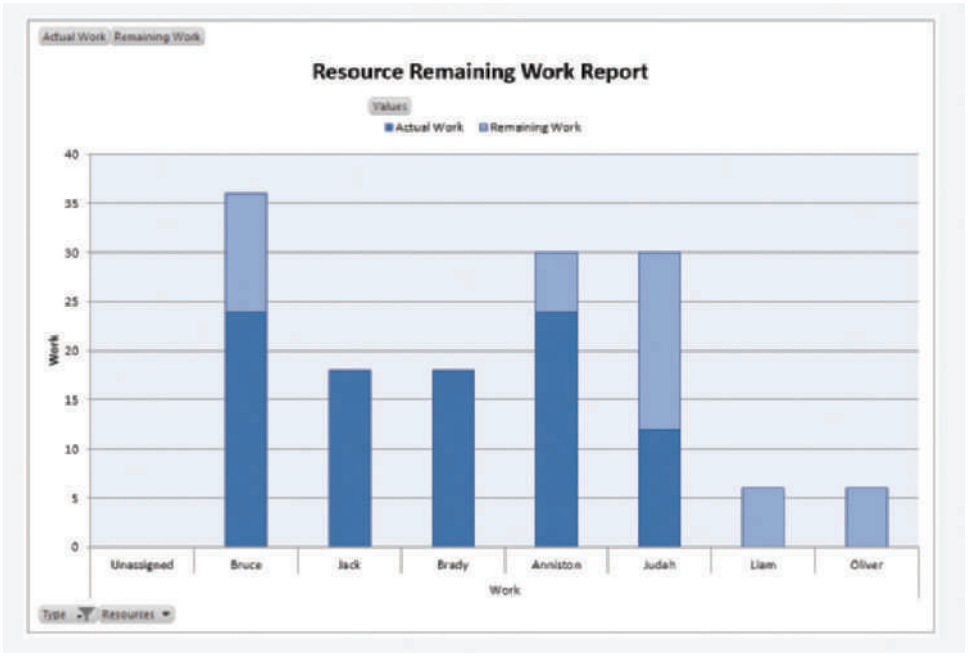
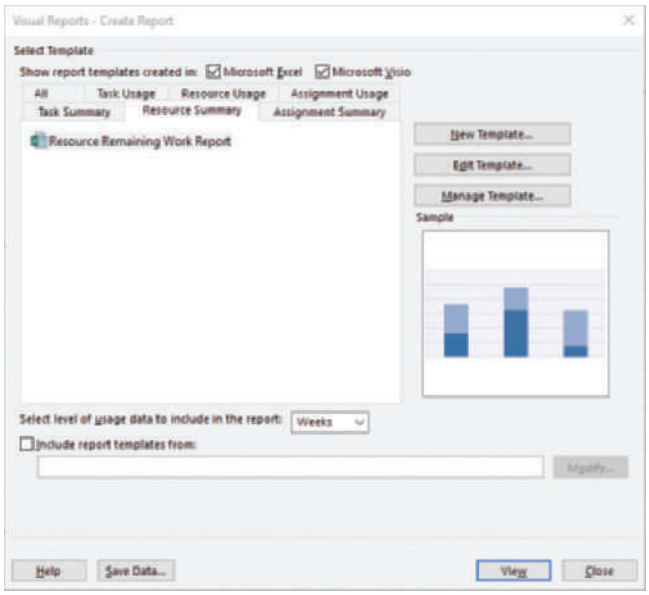


EXHIBIT 15.10



for future projects. Specifically, it is helpful to complete and archive the schedule and to capture lessons learned from to the scheduling process:

1. Complete the schedule to maximize its future usefulness. This includes the following:
   - Applying performance data
   - Applying approved changes
   - Ensuring all activities are complete
2. Archive the schedule for use as a template or "starter" file. A good way to start a new project, particularly if it is similar in nature, is to reference or build from the last project:
   - Decide the data format—MS Project or a longer-term format.
   - Schedule data from the Gantt chart can easily be copied and pasted into applications like MS Excel or Word.
   - Decide which baselines to keep (if there were multiples due to changes).
3. Capture and publish lessons learned about the effectiveness and efficiency of the employed schedule and cost management processes. Having this data as you start your next project, particularly the lessons learned, will give you an edge. Consider retaining items such as the following:
   - Frequency and method of team member performance data collection
   - Activity duration maximum and minimum limits
   - Status reporting to stakeholders
   - Communication technologies employed and their effectiveness
   - Schedule and cost estimate accuracy
   - Max Units value—maximum availability of a resource for work
   - WBS structure

PMP/CAPM Study Ideas

Fewer than 10 percent of the PMP test questions concern the Closing Process Group. That said, there are no formulas and only a handful of processes associated with closing, so you should do well if you can remember a few important things.

First, be sure that you are studying from the most current (6th) edition, since there have been substantial changes made within the Closing Process Group. Most notably, there used to be a *Close Procurements* process, but it has been removed in the *PMBOK*'s 6th edition, and its activities have been reassigned to either *Control Procurements* or *Close Project or Phase*. In other words, all closing activities—whether contractual, administrative, or other—now fall under the *Close Project or Phase* process.

Second, PMI likes to stress knowledge management, so remember the importance of capturing, storing, and disseminating lessons learned (this can and should happen throughout the project but is especially important at a project's end). This needs to take place whether or not the project reaches a successful conclusion.

Third, *Close Project or Phase* is the very last step of a project. It cannot be completed until *everything else* has taken place. *Close Project or Phase* is also known as the Administrative Close, since it involves gathering and storing lessons learned, writing reports, and updating project documents. Whether or not a project reaches a successful conclusion, recognize that the project manager often has limited authority and that the sponsor should be involved in the *Close Project.*

Summary

Hopefully, most projects will be successfully completed. However, some projects are terminated early either because the customer is dissatisfied or wishes to invest their time and money in a different way. Regardless of whether a project was terminated early or on time, a variety of closeout procedures are required. All activities must be completed, money paid and accounted for, documentation completed and distributed, workers reassigned and rewarded, *lessons learned* recorded, and success celebrated. A project manager would like to end a project with team members eager to work for her again and satisfied customers who will either hire the project manager again or direct other potential customers her way by their enthusiastic singing of her praises.

Key Terms Consistent with PMI Standards and Guides

validate scope, 500
punch list, 501
transition plan, 503
lessons learned, 504
closure of a project, 508
closeout report, 508

Chapter Review Questions

1. When does a project move into the closing stage?
2. What is *validate scope*?
3. What is the purpose of a "punch list"?
4. What should a project manager refer back to in order to make sure that all planned work has, in fact, been completed?
5. Under what conditions can a project be terminated early?
6. If both parties agree to stop the project before its planned completion but cannot reach an agreement via direct negotiation, what can be done?
7. Terminations for default often result from a problem with the project's _____, _____, or _____.
8. When might a contract clause be invoked?
9. During project closing, customers are asked both to accept the project deliverables and to _____.

10. What should be done with any activities that remain incomplete at the time of project closure?
11. What is the first step in capturing lessons learned at the end of a project?
12. How is a project transition plan similar to an instruction manual?
13. What does a typical closeout report include?
14. How can Microsoft Project be useful during the closing stage of a project?

