SCOPE

INTEGRATION

TIME

COST

RESOURCES

PROJECT MANAGEMENT MATURITY

Back to the Basics

RISK

QUALITY

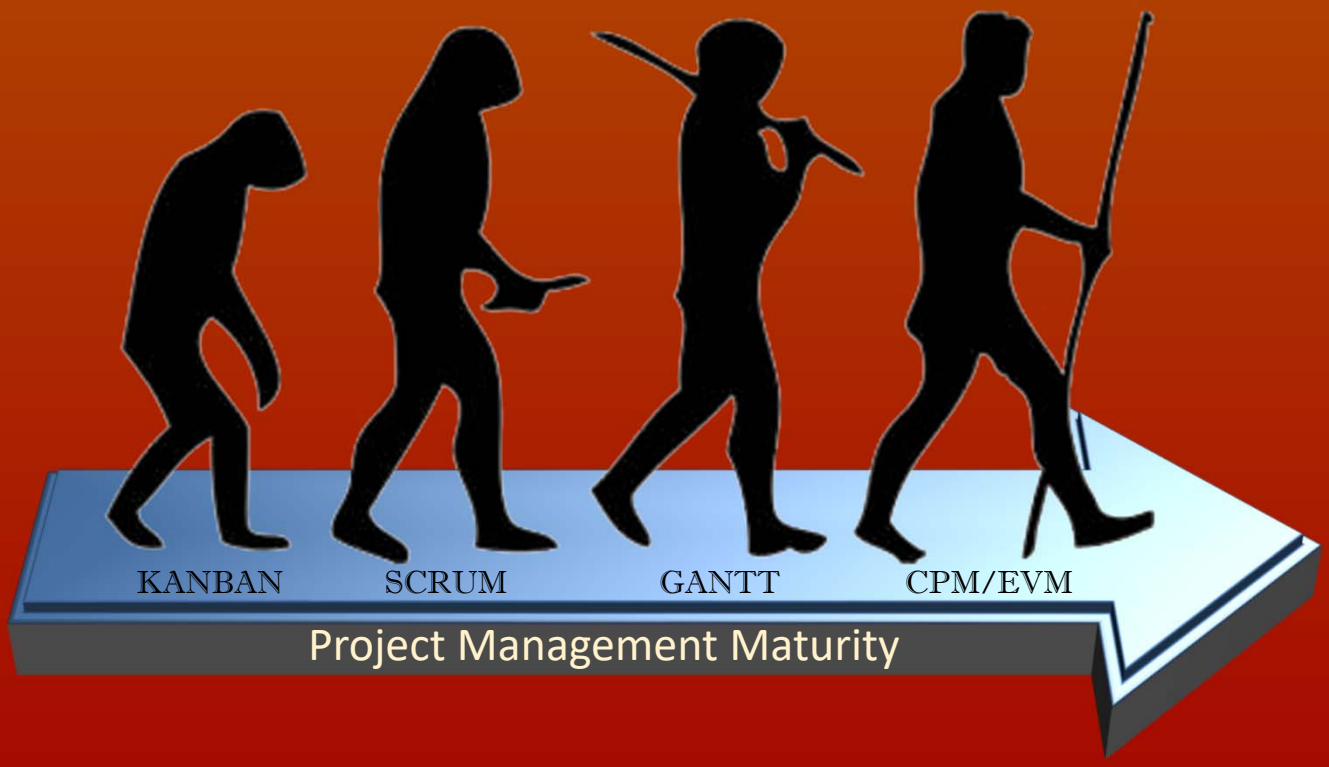
By

Tammo Wilkens, P.E., PMP, CSM

COMMUNI CATION

PROCURE MENT

With Foreword by Bruce Taylor, PMP (Ret)



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Back to the Basics

By

Tammo Wilkens, P.E., PMP, CSM

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PMI refers to the Project Management Institute, Inc.

PMP® refers to the Project Management Professional Credential offered by the Project Management Institute, Inc.

PMBOK® Guide refers to the PMI publication of the Project Management Body of Knowledge Guide

Contents

Foreword

Tammo Wilkens, P.E., PMP, CSM, has been working on projects since before the term "project management" entered the conscious mind of most people working on projects. And he's been managing projects for many decades. He was among the first 300 people to obtain his PMP certification. He created the entire curriculum of California State University Dominguez Hills' Project Management Certificate Program and has been teaching it continuously since 2007. As we are prone to say: "He's seen it all."

He wrote *Project Management Maturity - Back to the Basics*, to address PMI's radical change in the *PMBOK® Guide* format. From my conversations with project management practitioners, many of them do not understand or even agree with this change. They wonder: "Why didn't PMI create a new guidebook for the contents of the 7th Edition?" The first six editions of the *PMBOK® Guide* focused on the basic functions of project management, which they labeled Knowledge Areas.

