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William R. Peterson, *Editor*

Project Management

*A Common-Sense
Guide to the
PMBOK Program*

*Part Two: Plan and
Execution*

James W. Marion



MOMENTUM PRESS
ENGINEERING

PROJECT MANAGEMENT

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A COMMON-SENSE GUIDE TO THE PMBOK PROGRAM

PART TWO: PLAN AND EXECUTION

JAMES W. MARION



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Part Two: Plan and Execution*

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*Do it, stay on top of it, and finish it! A simple guide to developing,
executing and completing a project plan using the
PMI Project Management Framework*

ABSTRACT

Although the terms “plan” and “schedule” are at times used interchangeably, they are in fact very different. A complete project plan contains a project schedule—but it also includes much more than that (e.g., risk management, quality management, human resource management, and procurement). These differences have implications for the layman as well as the experienced project manager and have implications for successful project management practice. Additionally, the contents of the project plan have evolved over time as versions of the Project Management Body of Knowledge (PMBOK) were updated. Because of this, project plans today include important elements that were not included in project planning in the context of earlier versions of the PMBOK. Finally, the execution of the project plan requires guidance beyond that which is outlined in the PMBOK framework. The PMBOK emphasizes planning and monitoring and controlling—but very little support is provided for project executing. This begs the question, “just what does it mean to execute a project plan?” This guide clarifies the differences between plans and schedules, takes the project manager through the process of plan development, and finally points the way toward successful project execution.

KEYWORDS

PMBOK; project plan; project execution; project; process groups; knowledge areas

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PART I

UNDERSTANDING THE PROJECT PLAN IN THE SIXTH EDITION OF THE PROJECT MANAGEMENT BODY OF KNOWLEDGE (PMBOK®)

THE PROJECT PLAN—AND ITS EVOLUTION

Completing a project plan as described by the Project Management Institute is different today than it was 10 to 20 years ago. The processes associated with the development of a project plan have been updated over the years since the first PMBOK guide was published. Understanding how to develop a project plan today requires an understanding of the current PMBOK framework. This is a much easier task if the current guide is understood within the context of its evolution. In 2017, the Project Management Institute introduced the sixth edition of the Guide to the Project Management Body of Knowledge or *PMBOK*®. When encountering this process framework for the first time, the 49 different processes, including five process groups in 10 knowledge areas, will likely seem difficult to wade through and apply at first. However, if the rationale behind the framework as well as how the framework has evolved over time is better understood, developing a project plan using the PMBOK will likely make more sense. This is made especially clear when the current PMBOK is compared to the fourth edition launched 10 years ago. Examining the *PMBOK*® from the fourth through sixth edition will aid in understanding what the framework does, and why it does what it does as well as its underlying intent.

WHAT IS IT?

What is the project management framework anyway? It is a process-oriented series of guidelines for project managers. One of the reasons that the PMBOK framework is process oriented is that the management of projects occurs outside the normal ebb and flow of ongoing operations. It therefore requires policies, procedures, and processes to govern it. The fact that projects are different than ongoing operations becomes obvious when examining the framework beginning at the top left-hand corner of the framework (Table 1) at the intersection of the “Project Integration Knowledge Area” and the “Initiating Process Group.” Integration implies “summing up” or tying things together—and this is exactly what is done when the project charter is created. The project charter authorizes the project using formal documentation that advises all project team members (as well as all who have an interest in the outcome of the project) of the authority granted to the project team to carry out its mission. In an ongoing operation, the head of the department may verbally assign work to individuals or teams without a documented charter. The department and hierarchy of leadership are already authorized to do their ongoing work—so only in the project context is such authorization truly necessary. The project team once assigned may draw people from different functional groups and interact with different departments—and the charter enables this. This one simple example helps explain the need for a project management framework that governs the sequence of events from starting a project, planning it, carrying it out, finishing it, as well as listing the subject areas project managers need to know within these processes. The framework is not only useful—it is a necessity for planning and executing project work.

THE STARTING POINT FOR USING THE FRAMEWORK

The project charter example implicitly illustrates how to go about using the framework. Rather than thinking of it as “49 processes,” think in terms of the five process groups. Every project must be started, planned, carried out, followed-through, and finished. This commonsense series of steps for completing any type of work is captured in the five process groups that are labeled “Initiating, Planning, Executing, Monitoring and Controlling, and Closing.” The five process groups have not changed since the fourth edition of the PMBOK (Table 2). But, the processes that exist today in the sixth edition within each of the process groups have evolved considerably

Table 1. The sixth edition of the PMBOK

Knowledge Areas	Project Management Process Groups			
	Initiating Process group	Planning Process Group	Executing Process Group	Closing Process Group
Project Integration Management	Develop Project Charter	Develop Project Management Plan	Direct and Manage Project Work	Monitor and Control Project Work Perform Integrated Change Control
Project Scope Management		Plan Scope Management Collect Requirements Define Scope Create WBS		Validate Scope Control Scope
Project Schedule Management		Plan Schedule Management Define Activities Sequence Activities Estimate Activity Durations Develop Schedule		Control Schedule
Project Cost Management		Plan Cost Management Estimate Costs Determine Budget		Control Costs

(Continued)

Table 1. (Continued)

Knowledge Areas	Project Management Process Groups			
	Initiating Process group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group
Project Quality Management		Plan Quality Management	Manage Quality	Control Quality
Project Human Resource Management		Plan Resource Management Estimate Activity Resources	Acquire Resources Develop Team Manage Team	Control Resources
Project Communications Management		Plan Communications Management	Manage Communications	Monitor Communications
Project Risk Management		Plan Risk Management Identify Risks Perform Qualitative Risk Analysis Plan Risk Responses		Monitor Risks
Project Procurement Management		Plan Procurement Management	Conduct Procurements	Control Procurements
Project Stakeholder Management	Identify Stakeholders	Plan Stakeholder Engagement	Manage Stakeholder Engagement	Monitor Stakeholder Engagement

Table 2. The fourth edition of the PMBOK

Knowledge Areas	Process Groups			
	Initiating Process group	Planning Process Group	Executing Process Group	Closing Process Group
Project Integration Management	Develop Project Charter	Develop Project Management Plan	Direct and Manage Project Execution	Monitor and Control Project Work Perform Integrated Change Control
Project Scope Management		Collect Requirements Define Scope Create WBS		Verify Scope Control Scope
Project Time Management		Define Activities Sequence Activities Estimate Activity Resources Estimate Activity Durations Develop Schedule		Control Schedule
Project Cost Management		Estimate Costs Determine Budget		Control Costs

(Continued)

Table 2. (Continued)

Knowledge Areas	Process Groups			
	Initiating Process group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group
Project Quality Management		Plan Quality Management	Perform Quality Assurance	Perform Quality Control
Project Human Resource Management		Develop Human Resource Plan	Acquire Project Team Develop Project Team Manage Project Team	
Project Communications Management	Identify Stakeholders	Plan Communications Management	Distribute Information Manage Stakeholder Expectations	Report Performance
Project Risk Management		Plan Risk Management Identify Risks Perform Qualitative Risk Analysis Plan Risk Responses		Monitor and Control Risks
Project Procurement Management		Plan Procurements	Conduct Procurements	Administer Procurements Close Procurements

over 10 years. The process changes are found within the knowledge areas of the PMBOK. Knowledge areas are those specific skills, knowledge, or domain expertise that must be applied in the process groups to get the work of the project accomplished. While the process groups clarify the order of events or the steps in the process, the knowledge areas provide a content view—or what needs to be done at each step. The flow of PMBOK processes remains very similar when comparing PMBOK 5 and 6 (the current and previous edition of the framework), but as the PMBOK has evolved more direction is provided in knowledge areas and, in some cases, additional knowledge areas are given to support project activities. This is a consequence of the evolution of the field of project management over time. To fully understand the framework that exists today, it helps to understand what came before. The examination of the sixth edition therefore begins with understanding what changed between version four and version five—the predecessors of version 6—which is the current *PMBOK® Guide*.

WHY STUDY PREVIOUS VERSIONS OF THE PMBOK?

The fifth edition of the Guide to the Project Management Body of Knowledge is where a leap forward in terms of changes and increased structure is observed. What then changed between versions four and five of the PMBOK? There is a simple answer and then a complicated answer.

For the simple answer, there was an additional knowledge area added to the fifth edition (Table 3). Although the five process groups are exactly the same, the communications knowledge area was divided into two: one knowledge area for project communications management, and then one referred to as project stakeholder management.

Why were project communications and project stakeholder management separated? Originally communications and stakeholder management and engagement were considered to be closely related and therefore treated as a single aspect of managing a project. Because of the apparent similarity and the thinking at the time, the knowledge areas were therefore combined. However in the fifth edition of the PMBOK, it became evident from experience that communication is quite a bit different from the identification and in-depth engagement and management of stakeholders. Because of the complexity and level of effort required, it was determined that stakeholder management deserved its own sequence of processes to support the activity. It was therefore separated out from communications management for emphasis and attention to detail required in collaborating

Table 3. The fifth edition of the PMBOK

Knowledge Areas	Project Management Process Groups			
	Initiating Process group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group
Project Integration Management	Develop Project Charter	Develop Project Management Plan	Direct and Manage Project Work	Monitor and Control Project Work Perform Integrated Change Control
Project Scope Management		Collect Requirements Define Scope Create WBS		Verify Scope Control Scope
Project Time Management		Define Activities Sequence Activities Estimate Activity Resources Estimate Activity Durations Develop Schedule		Control Schedule
Project Cost Management		Estimate Costs Determine Budget		Control Costs
				Close Project or Phase

Project Quality Management	Plan Quality	Perform Quality Assurance	Perform Quality Control
Project Human Resource Management	Develop Human Resource Plan	Acquire Project Team Develop Project Team Manage Project Team	
Project Communications Management	Identify Stakeholders Plan Communications	Distribute Information Manage Stakeholder Expectations	Report Performance
Project Risk Management	Plan Risk Management Identify Risks Perform Qualitative Risk Analysis Plan Risk Responses		Monitor and Control Risks
Project Procurement Management	Plan Procurements	Conduct Procurements	Administer Procurements Close Procurements

with managing the stakeholders who are always a critical part of managing a project.

The addition of the stakeholder management knowledge area within the fifth edition of the PMBOK added five additional processes—bringing the total number of processes from 42 to 47. This number seems significant and not a simple matter for a project manager to keep up with. However, it is interesting to note that it is the planning process group where most project management processes—including many of the new processes—are found. It is within this process group where additional changes were made to the fifth edition. Approaching the understanding of the new processes in a step-by-step manner using the process groups as a guide can aid in making the framework more manageable and easier to digest.

CHANGES TO PLANNING IN PMBOK 5

“Plan first, then do” is a central principle with project management practice. Most knowledge areas from PMBOK 4 and earlier did focus on planning prior to doing. But—noticing in the planning process group in PMBOK 4 (Table 2), starting from the top with the project integration management knowledge area and moving from top to bottom—it can be observed that some knowledge areas begin with a plan, whereas others do not. For example, quality begins with plan quality, communications begins with plan communications, risk begins with plan risk management, however others do not. Scope, time, and cost—considered the most important aspects of managing a project since they relate to “How much?” and “When?” and “What?” is to be delivered—do not begin with a “plan” step. There is therefore an inconsistency observed in the planning process group with respect to several important knowledge areas. In the *PMBOK*® version five (Table 3), it can be noticed now that scope, time, cost, quality, human resources, communications, and risk begin with the development of a plan. What this suggests is that every process in project management is going to be approached in the same way. Project managers can therefore follow a rhythm of planning what is going to be done first before actually doing it. Once the plan for the activities is done, the project manager follows up to confirm its completion.

A PLAN FOR A PLAN?

Beginning each knowledge area with a plan begs the question, “The planning process group inherently involves plan—so what in addition needs to

be planned at the beginning of each knowledge area within the planning process group?” The rationale behind beginning with a plan in PMBOK 5 is that it is important for project manager to clearly think through and lay out the basic approach to managing each knowledge area. For example, scope, schedule, cost, quality, resource, communications, procurement, and stakeholder management each begin with a plan as outlined in Table 4.

In short, the PMBOK in version 5 now guides project managers to determine the basic approach or strategy to be taken as they carry out each of the knowledge areas found in the planning process group. To give an example, the direction “Plan scope management” does not infer the actual planning and managing scope—but rather how scope management will be approached. This is a strategy—or a “plan for a plan.” This encourages project managers to think before doing and avoid ad hoc actions and decision making. This process-focused approach to getting work done is a mark of mature, disciplined organizations.

As previously mentioned, the stakeholder management knowledge area was separated from communications management. With this change in knowledge areas, more process support and details on stakeholder management including management engagement and controlling stakeholder engagement are now found in the newly created stakeholder management group. These supporting processes go far beyond the communications knowledge area. For example, presenting reports, holding meetings, and carrying out other activities other than simple communication are needed to keep stakeholders involved in the project and supportive. The project

Table 4. Each knowledge area begins with a “plan”

Knowledge area	Planning process group initial activity
Project scope management	Plan scope management
Project time management	Plan schedule management
Project cost management	Plan cost management
Project quality management	Plan quality management
Project human resource management	Plan human resource management
Project communications management	Plan communications management
Project risk management	Plan risk management
Project procurement management	Plan procurement management
Project stakeholder management	Plan stakeholder management

stakeholder management knowledge area therefore illustrates the degree to which project teams collaborate with stakeholders in the course of carrying out the work of the project.

COMPLEX CHANGES IN PMBOK 5

There are additional and more complicated differences between *PMBOK*® four and *PMBOK*® five beyond planning processes and the addition of a single knowledge area. One of these differences is involved in determining how the project ensures that it is meeting the requirements of the customer. PMBOK 4 accomplishes this through the verification of scope. This means that the scope, or WHAT the project delivers, is checked against the project specifications. In verification, it is assumed that the project specifications for the customer deliverables are correct. Verification under this scheme is an indirect method of confirming that the project deliverables meet the requirements of the client. The fifth edition of the PMBOK uses scope validation instead of verification. What is the difference and why is this new term used? While verification is used to confirm that the deliverables meet the specifications, validation ensures that the specification itself is correct. This is a stronger form of confirming the project scope. To clarify the difference between the two terms, it could be argued that validation is equated to “doing the right things” whereas verification equates to “doing things right.” In PMBOK four the focus on scope was on verification, or “doing things right.” In *PMBOK*® five, it is proposed that validation or “doing the right thing” is more important in terms of process emphasis. Put another way, it does no good to simply focus on producing deliverables that match the specifications developed by the project. Instead, it is more important that the project specification matches what the client actually wanted in the first place. This is validation and it is found in the scope management knowledge area beginning with the fifth edition of the PMBOK.

CONSISTENCY IN PROCESS FLOW

The changes to the planning process group have consistency with other fields within operations management. For example Deming’s plan, do, check, act cycle is closely mirrored in the *PMBOK*® as initiate, plan, execute, control, close. The idea being expressed is to develop a consistent management rhythm and do the same things in the same way each time

Table 5. The Deming cycle and the process groups

Plan	Do	Check	Act
Initiate/plan	Execute	Control	Close

(Table 5). When processes are approached in the same way each time, the steps are not forgotten or left out. It is important in “the thick of battle” in the midst of a project when things get difficult to have a process flow that, to the project manager, may act as an “internal compass.”

THE DIKW MODEL

PMBOK® five provides a model for managing data produced by the project. Data that comes from managing work and collecting information on the progress of project work is used for analysis in project monitoring and control. How data becomes information and knowledge after the analysis of such data is described in the data model introduced in the fifth edition of the PMBOK. This model is known as the DIKW model, or data, information, knowledge, and wisdom model (Figure 1). This model illustrates that data becomes information when work is applied to it. Once the information is used and incorporated repeatedly in projects it becomes knowledge. Finally, the application and refinement of knowledge over time eventually becomes wisdom. This model sets the stage for managing knowledge within a project, capturing the data that the project produces,

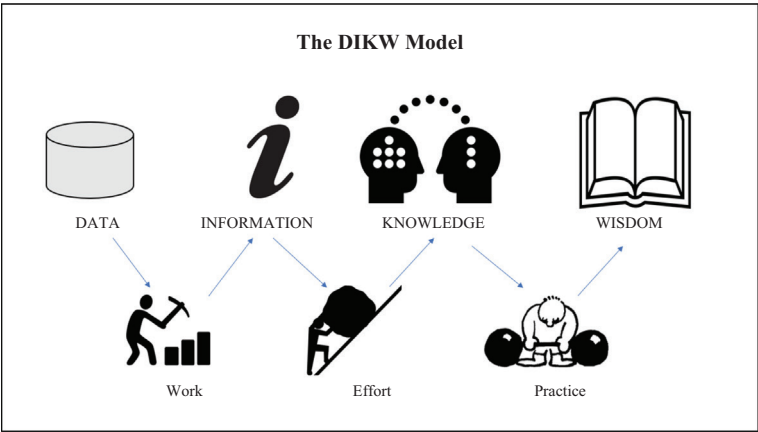


Figure 1. The DIKW model.

and then refining it, applying it in future projects, storing it, and retaining it. The introduction and clarification of the DIKW model led to the incorporation of knowledge management in the subsequent sixth version of the PMBOK.

PMBOK 6 AND THE PLANNING PROCESS GROUP

A simple count of processes within the PMBOK illustrates that the planning process group includes more processes than any other (Table 6). This is followed by monitoring and controlling, executing, and finally initiating and closing.

When *PMBOK*® five changed over to *PMBOK*® six in 2017, several changes were made to the planning process group. The changes included some change in nomenclature to more accurately reflect what was being managed. Instead of referring to “time,” the process group previously labeled as “Project Time Management” is now referred to as “Project Schedule Management.” This makes sense as, although time is certainly involved, what results from these activities within this knowledge area within the project planning process group is a schedule. Further, the estimation of activity resources process is moved from “Project Schedule Management” to “Project Resource Management.” Although resources and resource constraints impact a schedule, the activities of estimating and planning resources are a natural fit within the newly named “Project Resource Management” knowledge area. Why the change from “Human Resources” to “Resources”? Because resources used on a project do not have to be human resources. Resources could be machines, equipment, and even funding.

Table 6. Planning as the largest process group

Process Group	Processes	Percentage
Initiating	2	4.08%
Planning	24	48.98%
Executing	10	20.41%
Monitoring and Controlling	12	24.49%
Closing	1	2.04%
Total	49	100.00%

PMBOK 6 AND THE EXECUTING PROCESS GROUP

The executing process group in PMBOK 6 places formal emphasis on knowledge management. This is the first time that knowledge management has appeared within the PMBOK framework. Knowledge in the context of a project involves the retention of lessons learned in such a way that it is organized and made available for use in future projects. While lessons learned have appeared within earlier versions of the PMBOK, knowledge management infers a more active development and application of project lessons learned. Note that the DIKW model infers that work must be performed on data to create knowledge. The creation and management of knowledge developed suggested by the new “Manage Project Knowledge” processes assumes the transition of data through information and knowledge and uses the DIKW model as its foundation. Notably these are placed within the executing process group so that emphasis on lessons learned is placed throughout the project while the work of the project is getting done and problems are encountered and solved.

RISK AND QUALITY PROCESSES

The executing process group has also been expanded in the sixth edition of the PMBOK to include additional processes in risk, and quality. Quality is now managed in the executing process group. Quality management contrasts with “Perform Quality Assurance” as given in PMBOK 5. Managing the quality of project deliverables is now considered a more all-encompassing effort that goes beyond the more narrow focus on quality assurance alone. Finally, an additional process is added to the project risk management knowledge area within PMBOK 6. The previous PMBOK standard (version 5) emphasized risk identification, assessment, and the planning of risk responses. The sixth addition now includes the “Implement Risk Responses” process that supports escalating and managing risks that become issues. This process guidance for risks adds execution focus beyond the heavy emphasis on risk planning observed in both PMBOK 5 and 6. This is a bit of a “gray area” in risk management. Technically, when a risk is realized (i.e., occurs), then it is no longer a risk—but an issue. In spite of this technicality, the resulting issues linked to risks will naturally map to the risk response plans.

PMBOK 6 TOOLS AND TECHNIQUES SUMMARY

The sixth edition of the PMBOK includes a comprehensive listing of tools and techniques that are mapped to each of the knowledge areas. This mapping of 132 tools and techniques is illustrated in a series of tables located in Appendix X6 of the sixth edition of the PMBOK. This reference tool allows project managers to see at a glance the tools and processes associated with each knowledge area. Project managers are advised to bookmark this comprehensive reference when dealing with challenging situations in which unique approaches may be required. Further, this final toolset summary can act as an index to save time in locating the right tool or process when needed. Project teams, even after significant exposure to the PMBOK framework through training and application, can still at times become a bit overwhelmed by project events. When in doubt and need some immediate project advice, jump to Appendix X6.

PMBOK 6 AND AGILE

PMBOK® six emphasizes agile methodologies throughout. The sixth edition combines both project management and agile guidance within a single publication. The reason for this is that agile is becoming increasingly utilized throughout industry. The idea behind agile is to produce tangible deliverables quickly that the customers can evaluate, and break larger projects into smaller pieces, so that the larger project deliverables may be built up using an iterative sequence of smaller deliverable sub-projects or “sprints.” Agile is therefore focused on simplifying processes, moving quickly to produce tangible outcomes, and breaking larger projects into smaller pieces. This methodology is become more widely used beyond its origins in software development. Agile methods are incorporated throughout PMBOK six to give better visibility to project managers that this is an important way that projects are being managed today. Finally, it bears remembering that the process groups may be applied not only to the overall project but also to project sub-deliverables and any complex deliverables. The process groups may be used iteratively and therefore fit well with the agile methodology.

PART II

FROM PROJECT SCHEDULE TO PROJECT PLAN

INTEGRATION, THE PLAN, AND THE PROJECT MANAGER

The very first knowledge area in the Guide to the Project Management Body of Knowledge (PMBOK) framework is the integration knowledge area. The term “integration” implies “summing up” or “tying things together.” This is exactly what a project manager does. The project manager creates a holistic picture of the work that needs to be done and communicates this to project stakeholders via the development of a comprehensive project plan. As observed in the first volume of this book series, the plan begins with the project charter (Figure 2). The charter is placed within the integration knowledge area as it provides the authority

Simple Project Charter											
Project Name:											
Date:											
Project Manager Signature: _____											
Project Sponsor Signature: _____											
Project Purpose & Description:	<table border="1"><thead><tr><th>Project Role</th><th>Team Members</th></tr><tr><th>Position</th><th>Name</th></tr></thead><tbody><tr><td>...</td><td>...</td></tr><tr><td>...</td><td>...</td></tr><tr><td>...</td><td>...</td></tr></tbody></table>	Project Role	Team Members	Position	Name
Project Role	Team Members										
Position	Name										
...	...										
...	...										
...	...										
Key Milestones:											
High-Level Budget:											
Constraints:											

Figure 2. Simple project charter.

to the project to do work, acquire resources, and spend money—but more importantly it communicates this authorization to stakeholders. When stakeholders are aware that such authority has been provided, the project charter becomes a hub that links together the resources and support from internal and external stakeholders.

INTEGRATION AS “TYING TOGETHER”

While there is no doubt that the bringing together of all elements of the project creates an integration of the pieces of the project, the PMBOK framework itself may make this difficult to perceive at first glance. This is because the PMBOK itself has so many different “pieces”—5 process groups, 10 knowledge areas, and 49 processes. When making the transition from the project schedule—the project scope, schedule, and cost—to the complete project plan (all remaining knowledge areas), it pays to keep in mind that the overall project plan as identified in the integration knowledge area is an “umbrella” plan that consists of all the sub-plans necessary to develop and execute a complete project. Prior to getting lost in the details of the PMBOK processes, consider that a key role of project manager is one of integration. Beginning with the project schedule as the foundation or bedrock of the project, the next step in integrating the project “big picture” is to layer each of the additional subcomponents of the plan onto the project schedule (i.e., scope, schedule, cost) by proceeding through each of the knowledge areas one by one. At the end of development of the project plan, the project team will have at its disposal a “layer cake” of sorts with the essential supporting project sub-plans layered on top and integrated with the project schedule (Figure 3).

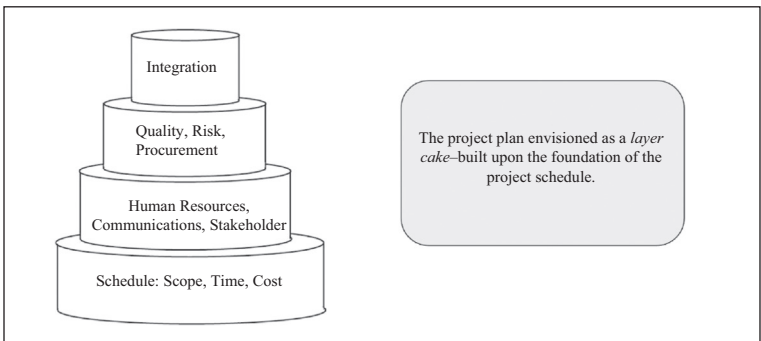


Figure 3. The project plan “layer cake.”

QUALITY MANAGEMENT: THE FIRST STEP BEYOND SCOPE, SCHEDULE, AND BUDGET

Project quality management is the knowledge area that follows the integration activity of the project charter, and the planning activities that include the development of the project scope, schedule, and budget. Project quality is closely linked to project scope. This is because a clearly defined project scope will articulate the specific performance levels of the project deliverables—and performance is one attribute of quality. There are, however, many facets to managing quality within projects that go beyond the focus on the performance of project deliverables. Further, the significant differences between managing quality in the temporary environment of a project versus the continuous environment of an ongoing operation require that project managers think carefully about how to approach the development of a quality management plan.

PROJECT QUALITY IN THE PMBOK

An inspection of the project quality management knowledge area within the Project Management Body of Knowledge suggests the presence of influence from the foundational thought leaders within quality management. For example, strong emphasis is given within this knowledge area to the “Seven tools of quality management” as pioneered and promoted by figures such as Deming, Juran, Crosby, and Kaoru Ishikawa (Figure 4). The history of quality management reveals that this important toolset has its origins in high-volume manufacturing.

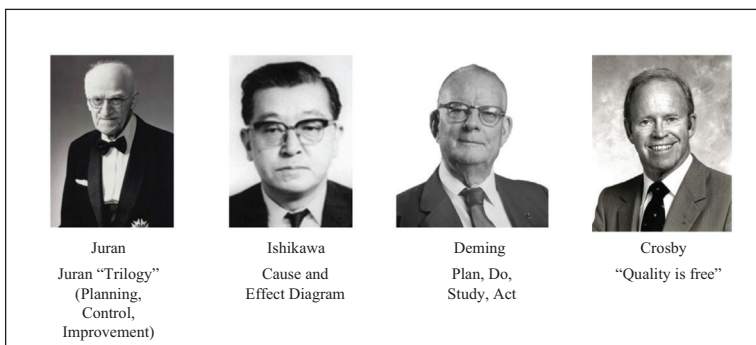


Figure 4. Quality management thought leaders.