Discussion Questions

1. Give two examples of why a project might be terminated early for cause and two examples of why a project might be terminated early for convenience.
2. How can a project manager help to prevent a project from being terminated early?
3. If an early termination of his project seems likely, what two avenues can a project manager explore to increase the likelihood of being able to continue the project?
4. A project manager is in the finishing stage of her project. It is apparent that one of the project's deliverables will not be completed before the project is wrapped up. What options does the project manager have for this uncompleted deliverable?
5. Provide an example of how poor escalation of a project problem can create additional problems.
6. How does celebrating the completion of a project benefit the project manager?
7. Why is it important to go through the process of closing, even for projects that are terminated early?
8. Why is it important as a project manager to help your team members secure follow-up work toward the end of your project?
9. Imagine you are creating a lessons-learned database for a recent project you have completed. What would you list as your top issues? Your top successes?
10. The sponsor of a large multiphased project you are managing suddenly decides to terminate the project early. How do you respond? How and when do you notify your team members?

PMBOK® Guide Questions

1. The process of meeting with customers and/or key stakeholders to formalize acceptance of completed project deliverables is called _____.
   a. validate scope
   b. control scope
   c. close procurements
   d. manage stakeholders
2. During which project management process would a company auditor verify that all contracts have been completed and all required purchasing standards and methodologies have been followed for the project?
   a. Validate scope
   b. Close contracts
   c. Close project or phase
   d. Conduct procurements
3. Terminations for _____ often result from a problem with the project's cost, schedule, or performance.
   a. convenience
   b. completion
   c. default
   d. confidence
4. At the end of the project or phase, lessons learned are finalized and transferred to the company knowledge base for future use. These lessons learned can include all of the following *except*:
   a. project issues log
   b. individual performance reviews
   c. project risk register
   d. which techniques did and did not work well
5. If the buyer decides to terminate a project early, his or her responsibilities to the contractor are laid out in the project's _____.
   a. work breakdown structure (WBS)
   b. communications plan
   c. scope statement
   d. procurement agreement
6. During the "close project or phase" process, the team and project manager may wish to review the _____.
   a. project charter
   b. WBS

c. risk register
d. all of the above

7. What key input is required before a project or project phase can move to the closing stage?
   a. Accepted deliverables
   b. Change Requests
   c. Updated Issues Log
   d. Work Performance Reviews
8. The new management team at a large company has reevaluated ongoing initiatives and has identified new goals and objectives for the year. They direct that all contracts in progress be terminated immediately. This is an example of _____.
   a. management by objectives
   b. termination for cause
   c. termination for convenience
   d. termination by consensus
9. What serves as an instruction manual in order to help the customer use the project deliverables as intended?
   a. lessons-learned database
   b. transition plan
   c. executed work contract
   d. issues log
10. Contracts can be terminated early for any of the following reasons *except*:
    a. default
    b. mutual agreement
    c. convenience of buyer
    d. convenience of seller

Exercise

1. Utilizing the ideas in Exhibits 15.1 and 15.3, create a project closeout checklist for a project of one of the following types:
   - Information systems
   - Research and development
   - Quality improvement
   - Organizational change

INTEGRATED EXAMPLE PROJECTS

SUBURBAN HOMES CONSTRUCTION PROJECT

The closeout phase is often assigned less importance because project-executing organizations are in a hurry to assign resources to new projects as quickly as possible while the project is still in the closing phase. The construction industry is no different. As soon as the construction work is complete, the resources are assigned to new projects and the closeout phase is often managed by only a few people responsible for tying up any loose ends. This is often the source of customer dissatisfaction.

Project closeout consists of two important activities. First, it is about formalizing acceptance of the project or phase and bringing it to an orderly end, and second, closing the contract after ensuring its completion and then settlement of the contract.

Suburban Homes realizes that there is a scope to improve its existing closeout processes and practices for both scheduled completion and unexpected termination of projects. The existing closeout process includes the following:

- Take stock of entire project.
- Tie up loose ends.
- Write the final report.
- Ensure that documentation is in good order.
- Account for and reassign resources.
- Meet with customers to ensure their needs are addressed
- Prepare for the handover with warranty documentation.