The 7th edition of the *PMBOK® Guide*, appears to be a socially charged guide with a Dale Carnegie style on How to Win Project Friends and Influence Stakeholders. While that is important, discovering *Project Management Maturity – Back to the Basics* is more important. This practical compendium brings us back to the basics of managing projects and it demonstrates that the practices in this book apply to any type of project. If you need proof, look at Appendix A.

Project management is evolving rapidly. Traditionally, project managers focused on executing projects and had little involvement in strategic planning or justification. That was left to higher levels of organizations. Their primary task was to understand and manage the project objectives; i.e. just get it done. It is my firm belief that the basics of managing a project are still the same, regardless of how much fanfare is touted about agile and adaptive methods. Every project should have some part of the following:

- A specific scope; without that, it is not a project by definition, even if the scope is at a very high level and the details are to be determined during the project, e.g. adaptive or agile.
- A deadline to get it done; without that, it is not a project by definition. A project is a temporary endeavor. If there is no timeline and deadline, it is probably simply operations.
- A cost for getting it done.
- Some amount of risk, even if the total risk is very small.
- Concerns about the quality of the product, service or result being produced.
- Stakeholders and communication issues, unless the project is performed by one single individual.
- Procurement considerations, even if it means that we are not going to procure anything.
- Human resource management factors if more than one person is involved in the project.
- The need to integrate all of these functions because they will affect each other.

Today, organizations recognize the value of project management at all levels, from portfolios and programs to projects and operations. Project management has become more integrated with the organization's strategic goal setting and decision making. An example is the creation of a Project Management Office (PMO) which oversees the management of projects

beyond single projects. It is important to note that, in this era, project management has both a broader and a traditional role.

This book focuses on the specifics of managing a project. It briefly covers strategic management, but mainly provides guidance and how-to's for achieving project objectives and expectations above the micro-management level of most agile practices. And yet, it provides the bridge between what many practitioners call "traditional" or even "waterfall" and the current vogue of agile methodologies.

While "agile" has been a catchphrase in the project management profession for many years now, today more attention is focused on Artificial Intelligence (AI) in project management. Using AI in project management will continue, but this is likely to only impact the technology rather than the actual functions of managing projects. While the holy grail or magic bullet of AI is pursued, when all the "smoke and mirrors" are removed, we will discover that AI is essentially tasks performed by machines or computers. It is what we normally call automation. However, the technology is advancing so rapidly that it seems like something totally new. As with other technologies, this book considers those to be specific technology tools to get things done rather than a change in the specifics that need to get done.

It appears to me that PMI has realized that the 7th Edition of the *PMBOK® Guide* created a gap between the knowledge base and the reality of how projects get managed. Consequently, a new publication, *Process Groups – A Practice Guide,* was issued, and it covers the missing material which used to be in the earlier *PMBOK® Guide* editions, but organized by process groups rather than functions. When someone searches for answers to project management questions, the questions are phrased more with regard to the functions, such as cost management, time management, risk management, etc. rather than by the phase of the project, such as initiating, planning, executing, etc. It is for this reason that I am so pleased to see this book "salvaging the baby from the bathwater."

This book also revises the information flow and integration of the project management functions. For example, the 6th Edition of the *PMBOK® Guide* "Plan Resource Management" process has a confusing and inconsistent arrangement of inputs. This book addresses this problem and others.

Another issue in the recent editions of the *PMBOK® Guide* is the relocation, combination, and elimination of some processes. For instance, material and equipment procurement has been merged with human resource management, even though they require different skills and methods. This book avoids such semantic confusion.

The intent of this book is to restore the basics of managing any kind of project, from planning a family trip to a trip to the moon. It shows how the methods, procedures and tools in this book apply to any project, regardless of scale. It also includes agile and adaptive approaches, as well as tailoring and scaling options. For these reasons I recommend the book *Project Management Maturity - Back to the Basics*, as being both timely and necessary.

Bruce Taylor, PMP (RET)

1. Introduction

1.1. The Matter of Maturity

As the title of this book implies, this is all about project management maturity. PMI defines Organizational Project Management Maturity as "The level of an organization's ability to deliver the desired strategic outcomes in a predictable, controllable and reliable manner." As I contemplate that definition, I am struck because if we take it at face value, then the adaptive project delivery methods cannot be considered to be "mature". And here we come to a conundrum: what is mature and who gets to say so? To understand that, we need to look back at "why project management in the first place?"

Project management got a shot in the arm and substantial support from project sponsors and customers as well as project teams in the late 60s to early 70s. The methods developed were intended to provide more certainty that projects would be delivered as expected and stakeholders insisted on knowing throughout the project life cycle how it was going; i.e. the status and cost primarily. This required consistent, predictable methods and constant communication regarding the project progress vs. the adopted plan. Achieving that goal of satisfying the stakeholders was considered to be mature.