When project managers consider how to apply these tools within a project, it is observed that the project context is quite a different environment from the ongoing operation. Given that projects are unique, complex, and temporary, rather than ongoing—and governed by process control associated with long runs of data—the application of traditional quality management techniques within the context of a project may be challenging.

QUALITY MANAGEMENT IN PROJECTS

The underlying principle in the management of quality is to manage the system (i.e., control the process) rather than the product. It is said that, if the system is under control, the product (output of the process) will be of good quality. It is upon this underlying principle that statistical process control in quality management has evolved. This idea of managing a process with upper and lower control limits over the long run however is difficult to apply within an environment that has no “long run.” According to the definition, a project is a temporary endeavor that produces unique deliverables. This begs the question, “What process (or processes) within the context of project management should be controlled to produce quality deliverables?” Further, the fact that projects are temporary and unique and often produce singular deliverables such as systems, or construction artifacts such as homes and buildings, would appear to question the degree to which many of the traditional quality management systems even apply within the project management context. It may also be observed that the role of projects that develop products for mass production is to produce a prototype design for which the manufacturing operation produces thousands and perhaps millions of copies. The significant difference between these roles would naturally suggest that some differences in the approach to quality management are warranted. This has significant implications to the development of the project quality plan including what processes should be applied as well as what project quality management tools should be employed. An inspection of the Guide to the Project Management Body of Knowledge or PMBOK reveals two major categories of project quality tools. These tools are the same tools employed in operations management and are therefore borrowed from the context of the ongoing operation and suggested to be applied within the project context. The first set of tools is outlined in the planning of project quality management. The second toolset is provided for use within the context of performing project quality assurance.

PLAN QUALITY MANAGEMENT TOOLS

According to the PMBOK, the plan quality management processes are used to support the development of project requirements and standards used to guide the development of the project deliverables. This set of processes also outlines how the project will comply with such requirements by planning the overall strategy that the project team will use to manage quality. The tools and techniques used to do this include the PMBOK version of the “Seven Quality Control Tools.” The project manager uses these tools for solving quality problems within the project. In the plan quality management group, the project manager would determine which of these tools would be applied in managing project quality through each of the project process groups. Project teams are advised to carefully consider which of these seven tools are appropriate to use for each phase of the project as many of the tools have more apparent applicability to ongoing operations rather than temporary project activity.

THE SEVEN TOOLS FOUND IN THE PMBOK

The Cause and Effect Diagram: This diagram pioneered by Ishikawa is a generic tool that could be used in virtually any setting. It is particularly appropriate for simplifying troubleshooting and problem solving. The project environment is known to face time constraints. Troubleshooting problems with deliverables and interim deliverables are likely to be a significant component of achieving the goals of the project. The cause and effect diagram therefore appears to be a tool that fits well within the project environment. Cause and effect analysis is also useful within the ongoing operation. In addition to its use in problem solving, it is of interest however to consider how this tool might be used in the context of project quality planning. Ultimately, project deliverables could be viewed as an exercise in meeting needs or solving specific problems faced by the client. The cause and effect diagram could therefore aid in visualizing the client problem or need so that planned project deliverables adequately address them.

Flowchart: Projects are often complex. It is not easy to readily understand how the inputs to the project fit together to ultimately become deliverables. Further, the process for completing deliverables may not be well understood. Given the time constraints under which a project operates, a flowchart would likely be useful in providing a guide for understanding the systems under construction as well as the processes used to deliver

them. The flowchart therefore could play a role in project planning—as is the case in its use within ongoing operations. The flowchart could also be used to document or clarify the behavior of the underlying project deliverables. The flowchart therefore is consistent with troubleshooting and correcting problems and with mapping out processes associated with the creating of project deliverables as well. Is the flowchart a quality planning tool, or is it more related to project execution? The versatility of the flowchart indicates that it is both.

Checksheets: Projects are often organized according to a series of life-cycle phases. Project lifecycle governance therefore typically proceeds to manage projects on a phase-by-phase basis. The checklist plays the role of ensuring that all targeted goals for each phase are completed. Further, the checksheet provides a means for confirming that the project deliverables satisfy the project specifications. Also, the checklist could be used to confirm that the specifications for the project deliverables are consistent with the original requirements as communicated by the client. A successfully completed checksheet could be used as evidence that the project has met the exit criteria for a given project lifecycle phase. Although checklists are routinely applied in operations, the checksheet tool does not assume a perpetual ongoing process or activity. This makes the checksheet a good fit for use in managing project quality to the degree that project quality is associated with the confirmation of the achievement and validation of requirements.

Pareto Diagrams: Pareto diagrams, emphasized by Juran, focus the attention of the manager on those issues that are creating the most problems. The general principle of the “80/20” rule would likely be applicable to any management context regardless of whether it was permanent or temporary. The Pareto chart, however, does tend to have more impact when there are volumes of issues to deal with. In highly complex projects, or in software-intensive projects where defects are analyzed and prioritized, the Pareto chart may be a good fit. However, the long-run application of the Pareto such as in the case of a manufacturing or service setting and its associated data volumes appears to be generally more applicable to an ongoing operation rather than a project. It is in the context of ongoing operations that the use of the Pareto chart in quality management originated. For this reason, the project team will need to consider if the Pareto analysis tool belongs in the project plan.

Histograms: The histogram aids the manager in seeing patterns in data—typically large volumes of data. Because the usefulness of the histogram increases with the volume of data under analysis, the histogram

would appear to be very useful for data collected as the result of long-running ongoing operations rather than short-term projects. However, the histogram may have a place in project management whenever significant data points may be generated over a short period of time. Such circumstances include software defect analysis and data collection from highly complex systems. The histogram therefore also appears to be moderately applicable to the project management context. As in the case of the Pareto chart, the histogram may or may not be applicable for inclusion in the project plan.

Control Charts: Control charts, as advocated by Shewhart, are the foundation of statistical process control. The control chart samples data over the long run in order to determine if the overall system is in control. A system is said to be out of control if successive long-run data points skew in a particular direction and exceed a given control limit. Given the temporary nature of project management, long-run data is rarely available. The control chart would therefore appear to be highly applicable to a high-volume manufacturing setting rather than within the project management context. High-volume manufacturing is said to be the birthplace of the control chart so it follows that the control chart would appear to be out of place within project management—particularly with respect to the planning of quality management. On the other hand, the use of the control chart may well depend upon what process is being controlled. If the process under control is the overall project life cycle, then control charts may be useful in tracking project progress. An example of this is using control charts to monitor earned value indexes so that action is triggered should the project appear to be drifting out of control. Again, the decision to use control charts in this manner is made when creating the project quality management plan.

Scatter Diagrams: The scatter diagram assists managers in seeing relationships between different variables represented by collected data. Like the Pareto chart and the histogram, the scatter diagram would appear to be a tool that is a better fit within a context where a large amount of data was collected. An ongoing operation such as manufacturing, or a project that produces software-intensive or otherwise complex deliverables that involve detailed testing, analysis, and troubleshooting, might implement this tool. The scatter diagram would therefore appear to be only moderately applicable to the project management environment. Its place in the project quality plan would depend upon the nature of the project and the amount of data that the project would reasonably be expected to produce.

QUALITY TOOL APPLICABILITY SUMMARY

The purpose of each of the seven quality tools presented in the PMBOK planning quality as well as their applicability to the project management context is provided in Table 7. Each tool is categorized as “High,” “Low,” or “Moderate” applicability to project management based on the degree to which it is useful within the context of a short-term endeavor versus an ongoing operation. A summary table outlining quality management tools may be used to stimulate project team discussion and brainstorming regarding which tools would be employed in managing quality throughout the project life cycle.

Table 7. PMBOK quality planning tools

Tool	Purpose	Applicability to PM	Applicability to OM
Cause and effect	Troubleshooting	High	High
Flowchart	Analysis	High	High
Checksheet	Audit	High	High
Pareto chart	Analysis	Moderate	High
Histogram	Analysis	Moderate	High
Control chart	Process control	Low	High
Scatter diagram	Analysis	Moderate	High

PERFORM QUALITY ASSURANCE TOOLS IN THE PMBOK

Quality assurance in project management puts in place systems that are designed to produce the desired level of quality in a project. In project management, such systems are audited to ensure that the correct standards are being used. The PMBOK suggests that the tools used in project quality planning may also be used in quality assurance. PMBOK 6 emphasizes quality management rather than quality assurance. However, the plan for managing quality is intended to establish the basic approach or system for managing quality. It is the system in the quality plan that assures quality in the project.

Seven additional quality management tools are also identified in the PMBOK as follows:

The Affinity Diagram: A structured method of brainstorming that groups together similar ideas. Given that projects are led by project teams, and such teams are tasked with producing solutions constrained by schedule, budget, and cost, the affinity diagram would appear to be a very useful tool. It is conceivable that this tool could be employed by the project team in putting together the overall quality plan.

The PDPC (Process Decision Program Chart): This tool is a technique for identifying the source of potential problems in a system. In the planning phase of the project, the PDPC tool appears to be ideal for managing risks and safeguarding against potential defects in deliverables. In these respects, the tools appear to be useful in developing a quality management strategy. Further, this tool could also likely be employed in risk management planning. The PDPC would appear to be more applicable to quality planning rather than quality assurance. However, the plan once developed does become the management system that assures quality.

The Interrelationship Diagram: A method of analysis that identifies the relationships between components in a system. Projects often develop and deliver complex systems. Systems are best understood when the relationships between the components are made clear. The interrelationship diagram serves this purpose. This tool appears to be a natural fit for the project quality assurance context. This tool could be employed directly in the quality management plan to illustrate the quality management processes to be used and upon what deliverables and activities the processes will interact.

Tree Diagrams: An analysis tool that breaks down a high-level goal, problem, system, or process for use in detailed analysis. The tree diagram decomposes problems in much the same way that the project work breakdown structure decomposes deliverables. Decomposition of larger goals or problems so that they may be acted upon is essential in the management of projects. The tree diagram therefore appears to fit the context of project management and would appear to be a good fit within the project quality plan.

Prioritization Matrices: The prioritization matrix is a weighted matrix used as a decision-making tool. Project execution is said to involve extensive decision making as well as information processing. The development of quality deliverables therefore involves decisions of priority. The prioritization matrix would appear to aid in such project decision making—perhaps even more so than in the context of operations management.

Network Diagrams: The network diagram is a tool for mapping out activities into a logical sequence. The network diagram is an inherent part of developing a schedule. It is a tool in which project managers will already

be familiar. The network diagram would appear to be a natural choice for analyzing sequence and flow of events, activities, or deliverables for the purposes of assuring quality. Network diagrams and the associated critical path method are also cited as being useful for the context of mapping out the process flow for ongoing operations. However, this application is a secondary use for this tool.

Matrix Diagrams: The matrix diagram is an analysis tool for illustrating relationships between groups. The matrix diagram is commonly used to capture and trace project requirements. This tool is therefore useful in assuring that the deliverables required by the client are the ones that are actually produced. Such a tool is likely to be applied regularly within the context of project quality management as meeting the client requirements is an essential element of managing project quality.

QUALITY ASSURANCE TOOL SUMMARY

The additional tools provided for project quality assurance within the PMBOK are outlined in Table 2. Once again, each tool is categorized as “High,” “Low,” or “Moderate” applicability to project management based on the degree to which it is useful within the context of a short-term endeavor versus an ongoing operation (Table 8). Further, the choice of tools employed in the quality management plan is tailored according to the context of the project.

Table 8. Additional PMBOK quality planning tools

Tool	Purpose	Applicability to PM	Applicability to OM
Affinity diagram	Brainstorming	High	Moderate
PDPC	Planning	High	High
Interrelation-ship graph	Analysis	High	High
Tree diagrams	Analysis	High	High
Prioritization matrices	Decision making	High	High
Network diagrams	Analysis	High	Moderate
Matrix diagrams	Analysis	High	High

HOW DO PROJECT MANAGERS MANAGE QUALITY?

Where does the limited applicability of some project quality management toolsets mean for project managers? If project quality is generally defined as meeting the requirements of the client, and projects are considered successful when they meet such requirements, then it could be said that project quality must be a primary goal for all project managers. It seems reasonable then that the overall project quality and assurance plan should emphasize the control of a process (or processes) that results in met requirements and satisfied clients. Project quality planning therefore involves deciding upon what standards need to be met to satisfy the client as well as how the project will assure that such standards are met. This is fundamentally an exercise in requirements collection and implementation.

PROJECT MANAGEMENT AS PROBLEM SOLVING

The client holds a central position within and throughout the project as an ongoing source of requirements information and progress confirmation. A project therefore could be viewed as the development of a solution to a problem that is delivered to the client as an output of a process in which the client participates. The process of developing requirements is that of requirements elicitation and vetting. Once the solution is delivered, the project is said to be successful to the degree that the requirements were met or, in other words, to the degree that the problem was solved. Viewing project management as a problem-solving process would appear to allow for the use of additional toolset for planning and assuring project quality. Such tools could be included in the project quality management plan.

PROBLEM-SOLVING PROCESS

The field of problem solving acknowledges that a structured process is essential for identifying the right problem, implementing a solution, and then following through to confirm that the solution is successful. The project life cycle proposed by the Project Management Institute is offered as a means of governing the overall project management process so that the delivery of correct solution is assured. As such, the project management life cycle itself may be viewed through the lens of problem-solving

process. The Project Management Institute (PMI) life cycle includes the following steps:

- 1. Requirements: What does the client need?
- 2. Feasibility: Can we do it?
- 3. Planning: Who, how, and when will we do it?
- 4. Design: Creating the solution
- 5. Construct: Building the solution
- 6. Test: Verifying and validating the solution
- 7. Turnover: Delivering the solution

The project lifecycle process flow appears by inspection to have much in common with quality processes such as DMAIC (define, measure, analyze, improve, control), PDCA (plan, do, check, act), and the PMBOK IPECC (initiate, plan, execute, control, close) sequence. The emphasis of each is on determining the requirements and the feasibility before taking action to implement, course-correct, or improve. The comparison of processes is given as follows in Table 9.

Table 9. Quality and the project life cycle

Project life cycle and problem-solving process flow comparison						
Require- ments	Feasibility	Planning	Design	Construct	Test	Turnover
Define	Measure	Analyze	Improve		Control	
		Plan	Do	Do	Check	Act
Initiate		Plan				

PLANNING QUALITY MANAGEMENT IN PROJECTS

The PMBOK defines the planning of quality management as:

The process of identifying quality requirements and/or standards for the project and its deliverables and documenting how the project will demonstrate compliance with quality requirements and/or standards. (Project Management Institute 2017)¹

¹ Project Management Institute. (2017). *A guide to the project management body of knowledge (PMBOK guide), Sixth Edition*. Newtown Square, Pa: Project Management Institute.

Given that the project life cycle includes steps for identifying requirements as well as implementation plans including design, construction, and testing, it is apparent that project quality planning is linked to the selection and implementation of the project lifecycle process. It is the lifecycle process that ensures that quality requirements and standards are identified and complied with. The central role of the project life cycle in quality management is an important concept that should be captured in project quality plan.

PERFORMING QUALITY ASSURANCE IN PROJECTS

The PMBOK defines quality assurance as:

The process of auditing the quality requirements and the results from quality control measurements to ensure that appropriate quality standards and operational definitions are used. (Project Management Institute 2017)

The PMBOK defines quality in terms of “inherent characteristics” and “fulfilling requirements.” It is interesting to note that the project life cycle and its associated process framework is the process used to produce quality deliverables. It is therefore reasonable to assume that quality assurance is an activity performed and managed within the project lifecycle process. What then within the life cycle could be audited so that quality is assured? Since the project life cycle is the process that ensures quality, then it is essential that each phase of the process be carried out completely. The audit function therefore would be performed at the entrance and exit of each project lifecycle phase. This type of audit function is outlined in stage-gate models of product or system development. The challenge of achieving quality in a project is successfully completing all lifecycle phase entrance and exit criteria. Characteristic of the auditing function, complete assurance of quality requires an objective, neutral observer that is able to judge and make “Go/No-Go” decisions for each phase to ensure the integrity of each gate. Project lifecycle governance models such as the Product and Lifecycle Excellence (PACE) process as championed by the Product Development Management Association (PDMA) in fact propose that a committee of management act as a product approval committee or PAC to carry out this function. The additional quality management tools provided by the PMBOK for project quality assurance do not appear to play a significant role in this important lifecycle audit and decision-making

function. However, such tools could conceivably aid in solving problems that prevent successful phase completion. The passing of quality audits and quality reviews employed as project phase exit criteria is an example of quality assurance measures that could be included in the project quality plan.

COMPLETING THE QUALITY PLAN

Given the variety of tools and approaches to managing quality within the context of the project, project teams may face uncertainty regarding how to proceed to develop a quality management plan. The PMBOK “Plan Quality Management” process focuses the project team on thinking through and documenting the overall strategy for managing the quality of the project deliverables. The quality plan will outline functions such as collecting and vetting client requirements. Further, the quality plan will explain how the project team will ensure that the deliverables produced not only meet documented specifications but as well match the requirements communicated by the client. The quality plan will also document the quality management processes that will be employed as well as the tools and techniques that will be applied. What is most important is that the quality plan be documented, that what is executed within the project follows the quality plan, and finally that the plan is tailored for the project environment and for the specific nature of the project deliverables. Finally, it bears remembering the dictum that “quality is free.” The implication of this statement is that the cost of quality management is small compared to the cost of repairing and addressing problems with deliverables after launch when they are in the field and being used by the client. Since quality is related to performance, quality could be said to increase scope as well as project effort. However, project managers are encouraged to consider the overall lifecycle costs to observe the balancing out of resulting quality costs.

THE ELEMENTS OF THE QUALITY PLAN

What elements should be included in the quality plan? In much the same way as a quality plan for an ongoing operation, the quality plan for a project should answer the following questions:

1. Who are the key players in project quality management?
2. What are the roles and responsibilities of the key players?

3. What is the overall strategy or approach for managing quality in this specific project?
4. What lifecycle methodology will be employed and how will it be linked to project quality?
5. How will both quality assurance and quality control be incorporated into the project?
6. What quality management tools will be employed in managing project quality?
7. How will quality process improvements from previous projects be incorporated into this project?

A PLAN IS NOT A PLAN UNTIL....

There is an old saying that “a plan is not a plan until it is fully resourced.” The reason for this is simple: Resources are scarce. However, when a project schedule is developed, resources are often not initially considered. The developer of the project schedule at first considers only the activities that must be completed to produce the project deliverables as well as the logical sequence of events. The implicit assumption in building the schedule is that infinite resources exist and, because of this, it is assumed that the activities outlined in the project schedule may be executed in the desired sequence and timeframe. The addition of resources to the project schedule adds a level of realism to the project. As resources are added to the schedule, it becomes clear that some activities rely on the same resources at the same time. For example, there may be two different pieces of software that need to be developed at the same time—and the specific know-how required to do this is available only in a single individual. Since no resource—be it human resources or equipment—can be in two places at once, something must give. That “something” is the schedule as previously proposed completion dates are pushed out and delayed due to resource constraints.

PLANNING RESOURCES—WHAT DO I NEED?

The most obvious initial question to consider when planning resources is “What resource do I need to complete a given activity?” In many cases, the resource is an individual who has a unique skill set. A system design activity within a project may, for example, require an individual who is highly experienced in system development, has systems engineering skills, or has experience in working in different technical domains. Not

every available resource will have this skill. If multiple activities require this skill, then the project team will need to acquire more of this resource, outsource some (or all) of the activity, or delay the activity (or set of activities) so that the activity utilizes no more resources than that which are available to the project. It should be noted that resources are not always people. The term “resource” is a broad category that includes equipment, services, funding—or anything associated with project task completion. As an example, a project activity may require specific test or diagnostic equipment. This type of resource must be identified and planned for in the same way as a human resource. Version 6 of the PMBOK explicitly acknowledges this by renaming the Project Human Resource knowledge area to the Project Resource knowledge area. This updated knowledge area includes guidance for planning and executing projects from the perspective of all categories of project resources. Determining what resources are needed is therefore an analytical exercise that focuses on the unique skills or capabilities required to complete project activities.

PLANNING RESOURCES—HOW MANY DO I NEED?

At first glance, the question of how many resources are needed for a given activity is deceptively simple. To begin with, there is a clear relationship between the number of resources applied and the time it takes to get the job done. Consider for example a lawnmowing project. Assigning two people (and two lawnmowers) to mow a yard will generally take less time than if only a single resource is used. However, the possibility exists for resources to “get in the way” of each other and cause management challenges (Figure 5). In the lawnmowing example, an addition of a single resource may well reduce the time by 50 percent. However, if

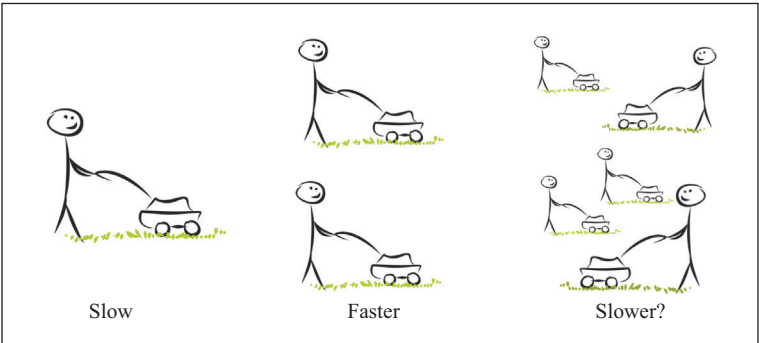


Figure 5. Lawnmowing and adding resources.

10 resources are added, the activity may well take longer than what one might think. This is because time will be needed to coordinate the overall mowing activity so that no mower will mow the same patch twice nor approach too close to another mower. Real projects however rarely involve mowing lawns. More commonly, projects today involve complex systems and are software intensive. Producing deliverables for such projects requires, in addition to scarce skills, significant learning of the system under development and the development environment, tools, and processes and procedures.

The need for resources to learn or become integrated into the project infers that any resource added to a project cannot be expected to produce results immediately. In fact, given that existing project team members and managers may need to be assigned to bring the new resource “up to speed,” productivity in the project may well drop in the period immediately following the addition of the resource. Also, as in the case of the “lawnmowing” example, even if it is assumed that additional resources added to the project are fully knowledgeable and may begin contributing to the development of deliverables immediately, the management and coordination effort may effectively limit the immediate output. In the case of nonhuman resources such as test equipment, development tools, or machines, programming or setup (rather than learning) may be required. Increasing the output of deliverables by adding machines, tools, or workstations therefore may not immediately nor ever produce the desired result. Further, the later in the project that the resources are added, the more that the resource needs to learn and the more time required to be effective. There may not be such time remaining as the project approaches completion. This is one reason why there is rarely a direct correspondence between additional resources and output. The determination of how many resources are needed to complete given activities ultimately depends upon many factors involving answering questions such as:

- (a) What is the target duration of the activity being resourced?
- (b) How many resources would be required to complete the activity within the target duration?
- (c) Is there a realistic, executable plan for dividing up the work so that it may be completed with the number of assigned resources?
- (d) Is the number of assigned resources manageable?
- (e) Does the complexity of the work associated with the deliverables lend itself completion by multiple resources?
- (f) Will resources assigned to the project be able to produce deliverables immediately? Or, will delays associated with learning and familiarity with systems and tools be expected?

- (g) Does the project activity require nonhuman resources that will need setup, programming, or other time-consuming preparation?

PEAK RESOURCES

It is reasonable to conclude that project task completion is constrained not only by the available resources, but also by the complexity of the work itself and the management burden of managing the assigned resources. These are not the only constraints. Once resources are assigned to all project activities, it is important for the project team to step back, “look at the big picture,” and acquire an overall understanding of the peak project resource requirements (Figure 6). This is because it is advantageous from both a cost and management perspective to minimize the peak number of resources required. A lower peak resource level translates to fewer people and equipment that need to be acquired and kept “on the books” adding cost to the project.

Although a lower level of peak resources is desirable, it is given that resources are linked to tasks that need to be completed to produce project deliverables. How then are peak resource requirements minimized? Recall that the process of producing the project schedule identifies activities that include “slack” or “float.” Activities that have slack are not on the schedule critical path but instead are in parallel with activities on the critical path. Such activities may be delayed by the amount of slack associated with the schedule duration. The slack in each noncritical path activity may be used to reduce the overall level of peak resources. If an activity is delayed

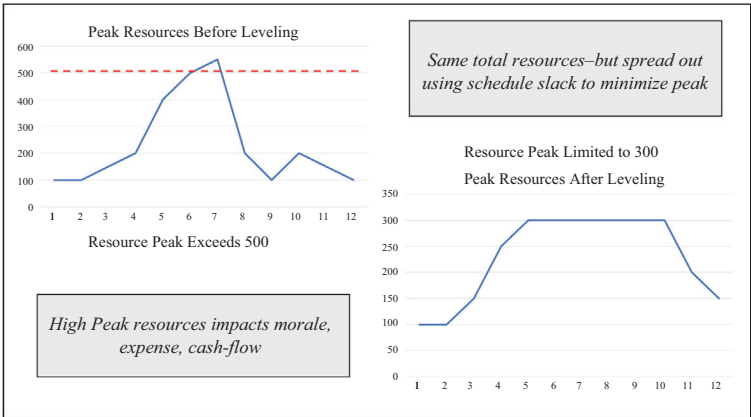


Figure 6. Reducing peak resources.

by its associated amount of slack, then resources may be applied to this activity late rather than immediately following a predecessor activity. This delay in activities with slack pushes out the associated resource requirements and contributes to lowering the overall peak resource requirement. The decision for the project team therefore involves balancing and trading-off the peak resource demand with the overall duration of the project. Additionally, it is important to recognize that utilizing slack to maneuver around resource constraints leads to a project that includes little to no slack. A project with no slack means that all paths in the project are critical and that a delay in any activity will lead to a delay in the overall project. Reducing peak resources using slack may well involve trading budget and resource risk for schedule risk.