To improve customer satisfaction, Suburban Homes is planning to redefine its closeout process. Adam Smith has requested that you develop a checklist for closing the project. The closeout process must address the following:

- Improve morale and a sense of achievement for the project team.
- Enhance customer satisfaction.
- Close the contract properly to avoid future legal implications.
- Provide Suburban Homes with a detailed project cost.
- Capture lessons learned for easy retrieval and use them to improve the performance of future projects.

CASA DE PAZ DEVELOPMENT PROJECT

Since the primary Casa de Paz project vision is to enable Latinas and their children to be able to live independently and achieve success in work and school, it is critical for those women to take a very active role in running Casa de Paz. What would you include in the transition plan to help them be successful? How would you capture lessons learned? Who would you share these lessons with? (*Hint*: Think about the partnerships developed in this project.)

Semester Project Instructions

For your example project, complete the following:

1. Capture customer feedback concerning your project using the questions from Exhibit 15.2 or other questions of your choice.
2. Capture lessons learned from your project to date using the questions from Exhibit 15.2 or other questions of your choice. Show how you will use these lessons both to improve the remainder of your project and for the next project on which you may work. Organize the lessons into categories such as *PMBOK* knowledge areas, ideas from Exhibit 15.4, or your own ideas.
3. Create a transition plan so that the recipients of your project deliverables will be capable and enthusiastic users. Secure client acceptance of your project.

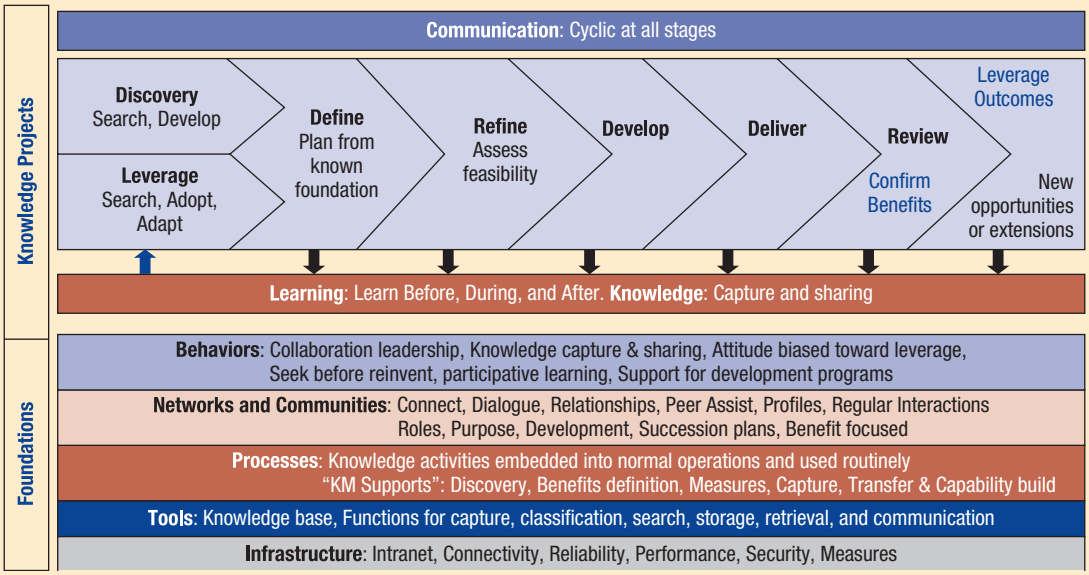
PROJECT MANAGEMENT *IN ACTION*

The Power of Lessons Learned

Projects are discrete. They have a beginning and an end, at which time the project team disbands and moves on to other things. Despite the fact there has inevitably been significant tacit learning during the project, there is often only a limited capture of this into a sharable form for future reuse. Too often, as the project team dissolves, the learning fades into the memories of individuals' minds. This makes it extremely difficult for others to benefit in the future from the insights learned. The usual excuses for this loss echoing through the corridors include "just too hard," "not enough time," "team disbanded before we had the chance," and many more. The key error here is the incorrect assumption that learning during or from projects is an "added bonus" or a "nice-to-have luxury." This is not the case in best practice environments.