Adaptive methodologies are, by definition, not predictable and deemphasize the "crystal ball" effect of more rigorous delivery methods. The primary tenet proposed by the adaptive methods is that the team will develop the expectations as the work proceeds, but most likely not at the beginning. Before the reader gets all excited, let me state clearly, I have no issues with employing adaptive methods and recognize they are the only practical way to deliver some projects. It might surprise the reader to learn that I actually delivered a hugely successful software application using Agile in the development process in 1969. And throughout my career, I actively engaged in adaptive delivery methods for decades, even long before the Agile Manifesto was published.

As the book's cover image implies, some of the most common delivery methods are indeed on a progression of greater maturity as we progress from Kanban to Scrum to Gantt charts to CPM scheduling, along with earned value management. Please consider, while Kanban is very effective, one must realize it is actually nothing more than a glorified task list, albeit providing great visibility of what's going on and functionality for tracking accomplishments, but there is very little to no forecasting of future expectations, lead times and velocities not withstanding. Scrum is a very detailed, down in the trenches, very structured, micromanagement process, but also with little forecasting unless it is combined with a layer of "traditional" project management, such as the use of burndown charts. Gantt charts are a step up towards maturity in that they provide not only visibility but also a limited ability to project the future progress of a project. When the team adopts CPM (Critical Path Method) scheduling and applies earned value management techniques to the project, it is possible to achieve the definition of Organizational Project Management Maturity as defined by PMI.

1.2. Taking Your Head Out of the *PMBOK® Guide*

This book was spawned out of necessity because of PMI's recent changes in the approach to covering the topic of managing projects. Over the years and through the various editions of PMI's *PMBOK® Guide*, the guide for the process of managing projects has become confusing, as I explain below. In an apparent attempt to be more inclusive and adapt to "changing" practices, the document has become more difficult to use due to too much generalization and rearrangement of topics into a convoluted collection of the processes and topics. I have found the need to explain to my students what happens in the real world, in contrast to what is described in the *PMBOK® Guide*. With the publication of the 7th Edition of the *PMBOK® Guide*, PMI has taken a radical step and divorced the discussion of project management from the guide on how to do it that it was. In my opinion, it now barely touches the so-called knowledge of project management. Instead, a new publication, "*Process Groups – A Practice Guide*," covers the material that was in the prior editions of the *PMBOK® Guide*. However, that publication covers the material by process groups, rather than the functions of project management.

It is my firm belief that when readers seek answers in the realm of project management, they are more likely to seek answers regarding specific functions of managing a project than whether their question relates to initiating, planning, executing, monitoring & controlling, or closing.

This book is intended to bring us back to the basics of managing projects of any kind, be it your sister's wedding, development of software, some organizational change, the trip to Mars or anything in-between. If you look at Appendix A, you will realize that the methods, procedures and tools covered in this book apply even to the tiniest imaginable project; it is merely a matter of scale. You will discover the inclusion of agile and adaptability, as well as tailoring and scaling the application of project management processes and methods. PMI has made a significant investment in pointing out that the 7th Edition no longer focuses on processes and the how to. Fear not, for this book aims to fill the gap that has been generated.

This book also takes a fresh look at the information flow and integration of the various project management functions. To illustrate, let us briefly look at the *PMBOK® Guide* "Plan Resource Management process" as it is in the 6th Edition. It lists as "Inputs" the Project Charter, the Scope Baseline, various Project Documents, and only two of the management plans: The Project Management Plan, and the Quality Management Plan. I leave the reader of the *PMBOK® Guide* to wonder why this particular limited arrangement of inputs. While, for example, the schedule, risk register and stakeholder register are documents, surely the Schedule Management Pan. Risk Management Plan and Stakeholder Engagement Plan would have been better to include among the inputs to planning how to manage the project's resources.

Another area in recent editions of the *PMBOK® Guide* that has become distorted for lack of a better term, are the relocation, combination and elimination of some of the processes. The Resource Management Knowledge area now includes material and equipment procurement. The reason behind this change, I believe, is that PMI considers these items to be resources, which they truly are. However, the management of equipment and materials differs significantly from that of managing human resources. Human resource management requires people skills, while equipment

and material require procurement skills. They have nothing to do with each other and combining them into one chapter for the sake of semantics is, at best, confusing.