RESOURCE LEVELING

Available slack in project activities is used not only for minimizing peak resource requirements, but as well for smoothing out or leveling project resources. When project resources are leveled, each resource assigned to complete project activities is utilized in a balanced manner. This means that resources are applied evenly rather than assigned to tasks in an “on-again, off-again” manner. Using an example of human resources who are assigned to complete project activities, it is understood that it would be poor practice to assign an individual 60 hours of work one week, followed by 10 hours in the following week, followed by another 60-hour week. This uneven scheduling is not ideal for many reasons. First, the morale of any employee who faces a week of significant overtime followed by relative inactivity is likely to be negatively impacted. Further, the employee assigned in such a manner may be forced to start work, then stop and do something else, and then start again. This form of multi-tasking and its associated multiple start-up and ramp-down sequences is likely to reduce productivity. Similar observations may be made regarding the use of machines and equipment to conduct project work. The productivity of capital equipment employed within a project is maximized under conditions of high utilization. Idle equipment incurs cost without producing output. Further, equipment that is used, set aside, and used again wastes time. Leveling resources—whether human or otherwise—serves to minimize waste and maximize productivity of project resources that would otherwise be due to human factors such as morale, or through the natural waste associated with stopping and starting work activities. Once again, resource leveling is carried out primarily by shifting activities

based upon the available slack in the project. Resource assignment may be more balanced when resources are leveled, but balance comes at the expense of schedule risk due to the limited amount of slack remaining after resource-leveling adjustments. An alternative to using up project slack is to simply push out activities and thereby delay the schedule. Neither of these solutions are ideal, so the project team must balance morale and productivity, schedule management risk, and schedule delay.

PLANNING RESOURCES—WHERE DO I ACQUIRE THEM?

The project charter authorizes the project team to acquire resources. This is necessary because the project team operates outside the ongoing functional operation. While the functional organizational structure is managed and governed by budgets and long-term goals, project teams are created and disbanded according to the need to produce specific deliverables. The project team effectively “borrows” resources from the organization and then returns them once the work of the project is done. Exactly how this works within an organization depends upon the type of organization that is in place. In some organizations the project is highly structured and in others the resources are acquired in a less formal basis. Regardless of the maturity of the resource acquisition process, the identification of required skill sets as well as the selection of project resources typically involves negotiation between the project manager and the functional manager.

FUNCTIONAL ORGANIZATIONS

Traditionally, organizations have used a hierarchical and functional structure to organize and direct the various disciplines employed within the company. Using the principle of the division of labor, resources associated with each discipline are grouped together. This allows individuals trained in each discipline to work together with others who have the same training and carry out similar job functions (Figure 7). The benefits of this type of organization result from efficiencies of grouping like employees together to accomplish similar functions. Also, the reporting structure is clear and unambiguous. Individual employees report to supervisors, who report to managers, who report to directors and eventually the vice president or general manager.

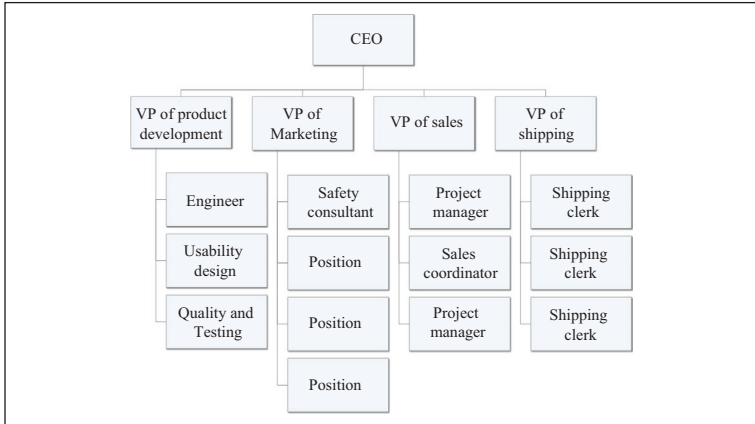


Figure 7. Functional organization example.

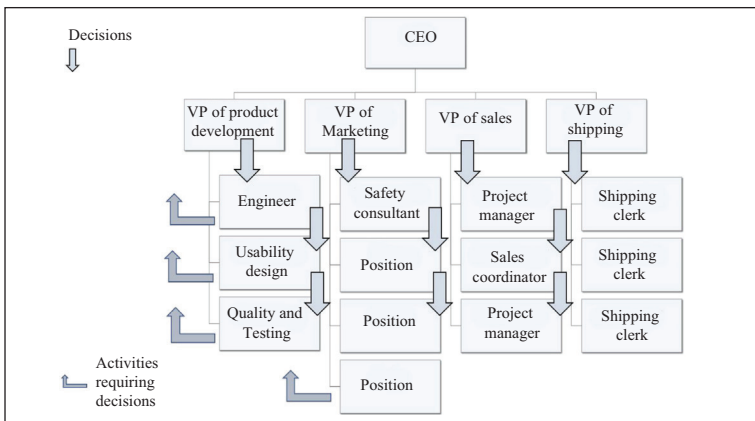


Figure 8. Functional decision making.

The flow of authority within the hierarchy from the top of the organization to the bottom is reinforced by the reporting structure. Once a decision is made at the top, the orders may be quickly executed. The problem with this type of organization however is multifold. Although execution occurs quickly once a decision is made, it may take quite a bit of time to make a decision. This is because activities requiring decisions must “bubble up” to the top prior to being made and then “pushed down” to the levels within the organization that execute the decision (Figure 8). Further, although employees within the same functional group may work together well and communicate frequently, they may not readily communicate with individuals in different functional groups. As an example, employees

trained in finance may not fully grasp details within the engineering functional group—and vice versa. Project management seeks to bring together the different disciplines and domains so the problems may be solved in a holistic manner. There is nothing like working closely together on a team to encourage the emergence of a common understanding—in spite of the difference in domain expertise and associated worldviews.

CROSS-FUNCTIONAL TEAMS

Project teams are formed to produce deliverables to stakeholders (such as clients) who are outside of the organization or the firm. The deliverables that project teams produce are usually the result of the skill and know-how from a number of technical and business disciplines within the organization. Because of this, such project teams are cross-functional in that they are composed of members drawn from multiple functional groups (Figure 9). Multiple functions are required to work together as a team to develop and produce deliverables composed of contributions from each represented discipline. The cross-functional structure also enables project teams to act quickly, make decisions, and work together across multiple disciplines in a holistic manner. How then do project teams acquire team members from functional organizations?

Typically, this is accomplished by negotiating with functional managers. Project team members first contact each functional manager overseeing the disciplines that are required by the project. The project manager then demonstrates the authority to “borrow” resources required by the project by reviewing the project charter with the functional manager. Finally, the

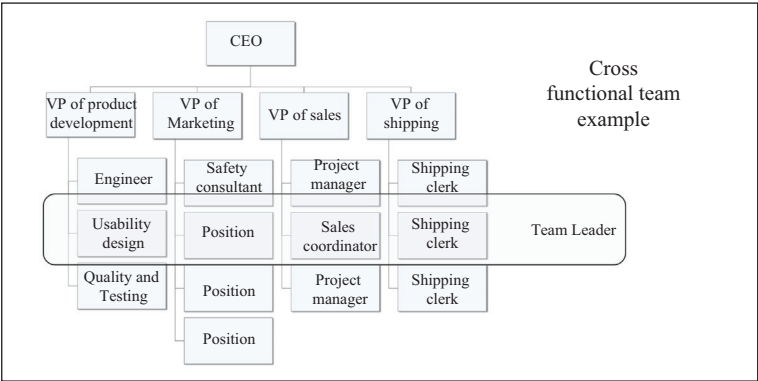


Figure 9. Cross-functional team.

project manager discusses with the project manager which skill sets are required to complete activities associated with project deliverables. The functional manager then lends resources to the project team and collects the accounting code for charging labor expense of the resources to the project. This is because during the time that the employee is working on project work, the expense of the employee is allocated to the project. Keep in mind though that, in some organizations, all resources in the organization may be centrally controlled by an organization known as the project office. Although resource assignment is coordinated between the project office, project manager, and functional management, the project office maintains control of resources so that available skill sets may be tracked organizationwide.

THE PROBLEM OF TWO “BOSSES”

Once an employee is assigned to work on a project team, the employee now effectively has two reporting lines that include both the project manager and the functional manager (Figure 10). This complication does not exist in a purely functional organization. How does the employee keep track of two bosses? Recall that a project team exists only to product deliverables. The project team is therefore concerned primarily with WHAT is being delivered (the project scope) as well as WHEN the deliverables are to be completed. The functional departments within an organization are effectively islands of specialized disciplines.

Functional managers are therefore primarily concerned with HOW things are done. The HOW relates to the process disciplines governed by

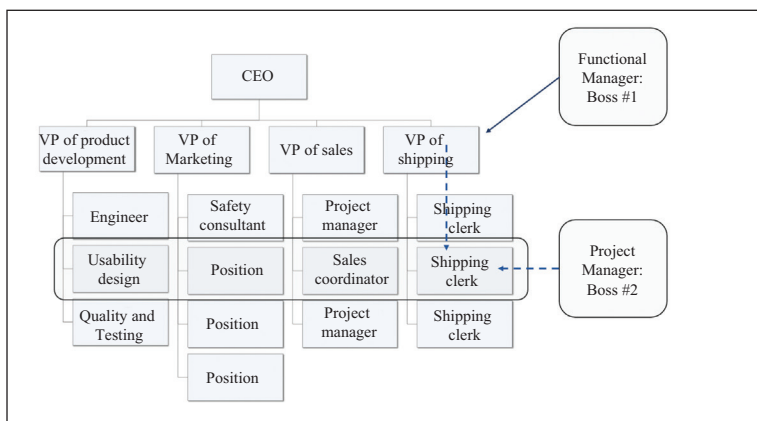


Figure 10. The two-boss problem.

the functional managers. Functional managers are also aware of which employees have the specialized skill sets required by the project team. For this reason, the functional manager is in command of WHO is assigned to do work within the project team. To simplify the chain of command in the project team, the employee is advised that the project manager is responsible for providing direction and making decisions for WHAT and WHEN, while the employee’s functional manager governs WHO does the work and HOW it is to be done.

Functional manager	Project manager
WHO	WHAT
HOW	WHEN

THE BALANCE OF POWER

The process of negotiating resources from the functional manager may be only an occasional activity in many functional organizations. The functional organization may carry out most of the work of the organization, and, when needed, the executive may charter a project as a kind of “tiger team” to deliver something outside of the scope of the functional organization and in a rapid and efficient manner (Figure 11). In this type of organization, the process for negotiating resources may not be clearly documented and may be carried out in an informal, ad hoc manner. Further, the project manager and associated team may be considered by the rest of the organization to have less authority than the functional groups within

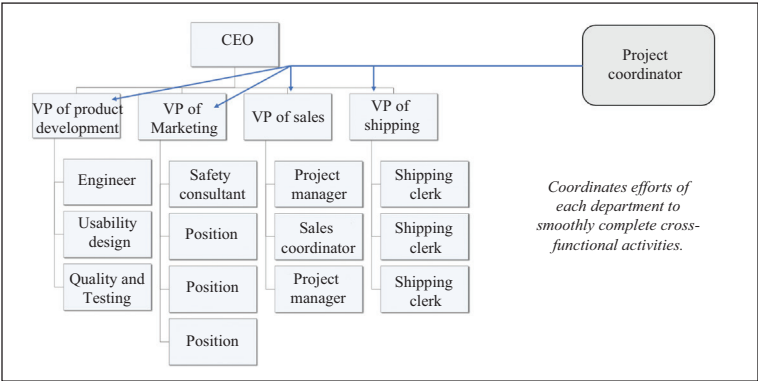


Figure 11. Functional group coordinator.

the organization. Further, rarely do documented policies and procedures exist to organization-wide governance for managing temporary team activities.

By way of contrast, some organizations may carry out projects on an ongoing basis as the primary means for producing external deliverables. This might include producing contractual deliverables for a client, or product development projects for the open market. Organizations such as these that use project teams as their primary vehicle for producing deliverables along with supporting functional groups are referred to as matrix organizations. A matrix organization, in the same way as a functional organization, groups together disciplines as functions, but includes a substantial governance and process framework for commissioning projects, assigning resources from functional groups to project teams, and coordinating all project activities. The matrix organization maintains the integrity of the functional disciplines while, at the same time, providing a vehicle for targeted cross-functional activity. The matrix project organization is said to provide “the best of both worlds” offering the advantages of both a project team and a functional organization. While there are advantages associated with the matrix organization, managing within a matrix organization tends to be more complex than a functional organization. While a functional organization employs the traditional structure of hierarchy and clear lines of reporting to accomplish organizational goals and complete deliverables, a matrix organization relies on highly refined and documented processes and procedures. While working within a functional organization may seem “natural” to an employee carrying out instructions from a supervisor, an employee within a matrix organization must rely on training and process discipline. It may take time and effort before working within such an operation becomes “second nature.” On the other hand, many technical organizations, due to the complexity of the project deliverables, have long since adopted the matrix organization structure. Given that technical organizations were some of the first to adopt the matrix organization, employees working in such organizations may well consider matrix organizations—including the “two-boss” problem—to be second nature and the normal way of getting things done.

EVOLUTION OF THE MATRIX ORGANIZATION

Organizations that operate matrix organizations deploy them differently depending upon the needs of the organization as well as the company strategy. Often, organizations that have traditionally operated within

a functional structure see the benefits of project teams as well as the cross-functional coordination that is made possible by the project manager. Instead of formally chartering a project, a strong functional organization may begin migrating toward a matrix organization by assigning a project coordinator to lead various cross-functional activities.

Examples of such activities include the expediting of a significant order or the coordinating of the development and launch of a project. Over time, the coordinator position may evolve to a more concrete project management role with an assigned team and the title of project manager. In the project coordinator stage of evolution, the functional organization has existed for a longer period of time and carries more weight in operational decision making. This may shift over time depending upon how often project teams are formed as well as the relative importance of the deliverables they are chartered to produce.

THE WEAK AND THE STRONG MATRIX

In some organizations, the project manager is chartered to request resources from the functional managers—but the functional managers may opt to decline such request. The functional managers are therefore observed to hold more power than the project manager. This type of project/matrix organization is known as a “Weak Matrix.” The weak matrix is one step removed from a project coordinator style organization in which the functional managers hold the largest share of power. However, the project manager, unlike the project coordinator, typically has project team members assigned to report to the project manager for the duration of the project in order to produce the project deliverables.

The weak matrix structure may operate well in circumstances in which the project team produces highly technical deliverables that need strong participation and decision making from functional domain experts. Recall that functional groups are owners of the technologies, processes, and know-how contributed to the project. The more that the project needs advice and support from domain experts, the more that the functional managers will have a say in how the technical work of the project is carried out. In contrast to the weak matrix organizational structure, the “Strong Matrix” uses a project manager that holds more power than the functional manager. In this situation, although resources report to the functional manager between projects, the functional manager is more of an administrative leader who develops resources with the right domain expertise so that the resources are ready and available to contribute to

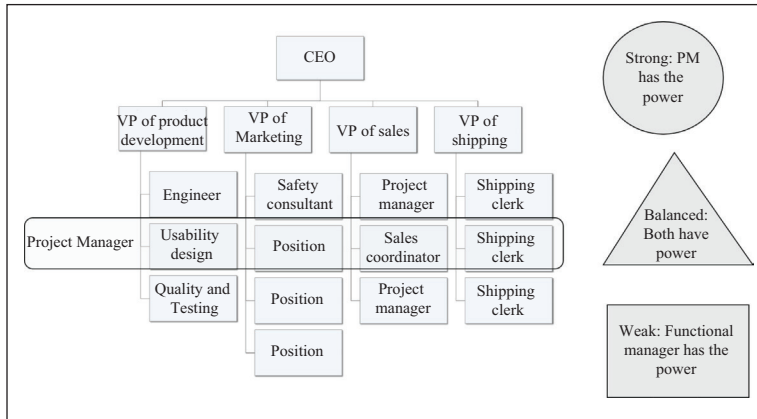


Figure 12. Strong, weak, and balanced matrix.

projects. The functional manager hires resources, trains them, and conducts annual performance reviews. When it comes to satisfying customers and producing deliverables to the outside world, the role of functional managers is not “where the action is.” The strong matrix is ideal for situations in which clarity of requirements, deliverables, and milestones is of primary importance to the project, the sponsoring organization, and the client. Recall that project managers govern WHAT and WHEN, so if these goals are high in priority in projects, it is reasonable to expect that a strong matrix organization will be in place. Finally, many companies seek to optimize matrix organizations by seeking to foster equal collaboration between functional and project managers. It is in this organization that the project manager and the functional manager are assigned equal power. The resulting matrix organization is referred to as a “Balanced Matrix (Figure 12).” The balanced matrix organization is a good fit for situations where WHAT, WHEN, WHO, and HOW need tight synchronization—thereby requiring significant ongoing collaboration between the project manager and the functional manager.

THE PROJECT ORGANIZATION

By way of contrast with the evolution of a traditionally functional operation, some companies, because of the nature of the product or service offered, were structured from the beginning as a project operation. A project operation features dedicated project teams. A typical example of such an operation includes a construction company (Figure 13).

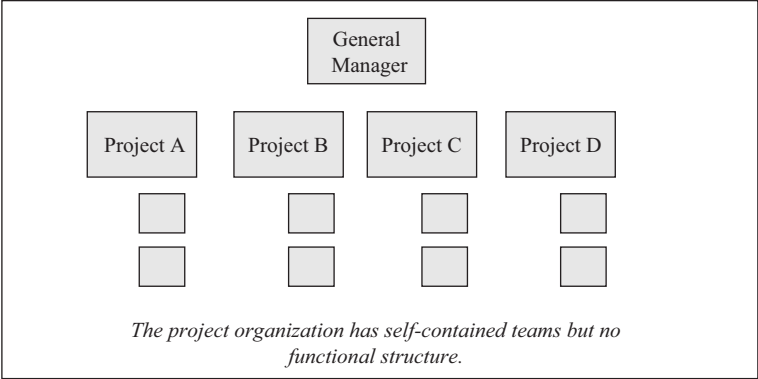


Figure 13. The project organization.

A construction company may have dedicated project teams for commercial construction as well as other teams for residential construction. Since all products that are delivered are delivered by project teams, it makes sense to organize the company as a collection of project teams. One negative aspect of the project organization is that projects tend to focus on project scope and schedule—potentially at the expense of the technical disciplines that tend to be reinforced within functional organizations. Project organizations therefore need to have policies in place that prevent schedule and budget concerns to override important technical and process decisions.

THE ORGANIZATIONAL STRUCTURE AND THE PROJECT PLAN

Since the project plan lays out the strategy for producing the project deliverables and satisfying the client and stakeholders, it is reasonable to consider the structure of the organization when developing the project plan. The organizational structure is in effect a plan constraint. The organizational structure provides guidance on where the project resources will be obtained as well as the degree to which such resources will be dedicated to the project team throughout the project life cycle. Finally, it is important to recognize that the relative power that the project manager has for directing team members is a function of the organizational structure. It pays to understand the properties of each type of organization and to take this into account within the project plan document.

RESOURCES AND OUTSOURCING

Regardless of the organizational structure, it is not uncommon for project teams to fail to acquire resources needed for the project solely from internal sources. The reasons for this are many including the need to staff more internal projects than the total number of internal resources is able to support. Further the need for specialized expertise may lead the project team to consider alternatives beyond the existing organization. In these situations, project managers may seek to acquire resources outside of the organization. This may involve the use of contract workers (or rental equipment in the case of nonhuman resources), and it may involve contracting out portions of work. Both outsourcing options require management expertise to ensure that the acquired resources perform according to internal standards, and as well produce work products in such a way that, upon completion of the work, the deliverables are easily integrated into the overall body of work of the project team. Such concerns are rarely simple to resolve when developing the resource plan. This requires developing an understanding of the internal policies, procedures, and processes of the outside source of resources. Often this may not be fully determined until the project team and the outside partner begin working together. By this time, if a significant mismatch in capability is uncovered, it is often too late to do anything about it.

MANAGING AND DEVELOPING RESOURCES

The temporary nature of the project suggests that in practice the team members assigned to the project from departments throughout the organization will often be working together as a team for the first time. Newly formed teams are not likely to perform at maximum levels. It therefore falls to the project manager to steer the team through the difficulties teams face as they work through roles, responsibilities, and working relationships. The guidance that the project manager provides the team is born of a good understanding of how individuals are motivated as well as the process that teams go through as they evolve from a collection of individuals to a unified whole. This is a highly nuanced management process, and much has been written about it in organizational behavior literature. Nevertheless, the project plan should include at least some high-level strategy for developing a highly functional and productive project team.

MOTIVATION

Motivational theorists such as Maslow, Herzberg, and McGregor (to name but a few) have proposed models during the last century that describe how humans in organization are motivated (Figure 14). Project managers are encouraged to draw upon these theories and consider how to apply them when managing project teams. Since the project resource plan outlines the strategy for how the project manager will acquire, develop, manage, lead, and motivate the team, the project manager should consider what team motivation and leadership techniques will be applied within the project. In practice, project teams often build their motivational strategy on the foundation of a good start. This usually involves an initial project kickoff meeting along with a number of team-building activities.

Another central consideration for team motivation is to involve the members of the team in the development of all project plans. The team project planning effort could be organized during the initial project kick-off and team meetings. A team planning workshop pays dividends later in the project as it is far easier to motivate individuals to execute a plan that they developed rather than to ask the team to carry out an idea crafted by someone else. Another important principle is to keep in mind that the project manager should never ask a team member to do something that the project manager would not do. When it comes to the difficult tasks of capturing project cost and schedule estimates, or dealing with difficult client, sponsor, or client negotiations, it is recommended that the project manager participate and lead rather than entirely assign the work to other team members.

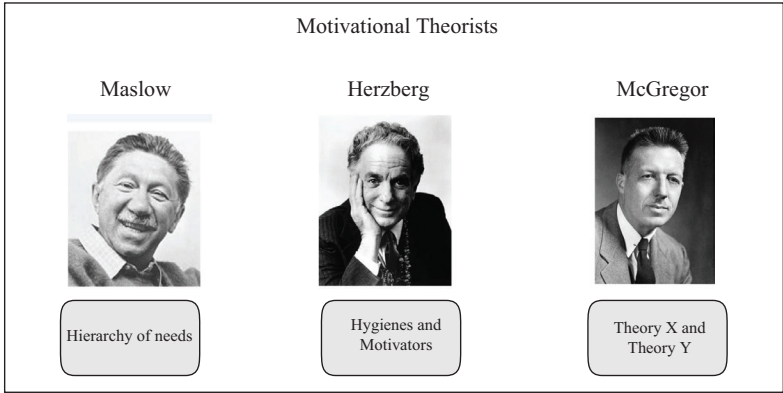


Figure 14. Maslow, Herzberg, and McGregor in project organizations.

TAKING CONFLICT INTO ACCOUNT

One possible factor that often gets in the way of individual and team motivation is conflict. When developing the resource plan, the effective project manager will recognize the human tendency for “no two people to see things the same way.” Project team members will have differences of opinion. This is a natural outcome of a diverse cross-functional team. Team members drawn from different functional areas will tend to, in the day-to-day context, focus on narrow technical issues associated with their domain of expertise. When team members are collected together in the project team, the project effectively acts as a small business that has as its goals producing the deliverables associated with its charter. This requires team members to take on a more global view and to communicate, discuss, and negotiate how best to proceed. Additionally, conflict may arise not as the result of differing perspectives resulting from different technical expertise—but rather from differences in outlook related to personality differences. There are a number of tools that may be used to assess personality differences. These include, but are not limited to:

1. The MBTI: The Myers–Briggs Type Indicator
2. The Big Five analysis of personality traits
3. The Birkman personality assessment
4. The DISC personality assessment

Each of these personality assessment tools has strengths and weaknesses. Cases may be made for or against each with respect to their overall validity. However, applying a personality assessment tool at minimum gets team members talking about themselves and how they think and additionally helps each person to better understand how others approach teamwork and decision making. Regardless of the validity measures of each test, making the effort to understand and discuss personality differences at the beginning of a project goes a long way toward minimizing personality-related conflict.

HEALTHY CONFLICT

Differences of opinion will always exist within a project, but this will often be a good thing. Conflict tends to prevent project teams from making decisions too quickly and, in addition, avoids the problem of groupthink that is characteristic of less diverse teams. Although conflict can be

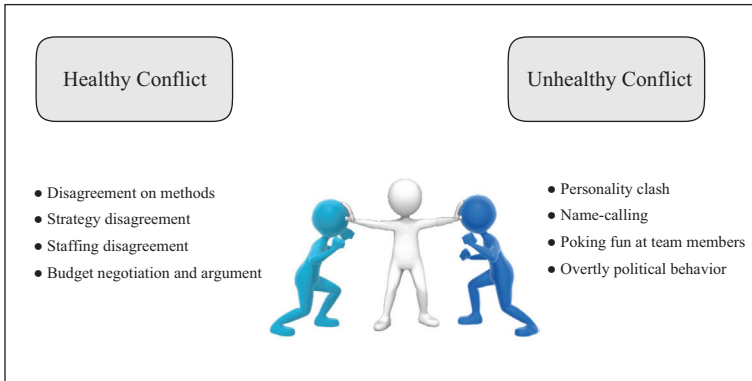


Figure 15. Healthy and unhealthy project team conflict.

healthy, the project manager leading the effort to develop the overall project plan will need to be aware that conflicts will take time to resolve and this will likely lead to the need for additional time. Finally, it is important to remember that there are forms of conflict that may be unhealthy for a project team. In general, conflict over strategy and methods for producing deliverables often leads to stronger decisions. Conflict of a personal nature however can be detrimental to a well-functioning team. This is an area that the project manager should be alert for so that it could be dealt with by employing a conflict resolution process in the overall project resource plan (Figure 15).

THE TEAM DEVELOPMENT LIFE CYCLE

The fact that teams take time to “gel” and become effective over time has inspired researchers and human resource specialists to attempt describe the process of team development. Two notable models are often cited to attempt to explain the team development process. The rationale behind providing such models is to provide guidance to managers of all categories—and especially project managers since all project work is executed in the context of the team environment. The model which most managers will be familiar is Tuckman’s “Forming-Storming-Norming-Performing” model. In practice, this model suggests that, after teams are initially brought together (forming), they then discuss, debate, and negotiate issues such as team responsibilities, decision making, roles, and processes. Often, disagreements and arguments ensue—and this is the reason that this stage is referred to as “storming.” Eventually, the issues are worked through and team members reach an agreement on the structure of the team and the

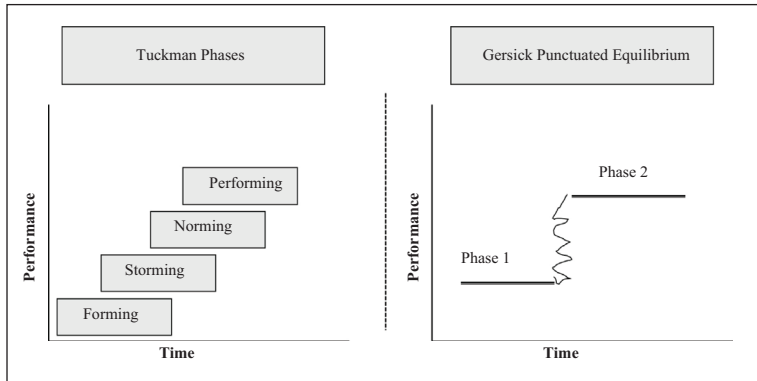


Figure 16. Tuckman, Gersick, and team development.

rules that will be followed (norming). After this stage is experienced, the team is said to reach a level in which it can execute together in an effective manner (performing). Project managers observe that it takes time for a team to evolve—and the stages of the Tuckman model are likely to seem intuitive to experienced project managers.