Those fortunate enough to work on a well-led project will have observed how learning is just part of how we work together. Experienced and knowledgeable project leaders understand the value in capturing ***lessons learned***, as an embedded part of normal daily activities. They engage the team to deliberately harness knowledge and highlight lessons throughout the project to provide insights and enhance performance (during the project and beyond). The value of doing this greatly outweighs the costs of implementation when it is done well and there is a culture of trust and collaboration. This capture of learning at each stage builds the capabilities of those involved and can form a knowledge base to be used by the team or by others in future stages and future projects. In some cases, this knowledge base remains only in the heads of those involved because there is no attempt to capture it in explicit form. This is a mistake because it is difficult to transfer this knowledge beyond the immediate team (although it can be to some extent if there is a culture of storytelling and low staff turnover).

There are many barriers to developing an effective lessons-learned knowledge base, and culture is often



the primary villain. If people involved in the project are not reflective and not willing to invest a little time to capture and share their insights, the lessons are not captured. Equally, culture influences the motivation to look at what has been learned through the discovery process *before* the project starts.

Good projects start with more questions than answers:

Has this been done before?

Did it work? I so, why? If not, why?

What has changed since the last time? (Something that did not work before might now—*if* the context is different.)

If we did it the same, would it still work, or do we need to adapt it?

These questions can be effectively answered only *if* there is some access to what was learned previously and those seeking answers can find it in a convenient and trusted way. This is why talking to someone you know and trust, who was actually involved in the prior project, is always the preferred option. However, in modern organizations, this is becoming increasingly difficult to achieve because of challenges such as high use of contracted team members, high employee mobility, regular restructures, incomplete records in lessons-learned systems (which may be poorly designed), and the fast change of supporting technologies. So what other good options exist?

Some organizations (including NASA and the U.S. military) have developed quite sophisticated lessons-learned databases. These are usually supported by processes that require people to submit comments into the project systems that will help other people in the future. Over time, these *"what we know"*–based systems build a large volume of data that can be interrogated to provide relevant insights when you need them (hopefully proactively to avert a potential risk becoming an issue, rather than reactively when the issue has occurred). These systems work best when people make it part of their normal work activities to record *both* errors and their solutions as well as what went right and why. Insights of both types are essential to ongoing success. The danger of rigid processes and systems is that people do not see the value in recording something that they believe is for the benefit of unknown others in the future and will not help them (but costs them precious time). So they either just don't do it, or they record only very basic, nonspecific information that will not be particularly helpful for someone in a future context. Some organizations have a "stick" approach and link recording of quality lessons learned to performance reviews or project sign-offs. Others take a "carrot" approach and

reward those who record effective lessons learned as judged by other people who found and applied the lessons.

Another approach used by an international project management organization is to combine a content-based system (as described above) and an understanding of *"who knows what."* People seeking insights can ring a "service desk" with their questions and the (experienced) employee answering the phone discusses what it is they need to find out. The service person can be from a range of backgrounds, such as a librarian, a semiretired employee with a long history of the organization's projects, a specialist, or a nominated representative of an internal group such as a technical committee or community of practice. Sometimes these people will know the answer, but if they do not, they can find a person or document that can guide the seeker. This PM organization records all questions asked and the relevant resources that helped the seeker in a database that can be interrogated in the future. This hybrid of tacit and explicit knowledge was found to be highly effective for fast discovery of ideas. It enabled good ideas to be quickly applied elsewhere and helped to prevent reinvention of ideas already developed in other parts of the organization. It also enabled the discovery process at the beginning of projects to reduce repeating of errors from earlier experiences.

"*Successful people learn from Their mistakes AND the mistakes of OTHERS.*" —Sir John Templeton

Source: Arthur Shelley, http://www.organizationalzoo.com/about/arthur_shelley.

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