A competing model of team development is Gersick’s “Punctuated Equilibrium Model” (Figure 16). This model suggests that teams do not smoothly transition between discrete stages—but rather tend to begin performing when it is recognized that deadlines loom on the horizon. The essence of this model is that teams do not perform at maximum levels until the team reaches the approximate halfway point of the project timeline. It is theorized that, at this point, the team is forced to gel and then experiences a step function in performance through the end of the project.

What do these models mean for the project manager and the resource plan? First, it must be understood that theoretical frameworks are attempts to model reality. Models only imperfectly describe reality—and any given project is likely to vary from any given academic model. The underlying principle that nearly always applies is that there is no such thing as an “instant team.” Teams take time to evolve and to reach a point when they are performing well together—and project managers are encouraged to take this into account in the resource plan and consider how the project team will be led so that its formative period may be accelerated.

REVISITING THE RESOURCE PLAN

A project resource plan describes how a project manager will make the determination regarding what resources are needed as well as the overall

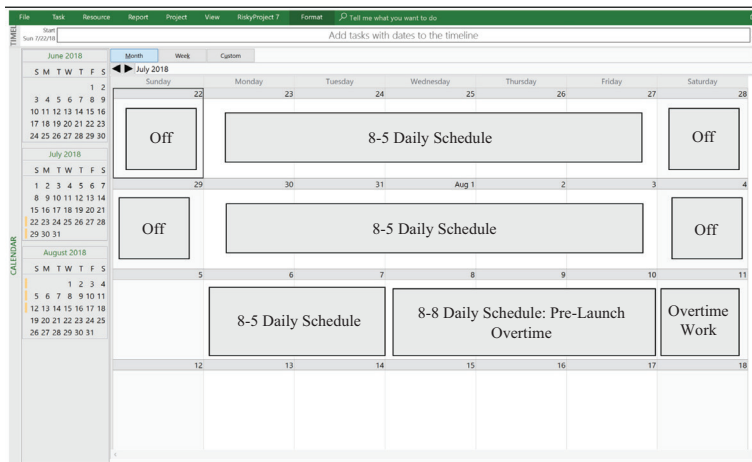


Figure 17. The project calendar.

number of resources. The plan is effectively the strategy that will be used for providing answers for project resource questions. Further, the plan describes how the acceptable level of peak resource demand will be determined. Peak resources are governed by the available project budget, the level of resources realistically available, and finally the management “bandwidth” of the project team. Each of these factors is considered in the project resource plan. The resource plan also outlines the management approach to the leveling of resources. For example, what calendar will the project use? The project calendar describes the number of hours assumed in a full day of work, as well as the number of days in a week (Figure 17).

The workweek plays a role in balancing work output, resource utilization, and project team morale. Will the project team work during weekdays only, or weekends? Will resources be scheduled for overtime? If so, how often and how will the expected decline in productivity and work quality be managed? Finally, will the project calendar for human resources be the same as the one used for resources such as equipment or machines that are able to run without human intervention? The questions that the resource plan answers go above and beyond the level of details contained in the project schedule. Completing a resource plan therefore takes the next step in developing an overall project plan.

THE ELEMENTS OF THE RESOURCE PLAN

What elements should be included in the resource plan? The project resource plan for a project should answer the following questions:

1. Who will I need to plan and execute this project?
2. From where (and how?) will I acquire these people?
3. What does the project need in terms of:
 - (a) Materials
 - (b) Equipment
 - (c) Funding
 - (d) Tools and supplies
4. From where (and how?) will I acquire these resources?
5. What basic approach will be taken regarding teambuilding, team development, and team motivation?

COMMUNICATION AND THE PROJECT PLAN

Project deliverables and project goals are produced and achieved through people. This includes people within the project team, people outside the project team but within the company, the client, and finally people within the community at large. Such people can be a great support to the project—or at minimum avoid presenting barriers to project success. The secret to maximizing support of those impacted by the project is to keep all informed. Why does communication hold the possibility of improving stakeholder support? One reason is that information tends to reduce uncertainty among stakeholders. Uncertainty may lead to fear or concern, and in turn fear and concern may lead to resistance. Communication therefore breaks the negative spiral at the beginning by removing or at least minimizing uncertainty. Communication however is by no means a simple task and it requires quite a bit of work on the part of the project team. In much the same way that journalists think about informing the public of news, project communication takes into account the “5 W’s” (who, what, when, where, how, and why) (Figure 18). The “Who” of project communications

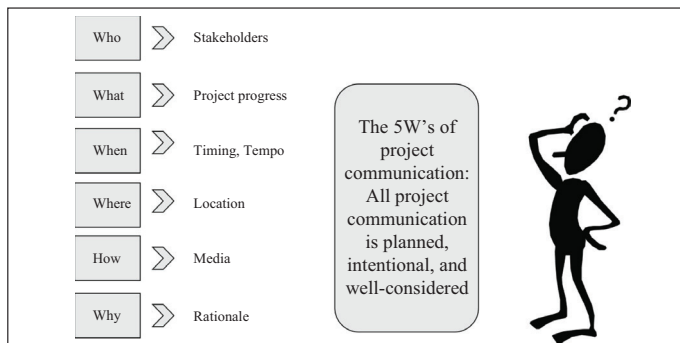


Figure 18. The communications plan and the five “W’s.”

involves stakeholders. This is so important a topic that, as we will see, the PMBOK assigns a separate knowledge area that is devoted to all aspects of stakeholder management. The “Who” therefore will be addressed in the project stakeholder management portion of the overall project plan.

THE “WHAT” OF PROJECT COMMUNICATION

The project triple constraint is a significant generator of project information. Those who have an interest in the project and its outcomes will want to know if the project will be on time, if it will be within its budget targets, and finally if it will meet the requirements of the client and the sponsor. The updates on the status of the triple constraint are essential project progress reporting information. This information would appear to be straightforward to communicate since it is at the heart of what a project does. The difficulty is that this information is likely to change every day. Progress reporting is therefore a moving target. In addition, it is not always the case that this information is generated automatically. It takes work to produce progress updates. Also, the progress of the entire project depends upon the progress of the underlying work packages of which it is composed. This infers that multiple individuals within the project team will likely be involved in generating and collecting information—as well as putting it into a format that is relatively easy for stakeholders to consume. The effort required to develop and report information could be considered a “tax” upon the project team. The irony is that, the further the project progresses, the more progress information is needed. The more the information required, the more significant is the effort to produce it. It is possible that so many team members could be tied up in collecting and reporting information that the project progress begins to fall behind. What does this mean for the project manager? Simply that the communication plan must identify in advance:

1. What information will be communicated?
2. How the information will be generated, collected, and formatted?
3. What resources will be assigned to do it?

It pays to notify parties of interest up front of the project policies on reporting information so that the burden to project resources may be minimized. It also pays to consider up front the degree to which information may be generated automatically. The rule of thumb is to try to

“enter information only once” and avoid spending resources on manual data collection and re-entry for further reporting. Finally, an ideal way to determine “what” is to be reported is to set up an application to collect information from a PMIS (project management information system) and report it automatically without the need to tie up project resources. This is an ideal that few project teams can achieve and may be limited to such teams that work within a large enough organization so that a high-capability PMIS is affordable.

THE “WHEN” OF PROJECT COMMUNICATION

The pace of project activity can be modeled on the project budget or “S-Curve.” A project tends to begin small—and slow at first—but then the activity increases. The project activity tends to peak as it moves beyond planning and into executing—and then gradually declines as the project moves toward closure. Project communication tends to follow the project activity with one serious exception: *project communication rarely decreases as the project inches toward project completion*. Instead, the demand for project communication from stakeholders tends to increase. Why should this be? Human psychology may play a role with respect to the pace of project communication. At the beginning of the project, team members and stakeholders often perceive that time is endlessly available. This is especially true within lengthy projects. Because of this, stakeholders may be less demanding in terms of frequency of information. Project reports submitted every two to three weeks may be considered adequate at the beginning. After all, the project activity is just beginning. As the activity in the project picks up, time itself will seem to speed up. The information that was presented biweekly may soon be requested weekly. As the project gets closer to the end, all who have an interest in the outcome of the project will want to understand what is happening. The weekly reports may become reports that are delivered twice a week. Soon, the reporting cycle may well shift to a daily report—and perhaps twice daily. It is easy for a project team to get caught up in this negative cycle of increased communication frequency (Figure 19). It is for this reason that the project communication plan should establish from the beginning of the project the frequency of the project communication as well as the degree to which the frequency of reporting will be permitted to change as the project progresses. Keep in mind the phrase “inquiring minds want to know” and be prepared for those demands for increased communication frequency.

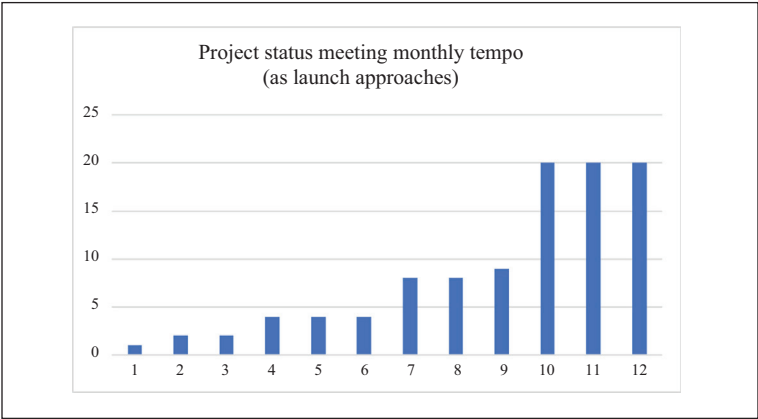


Figure 19. Project communications plan tempo.

PLANNING THE “WHEN” OF COMMUNICATIONS

In the spirit of “Plan first, then do,” develop and clearly state policy on communication frequency up front to set stakeholder expectation. Finally, the category of information communicated plays a role in “When” the information is communicated. There is an old saying in project management that project managers should communicate “Bad news early, and good news late.” The key is to ensure that apparent good news is actual good news so that the credibility of the project team is maintained. Further, bad news hidden from interested parties has a way of “backfiring.” Be assured that bad news will eventually leak from the project team and find its way to sponsors and clients. Reporting bad news early demonstrates both that the project management is aware of all serious issues and more importantly that the project manager may be relied upon to tell the truth (even when it hurts!). Finally, it is recommended to establish a weekly communication cycle in the minds of stakeholders that captures the flow of work, evaluation of status, review meetings, and reports. In this way it will become more clear that information demanded prior to the completion of the weekly information gathering cycle will likely be incomplete—or perhaps even erroneous.

THE “WHERE” OF PROJECT COMMUNICATION

The resource impact of project communication is also an issue when the location or the “where” of project communication is considered. Will,

for example, reports be delivered face-to-face in formal meetings? If so, where will these meetings take place? Who will arrange such meetings? Also, if the client is distant from the project location, traveling to such meetings can consume considerable time. Further, in addition to regular project progress reports, to what extent will project and design reviews take place—and where will these be held? If at a different location, will the venue alternate between meetings? Finally, if conference calls or videoconferences are used for virtual meetings, will this be sufficient in all cases? Or will it be supplemented by physical face-to-face meetings? The location—rather physical or virtual—requires thought, planning, and specification up front. It is because of these questions—to identify only a few—that “Where?” is an essential element of the project communications plan.

THE “HOW” OF PROJECT COMMUNICATION

When project managers consider “How” to communicate information to a wide audience, inevitably the overlap between “How” and “Where” becomes obvious. “Where” communication takes place refers to location—be it physical or virtual. Also, a face-to-face or virtual meeting can describe a communication methodology or media type. A project communication plan outlines the communication methodology—or media employed—for different types of reporting (Figure 20). For example, when communicating project progress data, an ideal method for reporting would be to automatically populate an Intranet dashboard using

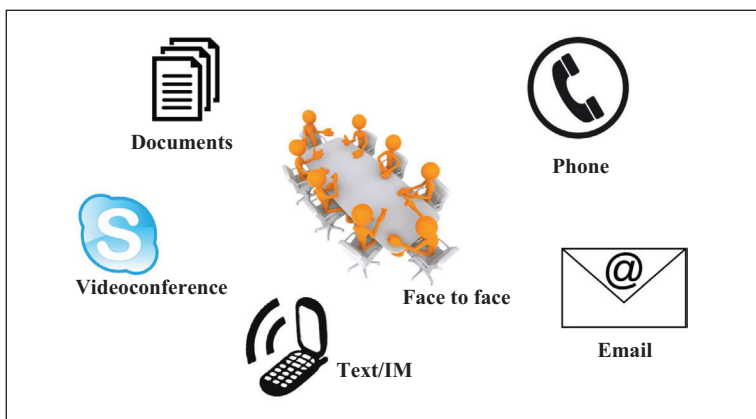


Figure 20. Project communications media.

information extracted from the project management information system. This saves considerable effort in extracting and formatting information for stakeholders. Caution should be applied with respect to what information is automatically extracted and reported. This is because project status tends to change daily—and putting too much raw data on an Intranet too soon may lead to a “rollercoaster” ride of sorts for stakeholders with reported daily ups and downs. In this situation, a certain amount of information control may be healthy.

THE AUDIENCE DETERMINES “HOW”

An additional consideration is the nature of the audience receiving the communicated information. For example, some audiences may benefit from a presentation using slide presentation packages such as Microsoft PowerPoint. Others may find documents more useful—and spreadsheets may be appropriate for stakeholders who require more data-intensive information. A range of media possibilities exists depending upon the context. However, some communication media require more preparation than others. Project managers when developing the communication plan should therefore consider the nature of the information, the preferences of the audience, the context in which the information is delivered, and finally the effort required to produce it. In general, the greater the level of preparation, the more the project team has the ability to distill the information and put the status of the project in its best light. Less preparation infers that the information presented will be more in the form of raw data than information—leading to the possibility of misinterpretation on the part of stakeholders. Communication media planning and preparation is therefore often a delicate balance between “too much” or “too little”—in terms of both effort and information distillation.

THE “WHY” OF PROJECT COMMUNICATION

It is reasonable to expect that those who have an interest in the status and outcome of the project will request information. Some interested parties may be comfortable with regular, standard reports. Others such as the client, the project sponsor, or functional groups associated with the project may demand ad hoc reports that address specific areas of concern. Preparing this type of information requires time, and resources—both personnel and funding. It is incumbent upon the project team to ask “Why?” specific

information is required as well as how it is expected to be used. Ideally, special requests may be addressed by referring to elements of existing standard reports—including presented data of which the interested party may not be aware. The minimization of effort produced by pointing stakeholders to existing information may only be done if the question of “Why?” is first posed. There are situations where asking “Why?” may be difficult. As an example, it is common to respond immediately without thinking to a client request for information. However, the client may well appreciate hearing this question as it suggests that the project team is carefully thinking through all demands placed upon the project so that scope, schedule, and cost are minimized. Although the client will be a frequent requestor of information, the client also tends to prioritize project deliverables over administrative tasks. Asking “Why?” when it comes to communications planning is important, not only important for the utility of the project team. Asking tough questions is also likely to foster an environment of mutual respect.

Another factor influencing “Why” is associated with the communication of low-level technical or financial details. Some information of this nature may go beyond the ability of the audience to understand. This is especially true when reporting information to executive sponsors or clients. When a presentation is being prepared, it is reasonable to review each element of the report and to ask “Why are we communicating this information to this audience?” Asking “Why” in this context has the potential to match the information delivered with the audience capacity to receive and process it.

THE ELEMENTS OF THE COMMUNICATION PLAN

What elements should be included in the resource plan? The project communication plan for a project should answer the following questions for the purposes of developing project communication policies and guidelines:

1. Who are the interested parties that require project information?
2. What categories and specific details of information are required?
3. How often will information need to be communicated?
4. Who will be assigned to collect, prepare, and deliver the information?
5. Where will communication take place?
6. What preferred media will be required for transmitting project communication?
7. Why is the information being requested? Why is it being communicated?

RISK AND THE PROJECT PLAN

No project plan is complete without consideration of risk. What is risk in the context of project management? Defined loosely, risk is anything that can stand in the way of project success. Risks are events that have not yet occurred but could occur (once risks do occur, they become issues and are no longer risks). Although it is true that there is such a thing as a “positive risk,” that is, the chance that something good could happen within a project, positive risks are the exception rather than the norm. “Murphy’s Law” could be said to govern project risks given that “anything that could go wrong, will go wrong” within a project. When risks are viewed as barriers to success, and project managers do their work so that barriers to success are minimized or eliminated, then project managers could be viewed as risk managers.

RISK AND REWARD

Viewing the project manager as a risk manager provides a lens for more clearly understanding the connection between risk and reward. It is often said that “without risk, there is no reward” and as well it is understood that the reward that is sought in any venture must be commensurate with the risk undertaken. Given that risks are defined in the project context as “anything that stands in the way of project success,” in a project that had no such risk, the project results would just “happen” and would not require management. In this imaginary environment there is no need for project managers. In the real world that projects and project managers inhabit, things do not just “happen.” They require management under conditions of risk. The role of the project manager is therefore a necessity, and it is a role for which the project manager earns a reward in the form of a salary. Further, once the project manager successfully shepherds the project to completion and produces deliverables, the client and the sponsors earn the rewards from the deliverables produced regardless of the ongoing risk of failure. Without the presence of risk in project management therefore, there would be no opportunity to earn the reward.

RISKS—WHAT ARE THEY?

Project risks are insidious in that they are often elusive, difficult to imagine, and usually intangible early in the project. It is often the risk that no

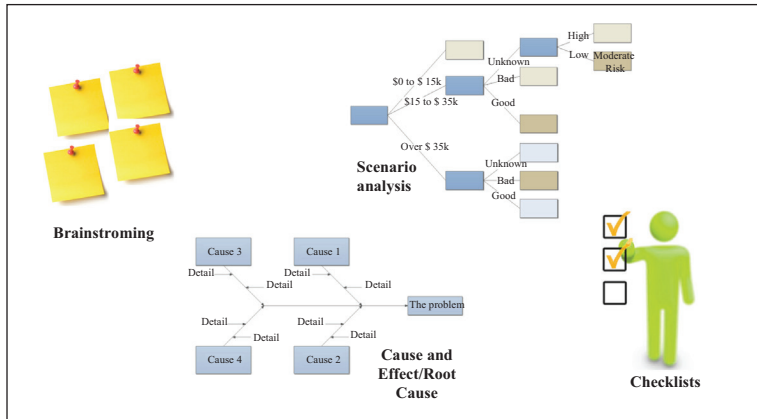


Figure 21. Risk identification methods.

one has considered that ends up being the one risk that brings down the project. Also, risks have a way of cascading. Small, apparently non-risky events may lead to other events that lead to yet others that snowball into a project catastrophe. A project team may be aware of a possible catastrophe as well as what that catastrophe might look like—but be completely unaware of the very small initial event that triggers the catastrophic chain reaction (Figure 21).

Because of the elusive nature of risks, the risk plan begins with risk identification. Risk identification is an activity for which a project manager must get creative and “think out of the box.”

RISK IDENTIFICATION METHODS

No one can accurately foresee the future. Most project teams have difficulty imagining what might be as the project unfolds. This is the reason why brainstorming is a fundamental and very important part of risk identification. Brainstorming takes many different forms, but at its essence is the emphasis of encouraging participants to think and speak freely unencumbered by constraints. Speaking freely opens the doors to ideas that on the face of it may seem highly unlikely. Yet, it is precisely these apparently unlikely risks that have a way of catching the project team off-guard. It is only after ideas are collected in brainstorming and discussion sessions that they are vetted for inclusion into the project risk plan. The risks that remain after vetting are those for which the project will keep within its sights and pay ongoing close attention. An additional tool for use in risk identification

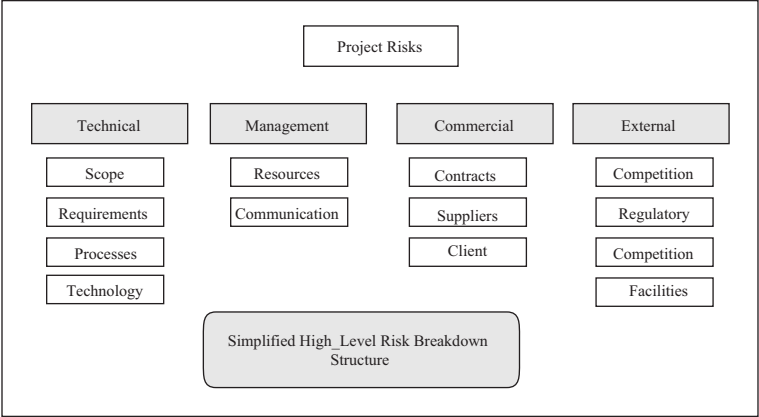


Figure 22. The risk breakdown structure.

is the risk breakdown structure or “RBS” (Figure 22). The RBS provides a structured set of categories that seed the risk identification process by highlighting typical categories likely to be sources of project risk.

RISK—HOW BAD IS IT?

An infinite array of risk events could appear in any given project to disrupt the possibility of project success. No project team or project manager could identify—much less manage—the total range of possible risks that the project might encounter. It is for this reason that the project team directs its attention to the most pressing risks. How are the most important risks identified? First, risks are evaluated in terms of the likelihood of occurrence. A risk that is more likely to happen is considered more important than a risk that appears only rarely. To consider an extreme example, a risk such as a component delivery being delayed is more likely to occur than a tsunami event or an eruption of the Yellowstone Supervolcano. The likelihood of occurrence is expressed as a probability ranging from 0 to 1. A likelihood of zero will never occur whereas a likelihood of 1 is a certainty. The likelihood of a coinflip resulting in “heads” is .5.

Once the probability of a risk is established, the resulting impact of the risk is considered and captured in the form of a monetary value. In the case of a delayed component delivery, the impact of this risk would be analyzed in terms of the cost incurred to the project by the resulting delay. Costs are driven by the additional activity required to recover from the delay, costs or penalties associated with the late deliverable, and finally other costs such as overhead or expediting fees.

Finally, the severity of the risk, in terms of its importance, is quantified by multiplying the probability of the risk event by the impact of the risk should the risk occur. If for instance the cost of the component delivery delay was determined to be \$1,000.00 and the probability of the risk occurring was .35 (or 35 percent), then the severity of the risk would be calculated as $.35 \times \$1,000.00 = \350 . The risks identified in project team brainstorming sessions are quantified by risk severity and ranked within a table known as a risk register (Figure 23).

The risk register includes ranked risks and associated details about each risk. The risk register is continually monitored and updated as necessary—but the primary focus of the project team is on the highly ranked risks based on the risk severity calculation. Most commonly, the review and updating of the project risk register is a weekly project meeting agenda item. Risks in the risk register may also be plotted in a matrix format for ease of visibility (Figure 24). The probability/impact matrix presents risks at a glance and as well uses colors to identify the most severe risks.

Simplified High_Level Risk Register							
Risk Identifier	Risk Description	Date	Assigned To	Response Strategy	Probability	Impact	Ranking
4252018	Supplier delay	1/25/2018	Jan	Avoid	0.25	\$17,500	\$4,375
2182018	Contract delay	1/18/2018	Jaclyn	Mitigate	0.2	\$15,000	\$3,000
3202018	Design flaw	1/20/2018	Jamie	Mitigate	0.1	\$10,000	\$1,000
1152018	Server failure	1/15/2018	Levi	Transfer	0.01	\$10,000	\$100

Figure 23. The risk register.

Probability	Supplier Delay Contract Delay Design Flaw
	Server Failure
Impact	

Figure 24. The probability-impact matrix.

Keep in mind that the primary focus of the risk register and especially the probability-impact matrix is risk visibility. Again, this is because of the tendency of risks to be intangible and difficult to perceive. For this reason, the probability-impact matrix is usually color-coded so that the most severe risks stand out. The colors used follow that of a traffic light with red meaning “alert,” green meaning “OK,” and yellow meaning “caution.”

QUALITATIVE VERSUS QUANTITATIVE RISK ANALYSIS

When numbers are employed within risk analysis, it is tempting to draw the conclusion that the analysis is quantitative. However, it is important to be aware that the presence of numbers does not automatically involve quantitative risk analysis. As an example, when the severity of the risk is determined, both the probability and the impact are provided by numeric values. However, the probability is likely to be subjective in nature—whereas the impact of the risk is likely to consist of only a rough estimate. When numbers are used to estimate risk severity as in the case of the probability-impact assignment and the placement on the probability-impact matrix, the risk analysis is subjective and qualitative. Under what circumstances would numeric risk analysis be truly quantitative? If, for example, the probability estimate and the likely value of the impact were generated from actual historical data, then the resulting analysis would be considered quantitative.

NUMBERS CAN MEAN DIFFERENT THINGS

When considering the use of numbers in risk analysis, it bears remembering that there are different classes of numbers that may be used in different applications—not all of which are quantitative. Imagine for example going to a restaurant with a friend and each of you order a numbered selection from the menu. If you ordered #10, and your friend ordered #15 off the menu, it would make no sense to inform the waitress that, as a compromise, your table will simply average the menu selections and each order “#12.5”. This obviously makes no sense—but the reason it doesn’t make sense is that these numbers are simply acting as names and are not intended to be employed in calculations. As such, these numbers are referred to as *nominal*. Another type of number reflects the ranking of different elements. For example, major cities in the United States may be ranked as #1, #2, #3, and so on. The rank in terms of relative size is

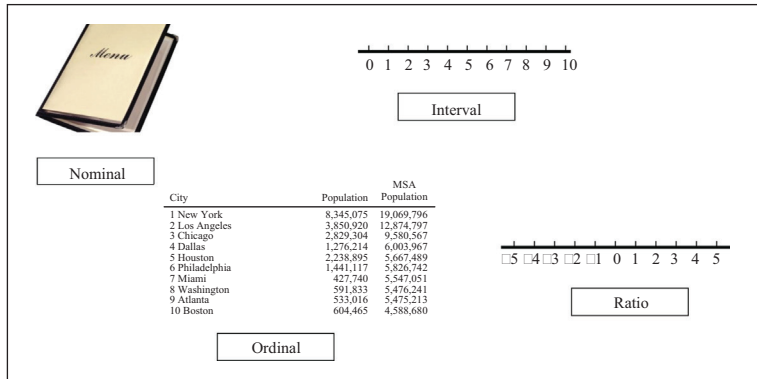


Figure 25. Number types—NOIR (nominal, ordinal, interval, ratio).

clear—yet the interval between each number is not defined. For instance, New York may be larger than Los Angeles in terms of population—but the ranking does not inform regarding how much larger one rank is compared to another. These numbers are referred to as **ordinal**. The next category of numbers does have a fixed interval between each number. For example, when counting integers from 1 to 10, each integer increases by exactly 1. These numbers are referred to as **interval**. Finally, numbers that include not only fixed intervals—but also a zero—are referred to as **ratio** numbers. Given the categories of numbers and the amount of mathematical information they do or do not contain, project managers should be aware of what kind of numeric information they are working with so that it will be clear to what degree the analysis of any kind—including risk analysis—is truly quantitative or qualitative (Figure 25).

RISK SIMULATION

Often after the initial qualitative analysis is conducted, further detailed analysis using historical data or probabilistic simulation is employed. One method commonly available in many current project management software packages is Monte Carlo analysis. This analysis evokes the image of the roulette wheel within a casino. This is not far from the actual methodology employed by Monte Carlo analysis. In this type of probabilistic analysis, duration and cost values are chosen at random from a range of inputs (drawn from three-point estimates) to the project schedule. After several thousand runs, the analysis arrives at a probability duration of schedule completion dates as well as costs. The thousands of runs could be considered a long-run simulation of the project (Figure 26). This type of

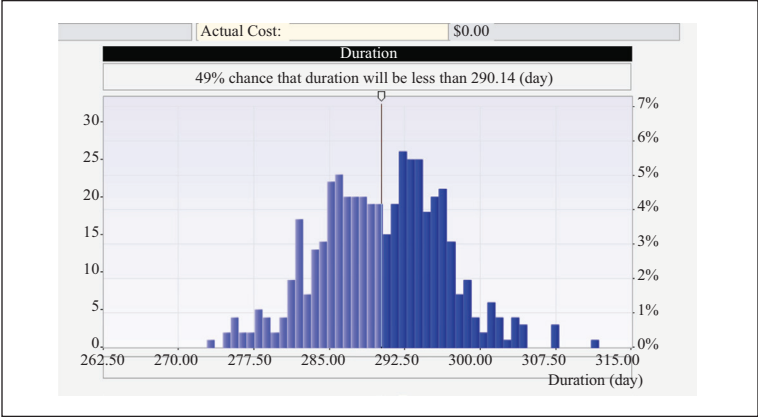


Figure 26. Monte Carlo analysis.

quantitative risk analysis informs project managers of the possible range of project outcomes calculated to be likely given the cost and schedule input data created from the risk brainstorming process.

RISK PLANNING AND BAYES' THEOREM

Risk simulations associated with Monte Carlo analysis and risk estimates using the weighted averages of PERT analysis are useful tools for predicting what is likely to happen in the future of the project. However, the problem with such approaches is that they are “frequentist” in nature. That is, the simulations and averages will provide significant information about the long-run outcome possibilities of the project—but will not say much about a “one time only” undertaking. Simulation outcomes produce statistical distributions, and PERT analysis produces probabilities associated with weighted averages. Unfortunately, all projects are “one time only” and are not typically undertaken several thousand times. So then, project risk planners should well wonder if the project has a chance at being on time or not. An alternative to the frequentist approach to predicting project outcomes is to employ Bayes’ theorem. Bayes’ theorem provides a formal method of making an educated guess that takes into account the prior probability estimate about a specific project outcome. This is following updating the guess with new evidence, and arriving at an improved or posterior probability. Bayes’ theorem uses the following formula:

$$P(G|E) = (P(E|G) * P(G))/P(E)$$

Where:

$P(G|E)$, (or “G given E”) is referred to as the posterior probability—or the new probability calculated by including new evidence,

$P(E|G)$ is the conditional probability of “E given G”(or “Evidence given the guess”),

$P(G)$ is the prior probability of the “guess” or “hypothesis”—or probability of G determined prior to including updated evidence, and finally

$P(E)$ is the prior probability E, or “Evidence.”

What this formula states in everyday language is:

“The probability of your guess given the evidence is equal to the probability of the evidence given the guess, multiplied by the probability of the guess being true, and divided by the probability of the evidence.”

Understanding and applying the Bayes’ theorem and using it within a project risk management plan may be a bit tricky. For starters, the formula will likely be confusing to project managers and even understanding the formula can be challenging. Also, it is not entirely clear how to determine the values for the equation to arrive at the revised probability. Finally, it is difficult to think about how to frame a project scenario so that Bayesian analysis may be applied. It is easier to understand how to apply the Bayes’ theorem by carrying out a simple visual project example. Also, project managers will find Bayesian analysis much easier to use by incorporating a shorthand, visual method for making risk assessments.

A BAYES’ THEOREM EXAMPLE

Assume that the project manager has attended a team midpoint project review and has been informed of the latest status of the project. Further, the project team has conducted a PERT analysis and adjusted the schedule so that a 95 percent project duration is achieved. The team further announces that the project will be on time based on the evidence of the adjusted schedule and the PERT analysis. Upon hearing this information, the project manager wants to believe that the project will be on time, but wonders is it true that the schedule has a 95 percent probability of being achieved? Is there any additional evidence that could be collected to improve the understanding of the likelihood that the project will be on time?

It could be said that $P(E|G)$, the probability of the evidence given the guess that the project will be on time, is 95 percent based on the PERT analysis presented at the project review. The reported probability is 95 percent, but this probability is only a portion of the overall Bayes’

probability calculation. What additional evidence could be collected to improve the understanding of the risk? Two questions could be asked to obtain a better picture of the actual likelihood. They are:

1. Historically, what percentage of projects was delivered on time?
2. What percentage of projects that presented a 95 percent PERT schedule at the midpoint project review was delivered on time?

The answer to question #1 provides the value for $P(G)$, and the answer for question #2 is the value for $P(E|G)$.

Assume that it has been determined that historically projects have been on time only 30 percent of the time. Therefore, the probability of the guess that the project is on time, or $P(G)$, is 30 percent. Finally, the project team has analyzed previous records of projects that exhibited a 95 percent probability at the midpoint project review—and determined that this evidence was present in 60 percent of the occasions where the project was on time, and 40 percent when the project was late. Using these values $P(E|G)$ is determined as $(.6 * .3 + .4 * .7)$ or .46. Putting the elements of the formula together, we have:

$$P(G|E) = (.6 * .3) / .46 = .39 \text{ or } 39\%$$

This informs the project team—based on evidence and prior probability—that the PERT 95 percent schedule reported at the midpoint project review in the case of the organization in this scenario is—in reality—a schedule with only a 39 percent probability of success.

VISUAL AIDS MAKE A DIFFERENCE

Identification and keeping track of the formula elements may seem like an impossible task. The good news is that it is not necessary when a visual Bayes' template is used. Bayesian project risk analysis is then easily applied using a series of steps involving visual aids as follows:

Step 1: Create a diagram illustrating the basic probability categories under examination. In this case, the diagram illustrates the overall probability of projects being on time versus being late (Figure 27).

Next, use the table to shade in the probability value of interest. In the case of this scenario, it is the on-time versus late probability of projects that reported a 95 percent schedule probability at the project midpoint. Once this is completed, the Bayes' formula elements may be directly

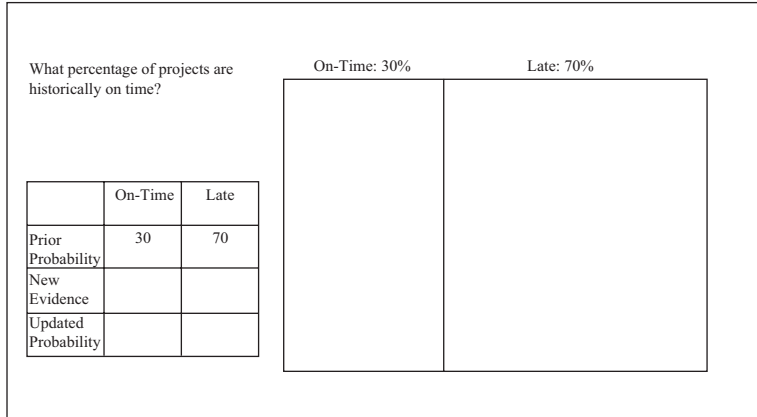


Figure 27. Step 1—identifying the basic probability categories.

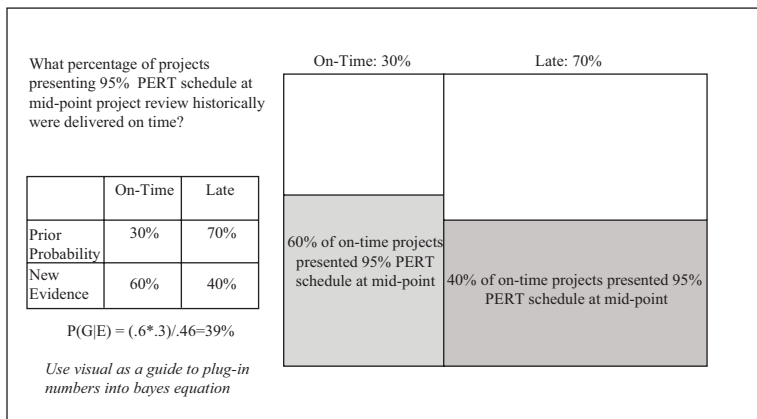


Figure 28. Step 2—shade in probabilities and plug into Bayes' formula.

plugged in (Note that the chart makes it easy to determine $P(E)$ by $.6 * .3 + .4 * .7$. This figure represents the total shaded area.) (Figure 28).

Finally, there is a simpler shorthand method for calculating Bayesian probabilities that does not require the plugging in of values to the Bayesian equation. In this method, use the shaded areas to complete the probability table. Then, multiply each column to arrive at the updated probability. What results is the odds ratio 1800:2800 or 18:28. What are the odds of being on time using this method? It is calculated by determining the ratio of 18 out of the total (18 + 28). The ratio is $18 / (18 + 28)$ which is .39 or 39 percent. This is the same probability as calculated using the Bayes' formula directly (Figure 29).

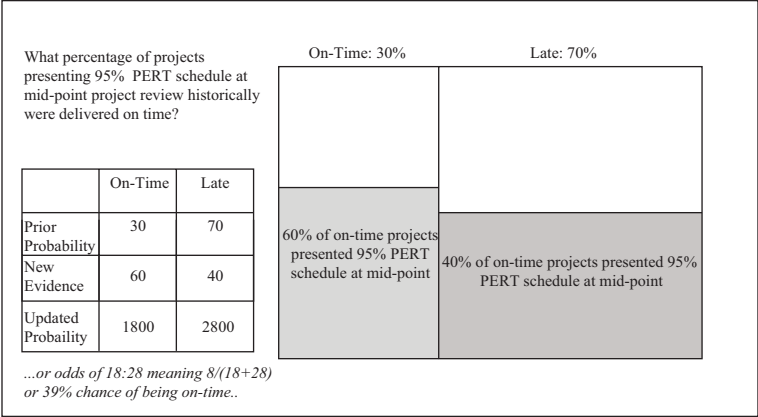


Figure 29. Bayesian analysis shorthand method.

Bayesian analysis is an important tool for updating the project risk outlook as new evidence becomes available. Because of its value, it is a methodology that is recommended to be included in the risk management plan.

RISK—WHAT SHOULD WE DO ABOUT IT?

Once risks are identified and analyzed, project managers next consider what should be done to address these risks. Each risk identified and ranked in the risk register is linked to an accompanying response strategy. There are four generic approaches to dealing with risks that each has its associated pros and cons. The four approaches may be recalled easily using the acronym “MART” for *Mitigate, Avoid, Retain, and Transfer*.

MITIGATE

The first inclination of the project team is to take some action that would minimize the possibility of the risk becoming an issue and—if it does—to minimize its impact. This generic approach is referred to as risk mitigation. The advantage to this approach is that it is an active strategy that directly seeks to counter any potential negative impact. The disadvantage is that a mitigation strategy will likely require the creation of a project subplan that will need to be staffed and funded. If mitigation is selected as a strategy, then there must be a reasonable expectation that mitigation will

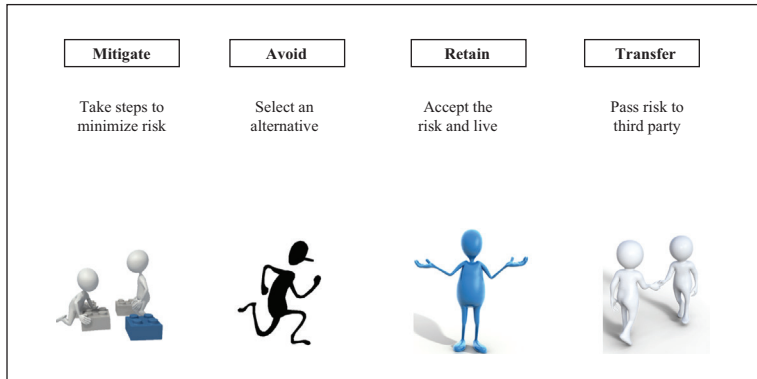


Figure 30. Risk response strategies.

successfully counter the risk. Often, potential for mitigation success can be evaluated by employing scenario planning and, in some cases, a trial run. Finally, the mitigation plan must be less taxing to the project than the risk itself. Often this is not the case and this explains why mitigation is not always employed as a strategy (Figure 30).

AVOID

When the risk is too significant to address via mitigation, it may be prudent for the project to *avoid* taking on project scope that is associated with the risk. When a project team chooses this approach for a given risk, then it forgoes the opportunity to complete some of the work that the project was chartered to accomplish. Unfortunately for the project team, this strategy is not always possible. The client may insist on the completion of the project as it was originally scoped. In this case, if the avoid strategy is still the optimal strategy, then the team could consider approaching elements of the project scope in a different manner. For example, the original risk may have been linked to the implementation of a given technological solution. An avoidance strategy in this case would involve the selection of an alternative technological solution rather than foregoing an element of project scope altogether.

RETAIN

There are some cases when the identified risk is significant enough to monitor, but not significant enough to neither take immediate action nor

avoid altogether. Under this circumstance the project team may decide to proceed according to the plan and address the risk only if it becomes an issue. Such a risk strategy is referred to as a *retain* strategy. When a risk is retained by the project, the “chips fall where they may” and the project team deals with the issue should it become necessary to do so. The advantage of the retain strategy is that it takes little effort to implement beyond monitoring the risk. The disadvantage of this approach is that it is possible for the risk to be underestimated and the resulting issue may result in much higher cost and effort than originally expected. Finally, even when risks are addressed by other response options, it is rare that the risk will be completely addressed. There is usually some level of remaining or residual risk. The residual risk is likely to be retained by the project as further risk responses may not be possible—or at minimum be too expensive compared to the value of the risk itself.

TRANSFER

Risk *transfer* is employed when the project team shifts the responsibility for some, or all, of the risk impact to another party. Risk transfer is often used outside of the project domain using the mechanism of insurance. When a firm purchases insurance, the insurance company is compensated for taking over the monetary responsibility for the insured loss. Insurance may be used in some circumstances in the context of a project, but more commonly the transfer of risk is carried out using contractual arrangements. For example, it is not uncommon for software and hardware component suppliers to contribute resources to the project team as a means of sharing the project risk. In this type of risk-sharing arrangement, it pays for the project manager to remember the phrase “no risk-no reward.” This is because that vendors who participate in a resource-based risk-sharing arrangement will be likely to specify in the contract that the intellectual property that is jointly created will be owned by both parties so that both parties to the contract may benefit in the future.

THE ELEMENTS OF THE RISK MANAGEMENT PLAN

What elements should be included in the risk management plan? The risk management plan for a project should answer the following questions:

1. Overall approach: How will risks be identified and assessed?
2. Roles and responsibilities: Who within the project team is responsible for the risk management process?

3. Categories: What categories of project risk will be targeted for focus?
4. Ranking and reporting: How will risk be ranked, reported, and revised on a periodic basis?
5. What risk response methods will the project team employ?

PROJECT PROCUREMENT MANAGEMENT

Few companies today are 100 percent vertically integrated. Vertically integrated companies, in addition to producing the final project, also make their own components. Because of complexity and specialization involved in modern highly technical projects, most companies rely on others to supply skills, know-how, and hardware and software components. Because of this, project managers will need to apply focused attention on developing a plan for managing outsourced components and labor. Some companies and projects alike experience varying degrees of success when outsourcing. One of the reasons for this is that, although companies may follow processes inside the company, the day-to-day nature of internal interfaces between functional groups can lead to an informal style of management. Requests for work products or resource assignments may be carried out with simple verbal requests and limited documentation. This style of management does not lend itself to working with outsource partners. An outsourcing partner is an entity outside of the internal organizational framework in which the project team resides. Such entities are likely to have a different culture, perhaps a different language, and may follow different processes and procedures. These differences require that all interaction must be formal and explicit rather than informal and implicit. All communications, requests, and orders within the outsourcing environment must be well documented so that nothing is left to chance. Project teams are supported by the PMBOK process framework because they operate outside the well-defined structure of the functional organization. Likewise, outsourcing to a team that operates outside the scope of both the company and its associated project team and functional hierarchy requires the highest degree of process discipline.

MAKE OR BUY?

The first step in project procurement is making the procurement decision. This decision is based on “make or buy” analysis. Make or buy is a determination whether it makes more sense to produce internally something

needed for the project, or to pay for third-party execution. Whether something makes sense or not depends upon many factors including the strategy of the company. Strategic management informs companies that strategically important work should be retained in-house whereas work not associated with the core competence of the company should be outsourced. Further, attention will be paid to the cost of the development—including the opportunity costs—as well as the overall capability of the project team. There are two questions associated with make or buy, and these are stated simply as:

1. “Can we do this?” and
2. “Should we do this?”

CAN WE DO THIS?

This first consideration in make or buy is one of feasibility as in “Can we do this?” It may make sense to produce hardware and software components in-house, but this really depends on the capability of the company. Capability may refer to resources, skills, time, specialized equipment, and funding. As a word of caution, project teams should observe caution the first time a feasibility study is conducted for an activity or component development. It may be tempting to compare in-house know-how with existing firms who have a lengthy track record of working with a given technology. Is it reasonable to expect that, even though in-house talent exists, a project team can match outside competence the first time that it is attempted? Chances are that the first attempt to produce a technology in-house will face more difficulty, consume more schedule, and cost more money than expected (Figure 31).

SHOULD WE DO THIS?

If it is determined that the team can produce a component or technology in-house, it is still important to consider if the team “should” attempt it internally. Regardless of cost or level of difficulty, strategic reasons at times will drive make or buy decision making. For example, if a piece of work or component is in alignment with the company’s core competence and is a source of strategic advantage, it may be prudent to keep the work in-house. Conversely, if an element of project work is deemed to not be of strategic advantage to the company, the work may automatically be considered a candidate for outsourcing.

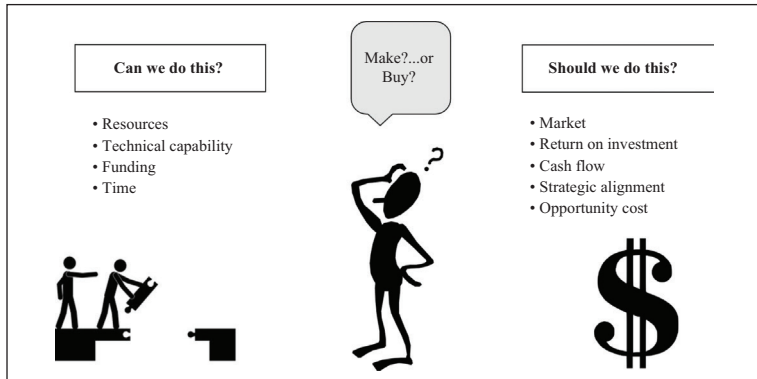


Figure 31. Make or buy analysis.

Another critical determining factor of outsourcing is the cost of internal development as compared to outsourcing. There are many pitfalls associated with the cost analysis of the “make versus buy” equation. These include the following important considerations:

1. *First time:* The first time a technology or component is developed internally, it will likely cost more than expected. A first-time make versus buy decision may understate the cost. Project management texts often refer to the learning curve in this respect. Although the principle of the learning curve applies, the mathematics behind it usually does not within the context of a project. In manufacturing, the learning curve assumes that the cost of a product or component decreases according to a specific formula as the output doubles. The doubling of output is rarely, if ever, a factor in the project context. Instead, the general principle that the “second time around” (or the “second time something is done is easier than the first”) applies.
2. *Outsourcing quote:* An initial quote from a potential outsourcing vendor may be appealing. However, it pays to examine the quotation closely. Often the quoted cost makes overly favorable assumptions. These assumptions may include the availability of well-documented requirements as well as the project team experience in managing outsourced partners. Further, it may be assumed that requirements and specifications will not change. Each of these assumptions is unlikely—leading to surprises in the actual cost experienced in the outsourcing engagement. Recall that informal communication and changes are likely to take place between the project team and functional groups inside the organization. If this

informal ad hoc approach typical of the internal environment is undertaken with an outsource partner, expect costs to rise quickly.

3. *Lifecycle costs*: It is one thing to develop a hardware or software component and estimate the expense of the development from conception to launch. It is quite another matter to support the developed component long after it is delivered. The ongoing support of the system or component after it is delivered is something that is often missed in the “make versus buy” example. For example, the use of open-source software provides an example of lifecycle costs that often get missed. Open-source software may be appealing as a basis for development. The license itself is free—but development using such software will often assume that an in-house staff is available to update and repair defects. It is also possible that the ability to maintain such software may exceed the capability of the project team in the long term. If so, then outsource service providers will be required to assist. The failure to consider total lifecycle costs has a tendency to understate the internal costs in a make versus buy analysis.

A common thread throughout these examples is the tendency to understate costs. The fact that internal costs are often understated should be a caution to avoid making an outsourcing decision too quickly.

VENDOR SELECTION

Once it is determined that project activities or deliverables will be outsourced, the project team will need to select an outsource partner. There are many facets to this decision and this may require taking steps to understand what outsourcing players exist in the market, and what they offer in terms of skills, know-how, or intellectual property. Often the process involves reaching out to the vendor community using formal inquiry and solicitation documents.

THE RFI

In many cases, a project team may lack sufficient expertise to determine an appropriate outsource partner. The project team may need a better understanding of the options that exist in the market, the architectures that are employed (in the case of components employed in complex system development projects), and the level of expertise and experience that exists. In this situation the project may issue an RFI or “Request for

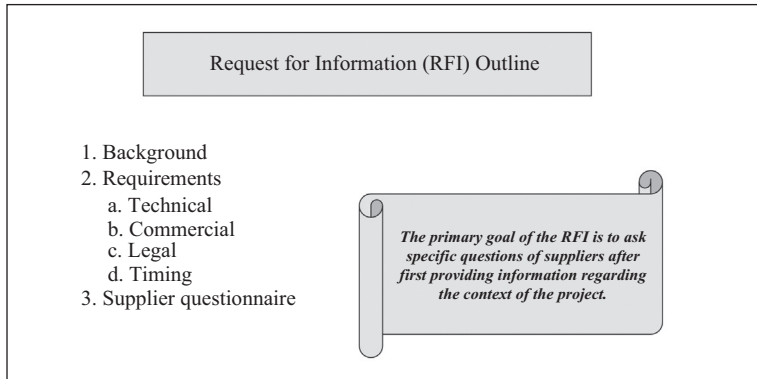


Figure 32. Elements of the RFI.

Information.” Although the RFI is used to reduce the unknowns in a procurement setting, the RFI should provide sufficient context for vendors regarding the nature of the problem that, through outsourcing, they will attempt to solve. Further, the RFI should seek answers to specific questions. Finally, RFIs are then evaluated and used as a means for educating the project team so that may properly frame further solicitations for potential outsource partners (Figure 32).

THE RFQ

When the project team has decided to outsource a relatively simple component—or labor to produce project deliverables—the project team may issue a “Request for Quotation” or “RFQ.” An RFQ could also be issued in the case of a complex outsource engagement, but is typically only employed if the solution is already defined. The RFQ may follow the issuing of an RFI and be based upon the information supplied from vendors. On the other hand, the RFQ may succinctly state the need, possibly the desired terms and conditions, and request a pricing quotation. Finally, it is also not uncommon for a project team to work regularly with different vendors. In this case, a formal RFQ is not always issued. However, in some cases an RFQ may be issued simply to avoid a biased decision and to ensure that competition is fostered between vendors (Figure 33).

THE RFP

A complex procurement involving a major subsystem, or significant hardware or software component, may require a detailed proposal from a

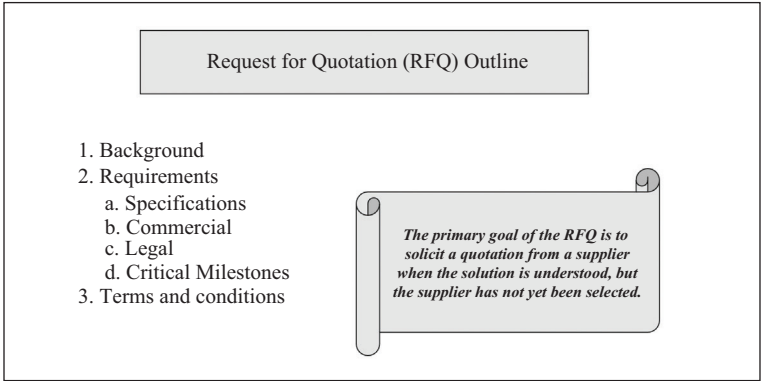


Figure 33. Elements of the RFQ.

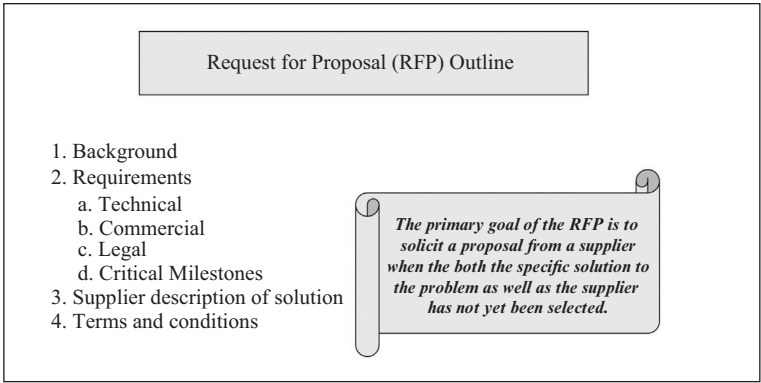


Figure 34. Elements of the RFP.

supplier. Such a proposal may be nearly as complex as the overall project as it may involve multiple deliverables, milestones, technical details, and payment schedules. When the project team has decided to outsource work or deliverables at a significant scale, a request for proposal or RFP is an appropriate vehicle for inviting suppliers to submit plans and compensation requirements for supporting the needs of the project team. The RFP will involve considerably more details than an RFQ and will follow the RFI in sequence if an RFI is used. The RFP therefore requests vendors to propose a solution to a problem or set of problems. In the RFP, neither the supplier nor the exact solution has been chosen. It should be noted that some project teams do not make a distinction between the terms “RFQ” and “RFP.” In some cases, a project manager or supplier may find that the terms are used interchangeably regardless of the degree to which the solution has already been defined (Figure 34).

VENDOR QUALITY MANAGEMENT

The quality management processes of the supplier are of key concern to the project team prior to initiating an outsourcing agreement. Having a certification such as the ISO 9000 family of certification is no guarantee of quality. Certifications require that a quality process be documented and followed—but it is not normative in the sense that it does not specify what quality process is to be followed. It is up to the project team to visit the candidate supplier, evaluate the processes, and audit the supplier to confirm that the processes it follows are sufficiently robust to support the requirements of the project team. It pays to consider normative quality management systems such as project management and software development maturity models. These are the “OPM3” (Organizational Project Management Maturity Model) and the “CMM” (Capability Maturity Model). Maturity models relate to quality in that they not only require that a company document and follow process but that the organization follow a specific set of processes (Figure 35).

Maturity models suggest process steps that, if followed, are recognized to produce superior outcomes. Another concern of maturity models is “process maturity.” A company is said to be mature in terms of process if it follows documented processes without fail and has initiatives in place to improve processes over time. Mature organizations reject the use of informal ad hoc action. Regardless of quality management system or maturity model said to be followed by the candidate vendor, there is no substitute for face-to-face engagement and evaluation by the project team.

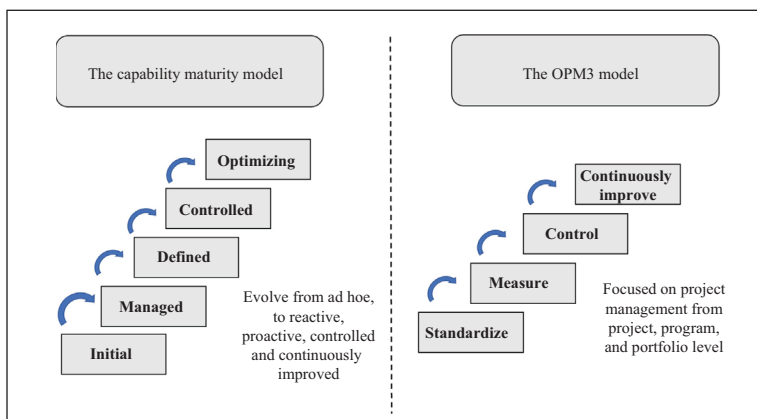


Figure 35. Maturity models.

PERFORMANCE TRACK RECORD

It is no secret that candidate suppliers have the tendency to “put their best foot forward” when making proposals. Vendor proposals will almost always appear to be very appealing. Project teams should be aware of this and seek to go beyond proposal responses and conduct due diligence on the historical performance of the supplier. One important means for accomplishing this is to reach out to previous customers of the supplier. A project team would be well advised to seek out these contacts without assistance from the candidate supplier to avoid bias in the process. As an additional suggestion, if the vendor customer base is relatively large, performance data may be collected via an electronic survey instrument. Regardless of how the data is collected or from where it originates, historical performance is a good indicator of the performance that may be expected in the future.

SUPPLIER FINANCIAL HEALTH

Although the project team will seek to minimize outsourcing costs, it is important to recognize that a supplier, just as in the case of the sponsoring project team, must be profitable to achieve long-term health and success. The project team must include in its procurement planning an evaluation of the financial situation of the supplier. The worst-case scenario is to design in a component or hire rare skills—only to have the vendor go out of business. Although outsourcing may appear on the face of it to be a short-term engagement, the project deliverables as well as the support of the deliverables are likely to be of concern for the long term. In addition to tangible requirements such as cost, performance, and delivery schedule it is essential that support after the launch be considered in the quote and the cost of the quote. In keeping with this sentiment, recall the old saying that “If something appears to be too good to be true—it probably is.” It is there is a good idea to scrutinize and possibly avoid the lowest outsourcing offer—particularly if long-term support is required.

In addition to scrutinizing the offer itself, the project team can collect financial information on the company. If the company is publicly traded, the project team may easily acquire the supplier financial reports for the past several years and, in addition, download current financial status from the supplier’s investor relations website. Further, investors who follow the company may periodically report their views on the long-term

financial prospects of the company. This is another important source of information.

CONTRACT NEGOTIATION

When the project team selects a supplier for an outsourcing engagement, the details of the outsourcing are spelled out in detail using contracts. The terms of the supplier contract make a significant difference in the outcome of the project and may make the difference between profit and loss. The vehicle for achieving the right contract terms is negotiation. Supplier negotiation, like all project activities, is planned prior to execution. Because of this, the approach to negotiation to be used by the project team should be outlined in the project plan. Project managers may well ask “What is it about project negotiation that can be planned?” This question is likely spawned by the presumption that negotiation is all about argumentation and meeting tactics. Contrary to popular belief, project contract negotiation is not something best carried out by “pounding the table,” but rather by clearly identifying what the project team needs as well as what the project team is willing to exchange for something else. Additionally, project teams include in their preparation an assessment of what the supplier is likely to need as well as what the supplier may be willing to exchange. The goal of a successful supplier negotiation is to achieve a result in which the project team exchanges what to them is less important for something that, to the project team, is more important. The possible scenarios for exchange should be carefully considered and rehearsed prior to the negotiation engagement. The results of the preparation should result in a spreadsheet that anticipates possible exchanges so that the meeting may be steered to a desired conclusion. When the negotiation begins, recognize that negotiation usually proceeds in phases—so do not expect to walk away with exactly what is needed for a project right away. In fact, a quick resolution to contract terms is not always desirable. One reason for this is that multiple vendors may be in the running for the project team contract. The longer that multiple vendors are competing, the better the opportunity for the project team to receive favorable terms. Delays based on commercial considerations must be balanced however with the logistics of producing the project deliverables. Keep in mind that commercial considerations are only one part of the supplier engagement. Technical professionals on the project team will seek to complete contractual terms quickly so that work on technical solutions may proceed as soon as possible. When developing the plan for supplier engagement and

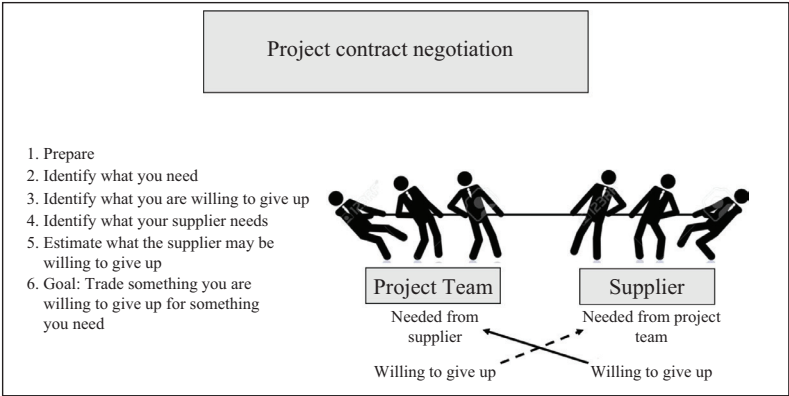


Figure 36. Project contract negotiations.

negotiation, recognize up front the conflict that is likely to arise between the technical and commercial arm of the organization (Figure 36).

CONTRACT SCOPE AND ACCEPTANCE CRITERIA

Contracts elaborate the responsibilities and assumptions of each party to the agreement. Contracts are also a means for distributing risk among the parties. For example, contracts typically outline a schedule for both deliverables as well as payments. The contract includes any required up-front payment amounts. Up-front payments reduce the risk of the contracted—but not necessarily the contractor. Further, the contract will describe any alternative risk-sharing arrangements such as making resources available to aid in completing the work—either on the side of the outsource party or the project team. Just as importantly, a good contract describes not only the scope and specifications of the contracted deliverables but also the acceptance criteria for the deliverables. The acceptance criteria include the acceptance testing process, set expectations for quality, and describe the order of events required for final payment. A contract without a clear set of acceptance criteria expectations is one that will likely lead to conflict with the supplier as the end of the project approaches. For example, it is possible that the supplier will declare that the work is finished—only to have the project team formally announce that it isn't. Acceptance criteria solve this problem long before it emerges in the project as a problem.

CONTRACTS AND RISK

The type of contract issued by the project team determines the level of risk sharing between the parties including which party bears a greater measure of risk. The ideal contract type for a project team is a fixed-price contract. In this type of contract, the supplier agrees to an overall amount for the work and deliverable thereby locking in the price for the project team. Such a contract is of high risk to the supplier given that cost overruns are not covered by the contract. Accepting a fixed-price contract therefore requires significant skill at project estimating. Although a fixed-price contract limits the risk of the project team, fixed-price contracts are not without risks. It is possible for a supplier to underbid for project work and end up in a position where the supplier is not able to complete the work. Worse still, if the project is a significant one, the supplier could go out of business due to losses associated with underbidding. The financial analysis of the supplier by the project team becomes even more important in the context of a fixed-price contract. Another way to attempt to reduce the risk of a fixed-price contract when multiple suppliers are bidding for the contract is to avoid accepting the lowest bid. One approach is to make it known that the project will accept the “second lowest bid.” This encourages suppliers to bid low—but not so low that they put their business in danger. Finally, the project team is advised to carry out its own cost analysis of the work for comparison and benchmarking to ensure that the quotation received is reasonable (Figure 37).

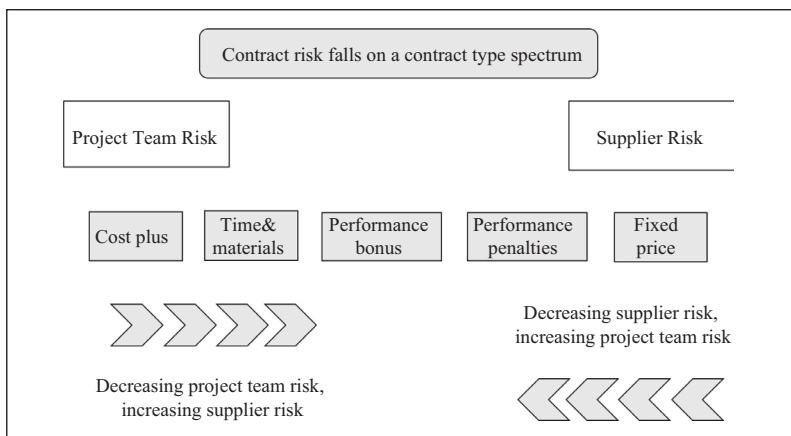


Figure 37. Contracts and risk.

At the opposite end of the risk spectrum lies the “cost-plus” contract. In the cost-plus contract, the project team agrees to cover the cost of the supplier and, in addition, pay a percentage of the overall amount as profit. Such an arrangement takes the risk burden off the supplier and places it with the project team. The project team lacks in this contract a clear way to control the cost and will naturally lack visibility in the final cost of the deliverables. While the cost is a disadvantage, the cost-plus contract may be necessary in some circumstances depending upon the financial health of the supplier. In addition, taking such an approach, although increasing the cost risk, may reduce other risks such as the lack of suppliers for an element of project work. A cost-plus arrangement is one method of “locking in” a supplier during a period when such resources are scarce. Between the two extremes of contractual arrangements, many others exist that may be employed depending upon the project circumstances. The choice of contract ultimately depends upon the context and which risk category is most desirable on the part of the project team to reduce.

CLOSING PROCUREMENTS

The PMBOK framework includes closure processes for not only the overall project, but also project procurement activities. Closing procurement engagements are particularly important because they involve considerable expense. For example, outsource labor and equipment rentals will likely involve ongoing monthly payments. If the contracts of these resources are not terminated, then the invoices for service will continue to be billed to the project. It is often the case, however, that some level of ongoing support for supplied components or other project deliverables will be required. This type of support will typically involve a contract addendum or an additional contract. Further, when a project terminates, there must be a formal methodology in place to manage the ongoing support. If the ongoing vendor support is continuous in nature, it may be prudent to formally hand over the long-term support of the deliverables to the ongoing operation of the company. On the other hand, if the support is likely to consist of a series of releases, it may make sense to charter a maintenance project team to work with the supplier after the initial procurement is terminated.

THE ELEMENTS OF THE PROCUREMENT MANAGEMENT PLAN

What elements should be included in the risk management plan? The risk management plan for a project should answer the following questions:

1. Should the project outsource the work or components in question, or should the work be carried out internally within the project?
2. What criteria—strategic and operational—will be employed in carrying out the “make versus buy” decision?
3. What means will be used to communicate requirements to potential vendors?
4. How will outsource vendors be selected?
5. How will the capability, performance, and financial strength of the vendor be evaluated?
6. What is the risk tolerance of the project and how will this be reflected in the vendor contractual arrangements?
7. What process will be employed to terminate project procurements?

PROJECT STAKEHOLDER MANAGEMENT

Stakeholders and communication go hand in hand—so much so that originally stakeholder management and project communication were combined into a single knowledge area. The stakeholder management knowledge area in the current edition of the PMBOK offers process steps for promoting a high degree of interaction with project stakeholders. The management intensity as well as the level of engagement infers that stakeholders should not be viewed as something distinct and separate from the project team—but rather part of a holistic system involving connections, communication, and constant interaction. The project stakeholder management knowledge area follows in lock-step with the five process groups. Stakeholder activities begin with the initiating process group and continue through the monitoring and control process group.

WHO ARE STAKEHOLDERS?

One of the first steps undertaken in any project is the identification of project stakeholders. On the face of it, this would appear to be a simple matter given that a stakeholder may be defined as “anyone who has an interest in the outcome of the project.” Stakeholder identification however is complicated by the fact that stakeholders exist who may not initially be considered. Take for example the case of an office relocation. The immediate concern of the project would be the employees involved in the move, the landlord of the existing and the new building, and finally other tenants in each building. A deeper consideration of stakeholders goes beyond this narrow view and considers individuals such as family

members employees, members of the community, local establishments such as restaurants and fast-food outlets, and finally local and regional government officials. In practice, it is not the stakeholders that the project team considers that are likely to become a problem—but rather those whom the project team fails to consider. When it comes to stakeholder identification, it pays to cast a wide net.

STAKEHOLDER IMPACT

Project stakeholders may be numerous, but not all project stakeholders have the same ability to impact the project. Further, the limited resources within the project team make it incumbent upon the project manager to pay closer attention to the stakeholders with the greatest ability to affect the project. It is for this reason that stakeholder identification does not end with a listing of project stakeholders. Rather, stakeholder identification includes the analysis of stakeholders so that the level of stakeholder management effort may be prioritized. Such analysis includes a determination of the power of each stakeholder along with the relative interest of the stakeholder in the outcome of the project. Naturally, the project team will spend more time and effort engaging with the stakeholders who hold sway over the resources or outcomes of the project as well as those who are highly interested in the project result. The list of project stakeholders is therefore supplemented by a “Power/Interest” ranking ranging from high to low for each factor (Figure 38).

When carrying out this analysis, it is important to remember that not all stakeholders with an interest in the project support the project. Some interested stakeholders may desire to see the project fail. This is especially true in large-scale public projects that engage with a wide array of stakeholder constituencies. Identifying “negative” stakeholders is a factor to be taken into consideration when developing project communication and engagement strategies.

STAKEHOLDER ENGAGEMENT

The term “engagement,” according to Dictionary.com, can refer to an encounter or, in the sense of mechanical mechanisms, the state of being interlocked. This definition provides a glimpse of the rationale behind project stakeholder engagement as described within the PMBOK. Project teams work closely together with stakeholders—and particularly those who rank most highly in terms of “power/interest.” Yet, an effective

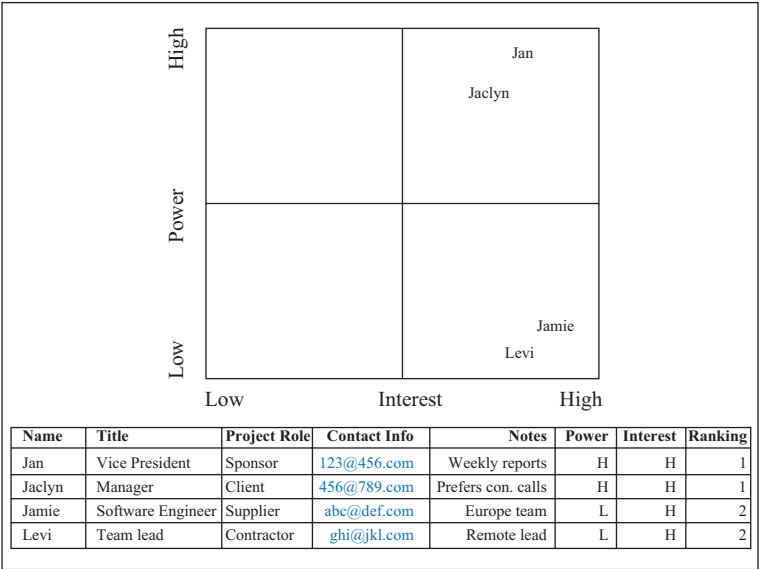


Figure 38. Stakeholder analysis.

project plan will lay out the strategy for “how” project stakeholders are to be engaged. An engagement plan may be multifaceted and make use of several approaches. For example, it is common to assign project team members specific stakeholders with which to engage. The engagement itself will likely take many forms ranging from formal and informal face-to-face meetings, ongoing conference calls or videoconferences, or gatherings at annual events such as industry conferences. Regardless of the chosen engagement strategy, in keeping with the fundamental approach of “planning before doing,” it is important to think through the engagement and to formally document it.

MANAGING AND MONITORING ENGAGEMENT

After the stakeholder engagement plan is documented, the project manager then engages assigned stakeholders and further takes steps to ensure that the engagement plan is being carried out. The execution of the plan may be carried out using the preferred tools and techniques of assigned team members. However, the progress to plan of stakeholder engagement as well as any exceptional issues should be reported out regularly in team meetings and project reviews. In the same way that stakeholder identification and analysis go together, managing and monitoring stakeholder

engagement are linked. To ensure ongoing engagement and monitoring of the engagement of key stakeholders, it is suggested that each team member assigned to engage a stakeholder should be referred to as a “stakeholder manager.” In addition to acting as a project team member, the adoption of the role of a project “stakeholder manager” brings clarity to the role and aids in the ongoing management and monitoring of the process.

THE ELEMENTS OF THE STAKEHOLDER MANAGEMENT PLAN

What elements should be included in the stakeholder management plan? The stakeholder management plan for a project should answer the following questions:

1. Who are the project stakeholders?
2. How will the project team determine management and engagement priority of project stakeholders?
3. How will project stakeholders be engaged?
4. Who on the project team is responsible for stakeholder engagement?
5. How are stakeholder managers assigned?

THE OVERALL PROJECT PLAN: A PRACTICAL EXAMPLE

The difference between a project schedule and a complete project plan is easier to understand with the use of an example of a simple project that is likely to be encountered within the workplace. The project used to demonstrate the elements of a complete project plan is an office relocation project illustrated in an outline form. Further, the plan is elaborated by successively progressing through the process steps outlined in the five process groups.

OFFICE RELOCATION PROJECT PLAN: INITIATING PROCESS GROUP

Project charter: An office relocation project usually begins with an assignment from a sponsoring executive. The sponsoring executive will

Office Relocation Project Charter													
Project Name: Office Relocation Date: 1/1/2018 Project Manager Signature: <u>John Smith</u> Project Sponsor Signature: <u>Ed Jones</u>													
Project Purpose & Description: Identify a new office location, acquire it, and prepare it for occupation. Pack and move existing furniture and equipment and close the legacy facility													
Key Milestones: Select new location: +30 days. Location Move-in Ready: +60 days pack and move from existing building: +75 days. Close project: +90 days.													
High-Level Budget: \$25,000 target total budget													
Constraints: Operations must not be interrupted by move. Maximize use of existing equipment. New facility must be within 25 mile radius of existing facility													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; padding: 5px;">Project Role</th> <th style="text-align: left; padding: 5px;">Team Members</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;"><i>Position</i></td> <td style="padding: 5px;"><i>Name</i></td> </tr> <tr> <td style="padding: 5px;">Project Manager:</td> <td style="padding: 5px;">John Smith</td> </tr> <tr> <td style="padding: 5px;">IT Lead:</td> <td style="padding: 5px;">Noah Weyers</td> </tr> <tr> <td style="padding: 5px;">Facility lead:</td> <td style="padding: 5px;">Bree Kause</td> </tr> <tr> <td style="padding: 5px;">HR lead:</td> <td style="padding: 5px;">Ben Effits</td> </tr> </tbody> </table>		Project Role	Team Members	<i>Position</i>	<i>Name</i>	Project Manager:	John Smith	IT Lead:	Noah Weyers	Facility lead:	Bree Kause	HR lead:	Ben Effits
Project Role	Team Members												
<i>Position</i>	<i>Name</i>												
Project Manager:	John Smith												
IT Lead:	Noah Weyers												
Facility lead:	Bree Kause												
HR lead:	Ben Effits												

Figure 39. Office relocation plan project charter.

typically appoint a project manager to lead the effort. In some cases, the project may be assigned informally. However, following good practice requires the formalization of the project by means of issuing a project charter. The project charter will likely include some high-level direction regarding scope and key constraints. On the other hand, the development and management of the project scope will likely be carried out by the project team (Figure 39).

BUDGET ESTIMATES AND THE PROJECT CHARTER

One of the constraints typically provided in the project charter is the budget estimate. This is an early estimate and likely to be inaccurate. The project team will at this early stage consider this estimate as an indication of the scale of the project as well as the financial statement of intent from senior management. The project manager should accept this as a top-down budget guide and proceed to develop a bottom-up cost estimate after collecting detailed financial information associated with each activity in the office relocation.

Project stakeholder identification: The planning process group outlines a series of processes to be included within the development of the project stakeholder management plan. However, in the initiating process group, the important activity to be carried out is simply the identification of project stakeholders. At this critical juncture, it is essential to think holistically in terms of who may have an interest in the outcome of the office

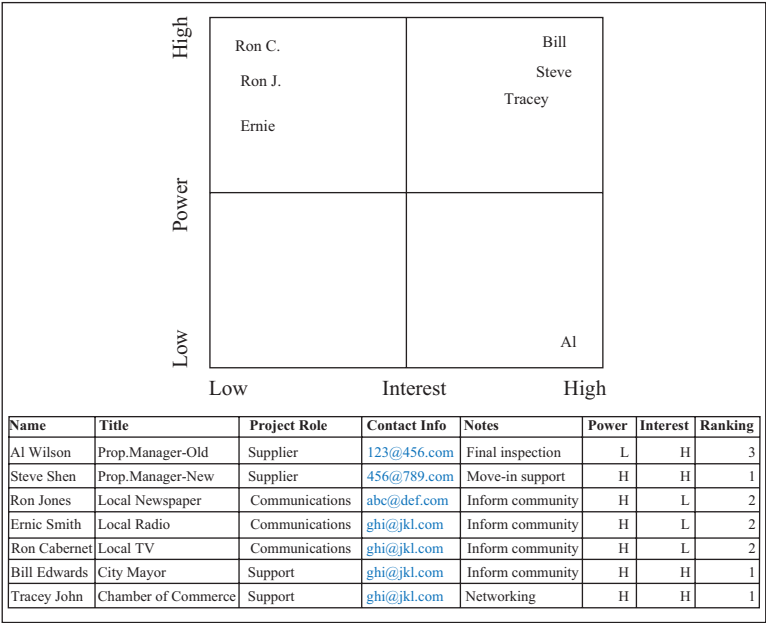


Figure 40. Office relocation project stakeholders.

relocation project. The project team would likely identify the following roles and individuals as candidates for project stakeholders (Figure 40).

OFFICE RELOCATION PROJECT PLAN: PLANNING
PROCESS GROUP

It is the planning process group where the work of developing the project plan for the office relocation project unfolds. Technically, the project plan begins with the project integration knowledge area with the “develop project management plan” process. Given that the plan for relocating the office has already begun, the first tangible step in developing the project plan is in the project scope management knowledge area.

Project scope management: A project that touches upon so many different stakeholders can easily grow in scope. Clear identification of what is in scope and out of scope is an essential step to prevent the runaway growth of scope. This begins with stating the basic strategy for managing scope.

Plan scope management: The “plan scope management” process directs the project team to outline the basic approach for identifying,

Simple Scope Management Plan Outline		
#	Scope Category	Management Strategy
1	Scope Statement Development	<i>Team Brainstorming</i>
2	WBS Development	<i>Facilitated team planning meeting</i>
3	WBS Dictionary Development	<i>Assigned to project core team members and reviewed by team</i>
4	Scope Baseline Management	<i>Client and sponsor sign-off followed by change control process</i>
5	Requirements Tracing and Confirmation	<i>Requirements database and client validation</i>
6	Deliverables Acceptance Criteria	<i>Document for each deliverable with client sign-off</i>

Figure 41. Scope management plan.

planning, and controlling scope. This need not be a complex plan—rather it must serve as a useful guide to direct the management of scope from the beginning to the end of the project. Since the plan scope management plan is focused on documenting the approach the project team will use to manage scope, it may require no more than a simple checklist or “fill in the blank” checklist (Figure 41).

Scope statement: The scope of the project is fully elaborated within the work breakdown structure (WBS). The WBS follows the simple and succinct statement of what is and what is not included in the project. The scope statement for the office relocation is stated as follows:

We will assess our current needs as well as growth needs for the next three years. We will identify, select, lease, and create an office layout in a new building and move our company. We will seek to use as much existing infrastructure as possible. Modifying our existing building will NOT be considered as an option.

Work breakdown structure: The project WBS provides a hierarchical and categorical structured outline of what the project will deliver. It is hierarchical in that it consists of multiple levels. It is categorical in that it includes all categories of project scope. The WBS outlines 100 percent of what the project will deliver. The WBS for the office relocation project is as follows (Figure 42).

Scope baseline: A project plan includes a baseline of project scope. The baseline is the agreed upon scope that is fixed as part of the plan. Any change to project scope after the baseline has been established is governed by the project change control process. The scope baseline includes the scope statement, the WBS, and the WBS dictionary. The WBS dictionary in the project plan includes, in addition to the WBS elements, a succinct definition of each WBS element (Figure 43).

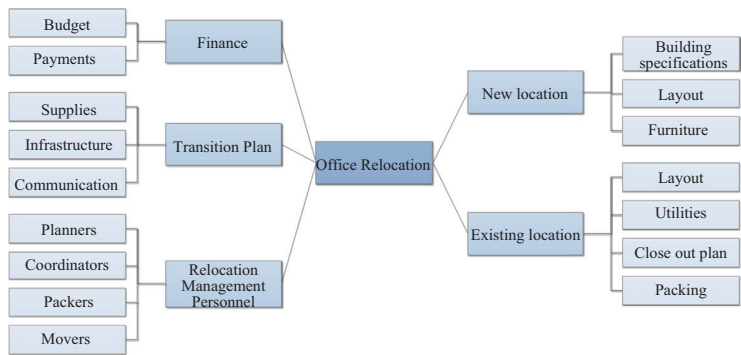


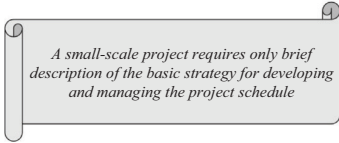
Figure 42. The office relocation WBS.

Simple WBS Dictionary		
	Office Relocation	Description
1.00	Finance	Funding and cash flow for move
1.10	Budget	Spending plan for move
1.20	Payments	Compensation for outside contractors
2.00	Transition Plan	Plan for move and uninterrupted operations
2.10	Supplies	Materials required for move
2.20	Infrastructure	Physical facility requirements
2.30	Communication	Information delivered to stakeholders
3.00	Relocation Management Personnel	Team members assigned to relocation project
3.10	Planners	Project team members assigned to develop plan
3.20	Coordinators	Project team members interacting with functional groups
3.30	Packers	Outside contractors responsible for packing
3.40	Movers	Outside contractors responsible for moving
4.00	Existing Location	Plans for transition from and shut down of office
4.10	Layout	Documentation of existing layout
4.20	Utilities	Documentation of utility requirements
4.30	Close-out Plan	Plan to shut down existing office
4.40	Packing	Preparing and packaging furniture and equipment
5.00	New Location	Plan for identifying, selecting, and occupying new facility
5.10	Building Specifications	Documented specifications of new building
5.20	Layout	Design of layout for new facility
5.30	Furniture	Plan for furniture in new facility

Figure 43. The WBS dictionary.

Project schedule management: The first step in schedule management is to describe the basic approach or strategy for managing the overall project schedule. This strategy will outline how activities will be defined and associated with deliverables, how the logical sequence of events will be determined, and what methods will be used to determine the overall project duration. Schedule management could also describe the methodology used to analyze and predict project completion including tools such as PERT, Monte Carlo, and Bayesian analysis. The high-level schedule management plan for the office relocation project is outlined in the following Figure 44.

Simple Schedule Management Plan Outline: Office Relocation Project		
#	Scope Category	Management Strategy
1	Methods	<i>Facilitated team schedule development workshop</i>
2	Tools	<i>Network diagrams, PERT Analysis, Gantt Charts</i>
3	Time Units	<i>Weekly time units given relatively short overall duration</i>
4	Reporting	<i>Weekly updates on schedule progress to plan: Executives and stakeholders</i>
5	Control	<i>Tracking Gantt chart and change control process with executive sign-off</i>



A small-scale project requires only brief description of the basic strategy for developing and managing the project schedule

Figure 44. Schedule management plan.

1	New location requirements
2	New location
3	Select
4	Inventory current location
5	New location layout
6	Select moving
7	Order
8	Purchase network &
9	Negotiate
10	Pack furniture
11	Pack computer equipment
12	Transport moved items
13	Unpack
14	Cutover to new
15	Close existing building

Figure 45. Office relocation activities.

Identify project activities: The WBS is created by considering all deliverables that will be produced by the project. Once the deliverables are defined, the project team next considers what activities will be required in order to produce the deliverables. The only activities that are used to develop the project schedule must be linked to specific deliverables. Activities are often identified by the project team using a brainstorming methodology, by the application of expert judgment, or historical project experience. The specific method used is identified by the schedule management plan. The activities required to support the deliverables of the office relocation project are identified in Figure 45.

SEQUENCE PROJECT ACTIVITIES

The office relocation project team next arranges the project activities in a logical order. To clarify the order of activities and prepare for the determination of the overall project duration, the project activities are sequenced using a network diagram. The office relocation project critical path is tentatively identified using initial duration estimates for each activity (Figure 46).

Project duration: The project activity nodes given in the office relocation network diagram are then expanded to provide three-point estimates for each activity. The three-point estimates are then combined using the PERT weighted average method. The critical path duration that results from the PERT analysis includes variances in project activities so that the result further supports the development of schedule completion predictions (Figure 47).

Project cost management: The cost of human resources assigned to project activities is typically the most significant source of cost within a project. However, many of the resources assigned to the office relocation project are internal resources who remain on the payroll regardless of assignment to the project or when working within an assigned functional group. However, the average “fully-loaded” costs (salary, benefits, plus overhead allocation) for each internal employee are captured in the project

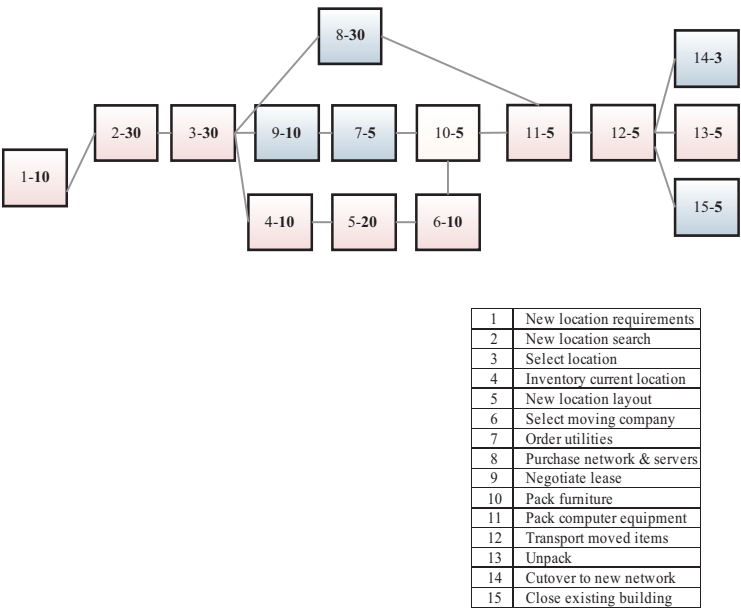


Figure 46. Sequencing office relocation activities.

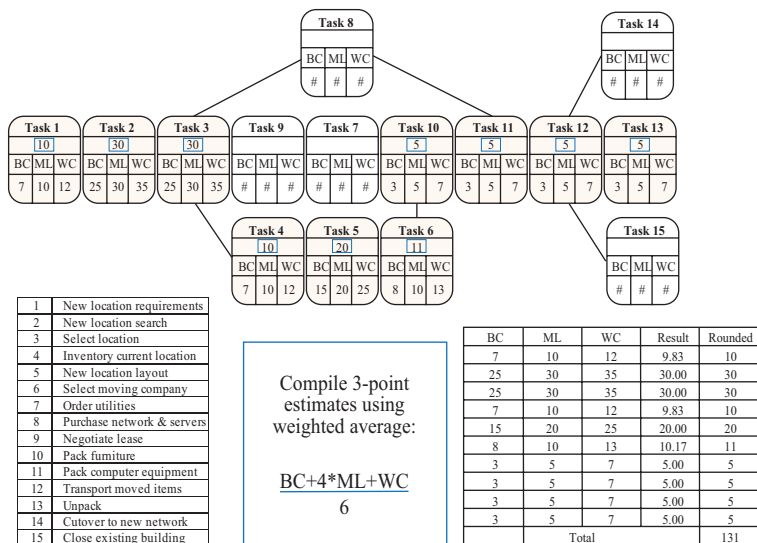


Figure 47. Identifying project critical path.

Simple Cost Management Plan Outline		
#	Scope Category	Management Strategy
1	Budget plan	Facilitated team budget development workshop
2	Tools	Cost accounting system, spreadsheets, LP Optimization
3	Estimation	Bottom up estimate compared with top-down management budget
4	Reporting	Weekly updates on schedule progress to plan: Executives and stakeholders
5	Control	Requisitions and check requests outside budget requirement management review

The cost management plan describes the basic strategy for estimating, developing, reporting and controlling the project budget

Figure 48. Office relocation cost plan.

cost plan as they are assigned to the project. Such costs are not indicative of an additional cash outlay but could be viewed as opportunity costs. Further, the costs of external resources used for packing, moving, new facility setup, and so on are captured in the budget as the resources are employed in the schedule. The project will track internal resource costs as opportunity costs, and actual cash outlays to outside vendors in separate accounts. The simple high-level project relocation cost plan is provided in Figure 48.

Project quality management: The focus of quality management within the office relocation project includes the meeting of requirements for the new facility, achieving the target budget and schedule, and minimizing disruption to the company during the transfer and relocation. In addition, the project team has the additional requirement of ensuring a smooth cutover of office networks and utilities as well as leaving the existing office in pristine condition. The project quality management plan for the office relocation project outlines the tools, techniques, and specific actions that the project team will take to ensure that the relocation project aligns with goals and requirements as the project unfolds (Figure 49). Quality in this project is defined as “meeting the requirements of the project stakeholders.”

Project resource management: The office relocation project will draw upon internal as well as external resources throughout the project. It is anticipated that some overtime will be required during the critical period of the move. In addition, the move will occur during a holiday weekend to minimize operational downtime. The resources assigned to the project will be informed of the extended calendar for the move dates. Finally, the resource management will direct functional groups and departments to form teams to inventory equipment and organize desk and personal items for packing and transfer. Of key concern of a project of this type is the clarification of responsibilities of team members assigned to carry out project activities. The tool used for this purpose is the responsibility assignment matrix (RAM) (Figure 50). A common approach to populating a RAM is to assign responsibility to specific activities that produce WBS deliverables, and in addition identify the nature of the responsibility

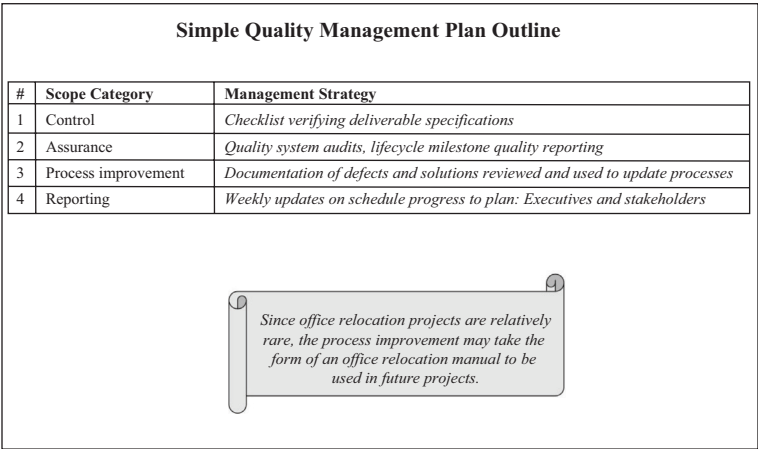


Figure 49. Office relocation high-level quality plan.

PARIS	Sponsor	Project Manager	HR Lead	Facility Lead	IT Lead
New location requirements	S	A	I	P	P
New location		I	A	I	
Select location	S	A	P	P	I
Inventory current location		I	P	A	P
New location layout		S	P	A	P
Select moving company		A	P	I	I
Order utilities		S		A	P
Purchase network & servers		S		I	A
Negotiate lease	S	A	I	I	I
Pack furniture		A	I	P	I
Pack computer equipment		S	I	P	A
Transport moved items		A			
Unpack		P	P	A	I
Cutover to new network		S		P	A
Close existing building	S	P	P	A	P

Participant-Accountable-Review-Input Required-Sign-Off

Figure 50. Office relocation project responsibility assignment matrix/PARIS chart.

held by each stakeholder. Some stakeholders may be involved with the development of a deliverable as a *participant*. The team lead for a specific deliverable may be ultimately *accountable* for that deliverable. Other stakeholders may be asked to *review* the work or to provide *input*. Finally, a stakeholder may be assigned to provide the final *sign-off* on the completed work. These responsibilities may be abbreviated as *PARIS*. Each responsibility category for each key stakeholder and deliverable is labeled as P, A, R, I, or S in the responsibility assignment matrix.

Project communication management: Of central importance to an office relocation plan is the reduction of employee uncertainty as well as helping stakeholders within the old and new building and community to feel comfortable with the relocation. The office relocation plan emphasizes communication to these important stakeholder groups and, in addition, describes the media to be employed as well as the frequency of communication. One of the key elements of the communications plan will be kickoff meetings to announce the project, a farewell event at the existing facility, as well as a ribbon-cutting event in the new facility (Figure 51).

Project risk management: An office relocation project has the potential to negatively impact the business in many ways. Employees who do not favor the new location or the commute may be tempted to look for alternative employment. System and operational downtime may damage the reputation of the company and cause customers to seek other options. These risks are linked to many causal factors such as poor communication

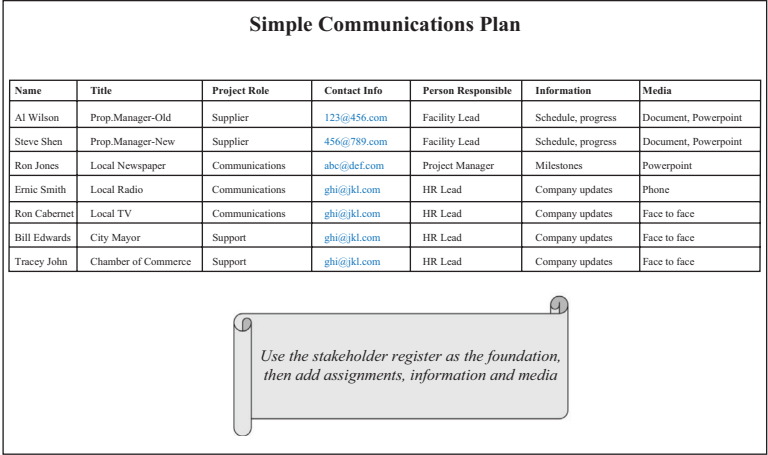


Figure 51. Office relocation communications plan.

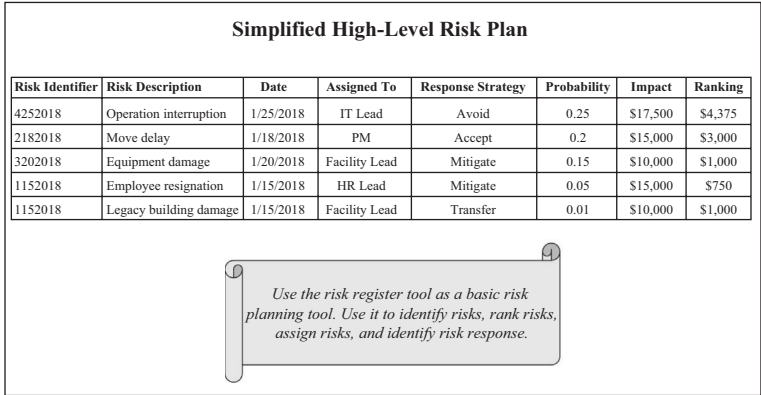


Figure 52. Office relocation project risk management plan.

to stakeholders and the community, to external suppliers failing to meet timely transition targets. The risk management plan for the office relocation project will therefore employ multiple brainstorming sessions as well as scenario planning so that risk and causal factors are identified and risk response mechanisms are planned. The high-level office relocation project risk plan is shown in Figure 52.

Project procurement management: Of primary importance to the office relocation project is the selection of major vendors including the owners of the new building property, the moving company used to pack, move, unpack, and assist with the setup of the new operation, and finally

Simple Project Procurement Plan
Project Name: Office Relocation project
Date: 1/15/18
Moving company selection method: Weighted Ranking Method
Building selection method: Weighted Ranking Method with key stakeholder input
Contract negotiation: Moving company: PM with executive support Building Lease: General manager Equipment and supplies: Project manager
Contract type: Moving company: Fixed price Building Lease: Fixed term lease Equipment: Purchase <=\$2000, otherwise fixed term lease Supplies and materials: Bulk purchase
Miscellaneous: Insurance: Project manager review and recommendation, executive sign-off

Figure 53. Office relocation project procurement plan.

the outside information systems support required for the shutdown of the existing office network operation and the cutover to the new. Minimizing problems with these key vendors will require clear documentation of requirements, significant communication and negotiation, and finally a contract that rewards performance and possibly penalizes lack of compliance in areas that touch upon business operation fundamentals. Further, contractual arrangements will place emphasis on timing so that the transition is completed during a quiet period so that impact to customers and employees is minimized. The high-level office relocation procurement plan is shown in Figure 53.

Project stakeholder management: Stakeholders in an office relocation project are many—and they may go considerably beyond what project initially expects. Office relocations touch entire communities, families, customers, and the general public. Further, relocations are sources of uncertainty among stakeholder groups as new neighbors and new facilities are encountered. During the time of greatest uncertainty, it is highly desirable to work with supportive and cooperative stakeholders. The project team will conduct multiple brainstorming sessions to capture different categories of stakeholders and uncover the layers of stakeholders within the community that may not be obvious initially. Further, stakeholder engagement tactics are outlined in the high-level office relocation project stakeholder management plan as shown in Figure 54.

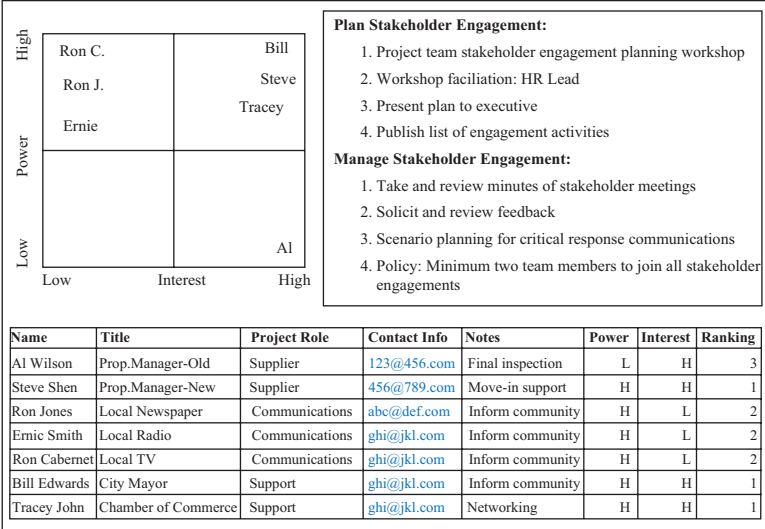


Figure 54. Office relocation project stakeholder management plan.

A SCHEDULE IS NOT A PLAN—REVISITED

The simple example of the office relocation project plan illustrates how extensive is a project plan compared to a project schedule. The schedule offers details about the project scope, the activities required to produce them, the duration of the schedule, and finally a limited estimate of the budget based on the resources assigned to the activities. By way of contrast, the complete project plan lays out the strategy for communicating with and managing stakeholders, to setting and achieving quality goals, to managing risks. A project schedule may be referred to as a plan, but in reality a schedule is only a small subset of the many elements under the purview of the project team (Figure 55).

CARRYING OUT THE PLAN: UNDERSTANDING THE EXECUTING PROCESS GROUP

Direct and manage project work: The PMBOK framework, as evidenced by the sheer number of processes, emphasizes planning over execution. This emphasis is well placed given the importance placed on preparation prior to acting. All action in the project is therefore guided by a plan. But, what is it that project managers do when executing a project? According

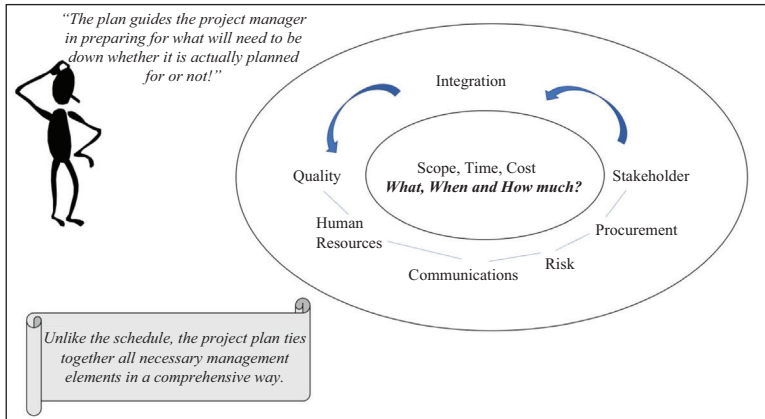


Figure 55. Project schedule versus project plan.

to the PMBOK, executing begins with “directing and managing project work.” From the definitions of “direct” and “manage,” this expression infers that the following activities will be carried out during the executing process group:

1. Providing instructions
2. Giving orders
3. Administering
4. Regulating

How is this done in practice? Project managers and team members typically bundle related activities into documented work assignments not to exceed two weeks in duration. This device for administering project work is referred to as the work package. The work package contains deliverables from the lowest level of the WBS. It also includes a high-level description of the activities associated with the deliverables, critical milestones, budget constraints, and finally tracking and accounting information. It is important to note that the work package contains elements typically found in the WBS (deliverables) as well as information typically found in the project schedule (activities, milestones, budget constraints). Because of this, the work package is neither a WBS nor a schedule—but rather a tool for assigning and managing work consistent with the direction provided by the integration knowledge area within the executing process group. It should be recognized however that “giving orders” in a manner that might be envisioned in the context of a military engagement rarely applies in the project management context. Work package instructions are

Work Package ID:		Account #:			
Description:		Assumptions and Constraints:			
Important Dates:		Quality:			
1		Technical:			
2		Contractual:			
3					
		Labor Estimate			
Activity	Assigned to:	Hours	Rate	Total	
		Material Estimate			
		Description	Cost	Total	
				Overall Cost	
Testing Criteria:					

Figure 56. Work package example.

rarely “thrown over the wall” to those who complete the work. Instead, what is included within the work package is a result of interaction, discussion, and negotiation between the project team and the individual who takes the lead role in managing the effort and activity as outlined within the work package (Figure 56).

Manage Project Knowledge: The integration knowledge area within the sixth edition of the PMBOK includes a new element for the executing process group. This is the directive to “manage project knowledge.” Previous versions of the PMBOK encouraged the collection of “lessons learned” and formally reviewing and storing these at the end of the project. The new direction instills a knowledge management approach that goes beyond lessons learned. Managing project knowledge requires the project team to collect and refine data and information, and actively apply it so that it becomes knowledge. Further, “lessons learned” is viewed less as an event or set of activities—but rather a way a life in which project process improvement is undertaken as each project is executed. Further, instead of filing away important lessons for future consideration, new learning is adapted into new processes and procedures, policies, and templates.

Manage quality: In the executing process group, project teams take action to ensure that the project deliverables are of the desired quality level. This is done by communicating requirements, conducting team meetings, holding project reviews, and checking work in progress to confirm that the correct scope and specifications are being applied. Managing quality in

project execution involves constant comparison between progress to plan, between project specifications versus actual, and finally between client requirements versus project deliverables.

Project resource management: The resource management knowledge area includes more process support than any other knowledge area within the executing process group. The presence of a significant amount of processes hints at the dynamic interaction between project manager, project teams, and the resources employed in the project. Project managers acquire resources to do the job. In most cases the effort expended to acquire resources is far more than putting forward requests. Instead, it may require extensive negotiation—or in the case of acquiring rare resources such as exotic test equipment, extensive networking and search. In many cases, acquiring resources is an ongoing battle—particularly when promised resources—currently assigned to other projects that had previously been expected to be complete—are not forthcoming. This usually requires the initiation of contingency plans involving outreach to other sources.

When resources do arrive, it may take time to make them productive. Equipment may require configuration and setup. Human resources will likely experience a learning curve as they seek to understand the context of the project and its associated technical details so that they can be productive and contribute to the project. This is especially true of resources who arrive late to the project and, as a result, not only require technical training, but also need to learn how to work together with existing team members. It could be argued that the real work of project execution involves the acquisition, development, and management of project resources. After all, it is not the project manager who completes the work of the project—but rather the core project team as well as the resources associated with the extended team.

Project communications management: The PMBOK directs project teams to “Manage Communications” within the executing process group. It is at this challenging time within the project where the project team discovers whether the communications plan developed earlier in the project was sufficient or not. Managing communication goes beyond “communicating” and involves assigning reports to be developed, information to be released, and meetings to be organized. Further, the role of managing communications as well as the associated workload tends to grow as the project progresses and the tempo of the project speeds up. The dictum “90 percent of project management is communication” becomes obvious to project managers when communication is managed during project execution. It should be remembered that the message to be communicated and the stakeholders receiving the message are not the only elements of

key interest in managing project communications. The number of project communications paths in the overall project is also an important concern. The number of communications paths increases exponentially according to the number of stakeholder groups that require individual attention. The number of communication paths in the project is described by the following formula:

$$\text{Number of communication paths} = (n^2 - n)/2$$

Where “n” equals “number of project stakeholder groups”

Project risk management: If risk is defined as “anything that stands in the way of project success” and the job of the project manager is to navigate through barriers to success in order to successfully deliver a project, then the primary role of the project manager is that of risk management. In the executing process group, project managers implement risk responses. Recall that risk responses are categorized according to the mnemonic device “MART” which stands for *mitigate*, *avoid*, *retain*, and *transfer*. The decision to retain or transfer risks is typically decided in the planning process group. Once the executing process group is engaged, there will likely not be sufficient time to transfer risks once they have materialized as issues. Further, risks that the project team has decided to retain may only be minimized once they have arisen as issues. This leaves risk mitigation and avoidance as key measures likely to be taken during execution. Project execution therefore employs risk reduction activities such as planning ahead, developing a “plan B” for major activities, and risk avoidance when carrying out activities identified in the plan.

Project procurement management: The project team in the executing process group of the PMBOK “conducts procurements.” This general directive indicates that project team members will be carrying out the “nuts and bolts” of procurement when executing. This will naturally include activities such as crafting and signing contracts, receiving deliverables, and overseeing the work of contracted labor. The ongoing discussion, negotiation, and natural “give and take” that occur with conducting procurements will mirror natural internal activity of cooperation between the project team and functional groups. The significant difference is in navigating the formality of additional documentation, contract terms, and general overall good housekeeping that comes with working with a third-party supplier.

Manage stakeholder engagement: The stakeholder knowledge area was separated from the communications knowledge area because of the

need for focus on managing the interaction between the project team and stakeholders. As a result, the project team in the executing process group oversees stakeholder meetings, discussions, interaction opportunities, and general communications. Recall that engagement implies much more than simple communication. Because of this, project team members in the executing process group will, in addition to managing project work, be networking and seeking to understand and bond with stakeholders to maximize benefits of stakeholder relationships.

KEEPING THINGS ON TRACK: THE MONITORING AND CONTROLLING PROCESS GROUP

Monitoring and controlling a project begins with the assumption that the project team has a baseline plan that the team and the stakeholders have agreed to and is under change control. The baseline is important because the control of a project may only be managed with respect to a standard of reference. The standard of reference is the project baseline. Monitoring therefore is an exercise associated with comparing the current project progress—or actuals against the scope, the schedule, and the budget of the original plan. Without a baseline, it is impossible to determine what was originally committed by the project team.

Monitoring and controlling a project is possible when a project baseline is established—but it is by no means easy to do. The project baseline lies at one side of the monitoring and controlling equation—but the progress of the project is the other. How does the project team determine the progress made by the project so that it may be compared to the baseline plan? For projects that produce tangible outcomes, progress measurement may be relatively simple. For example, a homebuilding project presents tangible measures of its progress as the lot is cleared, the foundation is put into place, and the frame is built. However, a complex software-intensive system development project may be a completely different matter. For example, suppose that a project was chartered to develop a system composed of multiple subsystems. The progress on each of the subsystems is determined to be good based upon the fact that the design and coding is complete and module testing is in progress. It is possible after hearing a progress report that the project could inform the senior management team of the excellent progress. Based upon the status of the subsystem development, it is estimated—and reported—that the project will complete ahead of schedule. Assume further that, in the following week, all subsystems are integrated in a scheduled project integration milestone.

Upon linking together each of the subsystems, it is determined that the overall system is nonfunctional and hundreds of defects are recorded. It is determined that it may take weeks to work through the integration issues to make the system functional. This is a major setback—and one week after reporting good progress, the project team now reports that the project will be at least two to three weeks late. Progress reporting in the context of complex systems clearly presents both progress measurement and progress-reporting dilemmas.

Another monitoring and controlling dilemma faced by the project team involves the reporting of the project budget status. Assume for example that the project is at the halfway point of the schedule—but less than half of the project budget has been spent. Is the project team under budget? Should it be reported to senior management that the project is under budget? The answer is that “it depends.” To begin with, it is important to recognize that it is rare for projects to be completed under budget. Project managers would be well advised to view claims of positive project budget news with skepticism. In fact, it is possible for a project to appear to be under budget at a given point in the project—but in fact be over budget. How is this possible?

EARNED VALUE AND PROGRESS REPORTING

The difficulty of reporting project budget status is observed when only two pieces of information are communicated. As in the example of a project that appears to be under budget at a given point in time in the project, there are two pieces of information: the amount spent to date and the planned spending at a given point in time in the project. When only two pieces of information are used in monitoring the project status—in this case, spending to date and planned spending—it is not clear whether the spending is less than planned because:

- (a) The project is being run by a financially savvy project manager who truly understands how to save money, or
- (b) The project has spent less than planned because the project is behind schedule and therefore has yet to spend money associated with completing the planned work.

In many cases, the reason for a project being apparently under budget is due to option “b” rather than “a.” However, it is impossible to know for certain unless—in addition to reporting spending to date and planned spending—the progress made in completing the project work is

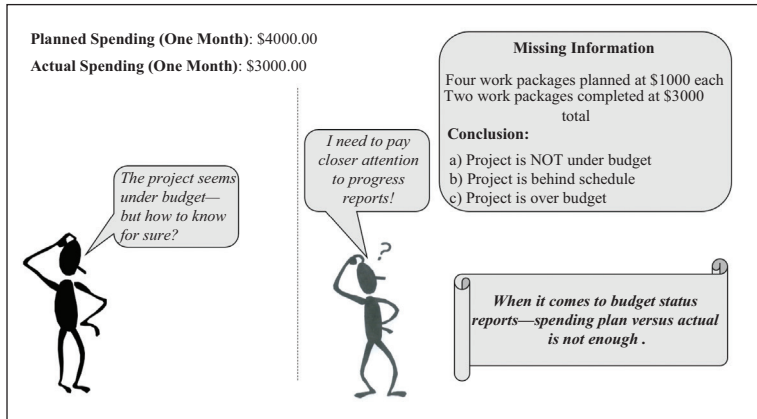


Figure 57. Work package budget reporting example.

also reported. As an example, assume that a project had planned to spend \$1,000.00 each on four work packages within a month's time. At the end of the month, the project reports that only \$3,000.00 was spent and was therefore apparently under budget by \$1,000.00. However, it is learned that only two work packages were completed rather than the four planned for the month (Figure 57). This means that:

- (a) The project is not under budget.
- (b) The project is behind schedule.
- (c) The project is in fact over budget.

The earned value method of monitoring project progress includes the progress made toward the project deliverables in addition to actual and planned spending. This third piece of information—the work progress—clears up the ambiguity associated with project progress and budget. Although earned value is often thought to be confusing with its acronyms and many derived formulas, the essence of earned value is determined by only three metrics, as follows:

PV (planned value—or “Budget”): The amount of money planned to be spent by the project over time.

AC (actual cost): The amount of money spent in the project to date.

EV (earned value): The monetary value of the completed work. This figure is calculated using the formula:

$$\% \text{ complete} \times \text{budget}$$

Note that the budget component of earned value is the total budget for the work being measured. Also, earned value can be calculated per time period or per project stage. A “per stage” approach to earned value often simplifies the calculation of work progress. In the example of complex system development and subsystem integration—for example—the earned value would not be typically reported until the system reached a specific stage such as an integration milestone. Once the system reached such a milestone, progress is often easier to assess.

EARNED VALUE WORK PACKAGE EXAMPLE

Earned value may be used to evaluate the exact status of the “four work packages” project example. The project had planned to spend \$4,000 during the month on completing four work packages. Therefore, the PV (or planned value, or budget) for the month is \$4,000. Recall that the project appeared to be under budget since only \$3,000 was spent for the month. Since \$3,000 was the amount that was spent, the AC or actual cost is \$3,000. These figures are relatively simple to determine within any project. The challenging number to calculate is the EV or earned value amount. The monetary value of the work completed is “% complete \times budget.” Since only two work packages were completed out of four, the per cent complete is 50 percent. The PV or budget for the month is \$4,000. Therefore, the earned value or EV is 50 percent of \$4,000 or \$2,000 (Figure 58).

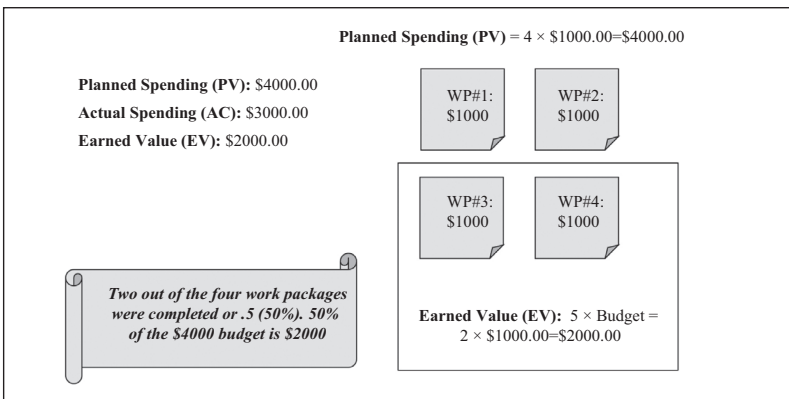


Figure 58. Work package earned value example.

WHAT DOES EARNED VALUE REALLY MEAN?

The beauty of earned value is that the three metrics—once calculated—can provide clear information regarding project status. This is done in two ways by calculating earned value variances and earned value indexes. Each of the calculations begins with the earned value metric as follows:

EARNED VALUE VARIANCES

Cost variance (CV): $EV - AC$ or $\$2,000 - \$3,000 = -\$1,000$

Schedule variance (SV): $EV - PV$ or $\$2,000 - \$4,000 = -\$2,000$

The negative cost variance of $-\$1,000$ illustrates that the project is over budget by $\$1,000$. Recall that the project was initially understood to be under budget given its actual spending was less versus planned spending. However, once the additional earned value metric was included, it becomes clear that the project is over rather than under budget.

The negative schedule variance of $-\$2,000$ indicates that the project, in addition to being over budget, is also behind schedule. The schedule variance in earned value management may be a source of confusion. This is because the schedule variance is described in the form of a monetary amount rather than a time period. A monetary metric for schedule delay, though confusing at first, could be easily explained in terms of the value of work that should have been completed, but was not. In the case of the work package example, the schedule is behind by $\$2,000$ worth of work.

EARNED VALUE INDEXES

Earned value variances are informative but since they generate absolute values the numbers produced make it difficult to compare progress between projects of different scales. Earned value indexes provide a consistent measure of progress regardless of project scale. Further, indexes may be employed to make projections regarding the final project schedule and budget. Earned value indexes calculations are similar to variances—but employ division instead of subtraction as follows:

Cost performance index (CPI): EV/AC or $\$2,000/\$3,000 = .67$

Schedule performance index (SPI): EV/PV or $\$2,000/\$4,000 = .5$

An inspection of the indexes illustrates that when an index is less than one, the project is over budget in the case of the CPI, and behind schedule in the case of the SPI. Note that a value of “1” occurs when the actual cost or planned value equals the earned value. Further, when the earned value is greater than the actual cost or planned value, the project is ahead of schedule or under budget. Since indexes are ratios, project progress may be compared regardless of the project scale.

EARNED VALUE CURVES

The numeric variances and indexes may be viewed and evaluated in a tabular form and presented in reports. However, it is useful to employ curves when communicating project progress using earned value. Recall that the budget or PV is displayed as a curve. The level of the curve changes over the duration of the project as it tracks the cumulative spending that is associated with the resources assigned to the project. This budget curve can be paired with curves that describe the actual project spending or AC as well as the monetary value of the work completed, or EV. Using this type of curve, the project status may be observed at a glance by confirming if the EV or AC curve is greater than or less than the budget or PV (Figure 59).

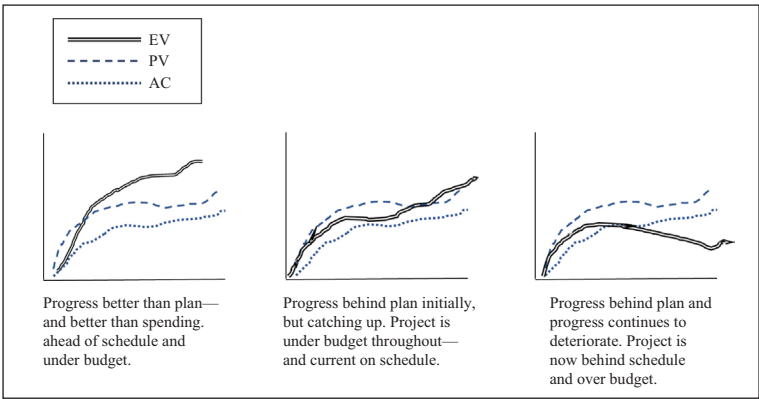


Figure 59. Earned value curves.

“REELING IN” THE PROJECT

It is observed that the budget curve in an earned value reporting chart curves upward and then downward as the project ends. This curve is said

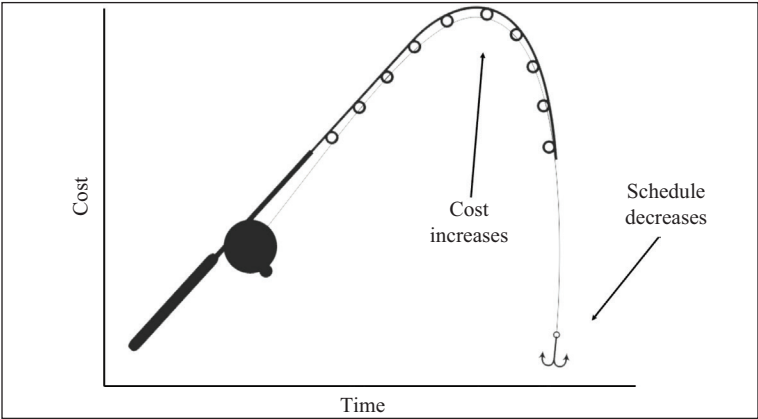


Figure 60. Reeling in the schedule.

to resemble the bend of a fishing pole. A fishing pole bends upward more steeply when the fisherman is reeling in the fish. Further, end of the pole bends inward toward the fisherman. Likewise, a PV or budget curve bends upward to the degree that planned project spending is planned to increase. Why increase the planned spending? Often it is done as a means for improving the project schedule. When the target schedule improves, the end point of the project budget bends inward. The analogy to the bending of the fishing pole applies in this case as the end of the project, like a “big fish” is “reeled in (Figure 60).”

MAKING PROJECTIONS WITH INDEXES

An additional benefit of using earned value indexes is that they can be used to make predictions regarding how the project will end if the current work progress and spending patterns continue. For example, assume the following project details (Table 10).

Indexes applied to these project numbers can provide a simple “back of the envelope” calculation to predict final cost and schedule targets—

Table 10. Work package project data

Costs to date	Remaining budget	Duration to date	Remaining duration
\$10,000	\$17,500	9 weeks	12 weeks

assuming that the existing “run rate” of spending and progress continues. For example:

Simple project cost projection:

$$\begin{aligned} &(\text{Cost to date}) + (\text{Remaining budget/CPI}) = \\ &\text{Simple project cost projection} \end{aligned}$$

$$\$10,000 + (\$17,500/.67) = \$10,000 + \$26,119 = \$36,119$$

This budget monitoring signal is very beneficial to the project manager as it suggests that intervention is needed to mitigate the significant projected cost overage. In the “work package” example, the original project budget would be no more than \$27,500 (and likely much less given the assumption that the project is currently overspending).

Simple project schedule projection:

$$\begin{aligned} &(\text{Duration to date}) + (\text{Remaining duration/SPI}) = \\ &\text{Simple project schedule projection} \end{aligned}$$

$$9 \text{ weeks} + (12 \text{ weeks}/.5) = 9 \text{ weeks} + 24 \text{ weeks} = 33 \text{ weeks}$$

This simple schedule projection method provides an indication to the project manager that action is warranted to improve the schedule that is already currently delayed.

ADDITIONAL EARNED VALUE METRICS

The number of different derived earned value metrics is nearly endless, and the calculations may become quite complicated. Project managers are advised however to keep calculations as simple and intuitive as possible. Reporting earned value metrics are useful—but only if the project manager can explain the metrics to stakeholders. Also, keep in mind that not all reference texts use the PV, AC, and EV nomenclature. The principles are the same regardless. Also, no matter how complex the metrics become, the essentials of earned value are contained in the three fundamental metrics (Figure 61).

EV IS MONITORING—BUT WHAT IS CONTROLLING?

Ideally, controlling a project involves the project taking action to prevent the project from deviating from the plan. Also, project controlling often

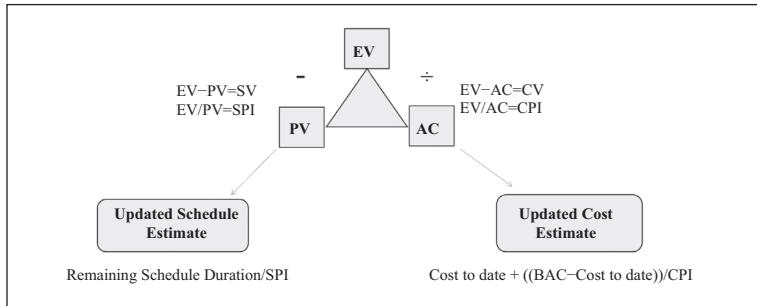


Figure 61. Earned value metrics.

refers to the returning of the project to the planned state after it has deviated from the plan. In practice, the project rarely tracks the project plan exactly. Controlling therefore requires constant attention and course correction on the part of the project team. Some steps that could be taken include adding resources, equipment, or funding to attempt to return the project to an ideal condition. In other cases, the project team may seek a different approach to one or more work packages to save time by increasing work efficiency. Finally, the project is likely to have fallen out of control due to risks becoming issues. In such a case, the project team could consider implementing risk mitigation plans as identified in the project risk management plan.

Should the project team seek to improve the schedule by adding resources or funding (as in “reeling in” the project), some caution should be observed. First, adding resources to a project after it is well underway comes with an inherent risk. Further, adding resources and funding may not in the end improve the position of the project schedule. It is advisable, under circumstances when the project schedule cannot be brought fully back into control, to attempt to negotiate a reduction in scope. Often this is a feasible option—particularly when software that may be later updated is involved. However, there may be circumstances when there is no other option but to attempt to reel in the project by adding resources and funding and accepting the risk. Schedule reduction done in this manner is referred to as “project crashing.” The term is an appropriate one given the risk. When project crashing is attempted, it is approached by analyzing remaining project activities, determining those activities on the critical path that have the possibility of being reduced, and finally applying resources to the least costly activity first. The goal is to maximize schedule reduction while, at the same time, minimizing additional project cost and resource addition (Figure 62).

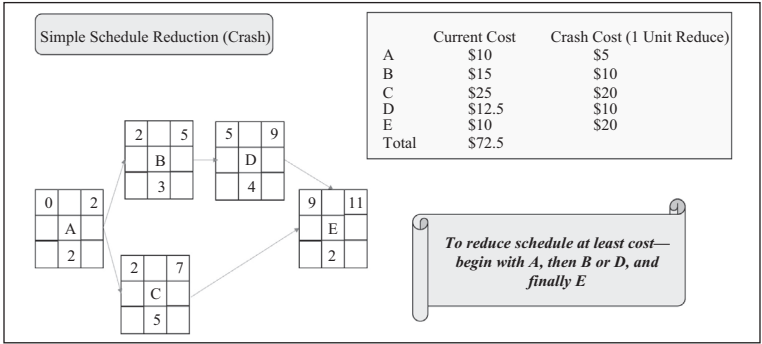


Figure 62. Crashing the project.

CONTROLLING AS “MBWA”

Controlling the project is not strictly limited to analyzing progress and evaluating metrics. It also involves talking to project team members and the larger project stakeholder community to perceive problems before they become problems. In this way the project team members can anticipate problems likely to derail the project and thereby keep the project under constant control. One approach to accomplishing this is “management by walking around” or MBWA. Constant interaction with those who are doing the work and those who have interest in the project can pay dividends. While it is true that issues constantly arise in projects and those issues reveal themselves in project metrics, it is also true that the resolution of issues is accomplished by people. The agile approach to project management—which is emphasized in the sixth edition of the PMBOK—recognizes the importance of frequent communication along with careful management of scope. Scope is carefully managed by attempting only a small portion of the overall project scope at a time, proving it out, and then building on it. There is less opportunity for the project to shift significantly out of control using this method. Further, consistent with the strategy of MBWA, agile project management employs a stand-up meeting at the beginning of each day. The stand-up meeting—or scrum—is kept focused and simple and asks each team member the following questions:

1. What did you do yesterday?
2. What will you do today?
3. What is getting in your way?

Interaction through face-to-face communication is an excellent method for keeping the finger of the project team on the pulse of the

project. Likewise, control is maintained by the very human activities of discussion, negotiation, and commitment—rather than a purely cybernetic response to indicator metrics.

RETURNING TO THE OFFICE RELOCATION PROJECT: THE CLOSING PROCESS GROUP

The termination of the office relocation project provides a challenge to the project team. This is because of the combination of deliverables, stakeholder groups, and outside vendors employed in the move. Where should the team begin? Recall that project closure amounts to good housekeeping so it is recommended to conduct a bottom-up evaluation of each WBS element to confirm that it is satisfactorily completed. The WBS elements in the case of this project may be used as a checklist for confirmation of completed activity. The completion status is evaluated by answering questions triggered by the WBS elements as follows: *Finance*: The finance deliverables for the office relocation project include the budget, and the required payments. Final questions to be asked and confirmed:

1. Have all payments to outside contracts been completed?
2. Have all fees and final payments for the existing location been paid?
3. Have the initial fees and lease payments for the new location been paid?
4. Have all initial fees and payments for utilities and services for the new location been paid?
5. Have all outstanding payments been audited for completion, recorded in the budget, and reported in the final budget close-out report?

Transition plan: The transition plan deliverables for the office relocation project include the supplies, infrastructure, and communication. Final questions to be asked and confirmed at the closing of the project include:

1. Are the telecommunications and utilities in the new facility confirmed to be working?
2. Have the telecommunications and utilities in the legacy facility been shut down?
3. Have building services such as security and maintenance for the new facility been notified of opening dates and schedules?
4. Have building services in the legacy facility been terminated?

5. Have all remaining supplies acquired for the facility move been collected and stored or distributed to departments that could use them?
6. Have final details regarding shutdown and start-up been communicated to all?
 - (a) Managers
 - (b) Employees
 - (c) Suppliers
 - (d) Facility managers
 - (e) Members of the community

Relocation management personnel: The relocation management personnel deliverables for the office relocation project include the planners, coordinators, packers, and movers. Final questions to be asked and confirmed with all relocation management personnel include:

1. Have all internal personnel involved in planning and coordinating the move confirmed that their individual plans are complete?
2. Have all internal planning and coordinating personnel been returned to their respective functional groups?
3. Are all moving activities confirmed to be complete? Is any follow-up required to finish any outstanding move work?
4. Has the completion of the work been confirmed with the moving company and the contract closed?

Existing location: The existing location deliverables for the office relocation project include the layout, utilities, packing, and the close-out plan. The packing and utility deliverables overlap with the transition plan checklist. Therefore, final questions to be asked and confirmed regarding the existing (now legacy) location include:

1. Has the legacy facility been closed?
2. If the legacy location has not yet been closed down, is there a plan in place to address this?
3. Have all furniture, cubicles, or other elements of the layout of the legacy facility been taken down?
4. Has the area of the layout of the legacy facility been cleaned?
5. Has a final walkthrough of the legacy facility been undertaken?

New location: The new location deliverables for the office relocation project include the building specifications, layout, and furniture. It can be

safely assumed that the specifications for the new facility are complete given that the move itself is complete. However, the layout and the furniture of the new location remain to be confirmed as part of the project closure. Final questions to be asked and confirmed include:

1. Is the layout for the new facility working well and are any adjustments needed?
2. Is all furniture for the new location set up and occupied?

LOOKING BACK, AND LOOKING FORWARD

The series of questions asked to confirm the completion of the project provide a glimpse of the detailed consideration required to ensure that everything that was intended to be completed was actually completed. The successful closure of a project leaves no remaining “loose ends.” Project termination, as revealed in the series of confirmatory questions, is a matter of good housekeeping. In the example of the office relocation project, the questions are but a guide to the type of information required to confirm that the project is truly over. There is however one final aspect of closing the project—and that is to review the lessons gleaned from the successes as well as the mistakes made as the project was planned and executed. A good way to carry this out is to hold a final project review meeting including project team members and key stakeholders such as the building manager. The outcome of the meeting would be to not only formally bring the project to a close, but to document lessons from the project that could be used as a guide for the development of future project plans.

PROJECT PLANS AND PROJECT SCALE

It is clear from the examples that a project plan—given its coverage of the 10 knowledge areas and 49 processes—can be very involved. It may be tempting for project managers leading relatively small-scale projects to skip most of the project plan elements, do them implicitly or informally, and then proceed to develop only a project schedule. This approach may work, but it also exposes the project to risk. Project managers are advised to take a step back and consider “Why were all of the knowledge areas developed in the first place—and to what end?” The answer is that planning out each of the knowledge areas increases the chances of project success. Each of the domains outlined in the knowledge areas—if planned and executed within the project—has the potential to avoid

serious problems that are likely to arise in any given project. Just because a project team, for example, does not bother with developing a quality plan does not mean that project quality will not be managed or will not be an area of contention between the client and the project. As a final consideration, consider that for a small-scale project a small-scale project plan may suffice. An overall project plan for a backyard project for instance may be developed in outline form and occupy only one to two pages. At least in a scaled-down plan each of the knowledge areas will be considered in the plan if only in minimal detail. On the other hand, the project plan for a commercial construction project may occupy hundreds of pages. This is expected due to the hundreds of additional concerns that go far beyond the backyard project. For the purposes of maximizing the potential for project success at the small scale of the project spectrum, it is better to develop a “lightweight” plan for a small-scale project rather than to avoid developing a plan at all.

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Project Management

A Common-Sense Guide to the PMBOK Program, Part Two: Plan and Execution

James W. Marion

Although the terms “plan” and “schedule” are at times used interchangeably, they are in fact very different. A complete project plan contains a project schedule—but it also includes much more than that (e.g., risk management, quality management, human resource management, and procurement). These differences have implications for the layman as well as the experienced project manager and have implications for successful project management practice. Additionally, the contents of the project plan have evolved over time as versions of the Project Management Body of Knowledge (PMBOK) were updated.

Due to this, project plans today include important elements that were not included in project planning in the context of earlier versions of the PMBOK and the execution of the project plan requires guidance beyond that which is outlined in the PMBOK framework. The PMBOK emphasizes planning and monitoring and controlling—but very little support is provided for project executing. This begs the question, just what does it mean to execute a project plan? This book clarifies the differences between plans and schedules, takes the project manager through the process of plan development, and finally, points the way toward successful project execution.

Dr. James W. Marion is an assistant professor with Embry-Riddle Aeronautical University Worldwide. He is currently the discipline chair and assistant professor of project management and the program chair of the MS in engineering management program. His experience includes leading large organizations in multiple product launches in the United States, Europe, and Asia, as well as significant experience with Japanese companies including NEC and Panasonic. Dr. Marion has a PhD in organization and management with a specialization in information technology management from Capella University. He holds an MS in engineering from the University of Wisconsin-Platteville, and an MSc and an MBA in strategic planning as well as a postgraduate certificate in business research methods from Edinburgh Business School of Heriot-Watt University.



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