The authors of the 4th Edition of the *PMBOK® Guide* merged procurement and solicitation planning into a single process. These are two distinct processes covering distinct parts of the procurement undertaking. The first occurring once for the entire project, while the second occurs for each individual procurement. Lumping them together for no apparent benefit other than semantics (planning is planning?), distorts the topics and adds confusion to the reader. Also, in the Procurement Knowledge area, the Close Procurement process was eliminated, leaving that topic to be discussed under Control Procurements. However, this is a very distinct and important process. I have experienced cases where the close procurement process took longer than multiple times the entire project duration. Imagine a process that drags on for 15 years on a particular procurement. Surely this deserves greater focus as a separate process.

One more area that I should mention here is the complication of relocating Estimate Activity Resources from the Time Management Knowledge area (now called Schedule Management) to the Resource Management Knowledge area. Again, I have to assume that the semantics overrode the logical flow of the work. Consequently, when focusing on the topic of developing a project schedule, after sequencing the activities, the reader has to make a detour over to Resource Management before returning to the process of estimating the durations of the activities.

This book also addresses a major misunderstanding of "critical path" in the *PMBOK® Guide*. (See the Chapter on Time Management.

And, finally, the Glossary included in this book, corrects many of the definitions found in the *PMBOK® Guide*, based on many years of experience in numerous industries in a broad range of settings, both private industry and public projects, on the owner's side as well as the contractor's side.

I do not intend to nitpick the *PMBOK® Guide,* but to provide an insight into "Why this book?" This book takes a fresh, no frills look at the various Functions of managing projects and the Components that comprise each Function. While the Functions are similar to what the *PMBOK® Guide* labeled Knowledge Areas, I discuss them in a fresh, logical and substantive manner. Within each Function are the Components that comprise the Function and within the Components are the specific Tasks that are necessary to accomplish the Components' objectives. (See Structure below.)

1.3. Overview

Following the discussion of some general basic project management concepts, I cover each of the Functions in detail. For each Function, the specific Components are covered by detailing the Tasks that support the Component's objectives. One challenge in discussing these interconnected Functions and Components is to determine what I call the "Chicken or the Egg" conundrum: What Tasks come first, or where do we start? The interaction and sequencing of Tasks is addressed as they are encountered. Chapter 11 ties it all together.

The goal is to ensure that the reader gains confidence in the coverage of the topics from four different angles: 1 - the Customer/Client/End User, 2 - the Seller/Contractor/Supplier, 3 - projects in Private Industry, and 4 - projects in the Public Arena. I consider all projects fall into two of these categories: Customer or Seller and Private or Public. I leave the reader to consider where his or her projects fall. This book will serve you well no matter what kind of project(s) you work on.

I also hope that this book will preserve some of the "how to" that the 7th Edition of the *PMBOK® Guide has suppressed or eliminated*. Obviously, each project is unique in its approach to managing the many functions, but it is my firm belief that at some generic level, the "how to" is fairly widely applicable. For example, a project is a temporary endeavor by definition, which means it has a deadline, a target completion date. The accomplishment of that project objective is well served by the use of a project schedule or timeline. To argue otherwise is to admit that we're engaging in some endeavor and when we think we've done enough, we'll declare it complete. Someone is not actively managing that approach, even though it may work. It just happens.

Therefore, some people may consider this book too prescriptive, which seems to bother their sense of comfort. However, without establishing definition, intent, and persecution, such an endeavor has a very slim chance of being completed within the constraints of the "Iron Triangle": Cost, Scope, and Time.

1.4. Scaling, Applicability & Tailoring

Projects come in many sizes and complexity, as well as a great variety of environments. How projects are managed is significantly impacted by organizational cultures, policies, and structures. Some organizations are very mature in their approach to managing their projects, while others seem to pay more lip service to the practice of managing projects than would be beneficial. This book acknowledges that project management maturity principles apply to all projects, but emphasizes scalability. To illustrate the scalability and the universal applicability of the project management concepts presented in this book, I refer the reader to Appendix A.

So, while the practices described in this book are scalable, they are generally present in all projects to some extent or another. Where a scope statement, when printed out on paper, for a large project, such as the Mars Landing, might occupy several volumes of six-inch benders, for a small project, it might only occupy one paragraph or a single sheet of paper.

Some project management artifacts, such as a Risk Register, might not be necessary for a small project, while for projects of a larger scale, I would consider it an essential item. Depending on the complexity of the project, or repetitiveness and familiarity, it might be impractical to rely merely on memory to track the essential information. But, as risk is so prevalent in most endeavors, the Risk Register is likely to exist for most projects, even considering this scalability.

In addition to scaling the methods and processes, tailoring is an important practice to undertake. Tailoring is the adoption, modification and refinement of these Functions and

Components that an organization or a project team employs to suit their specific needs and operational requirements. Tailoring in a project can involve adjusting tools, determining specific processes, defining types of artifacts, and deciding the extent of involvement of individuals and organizational groups. For a more extensive illustration of the tailoring process, I direct the reader to Chapter 3 of the 7th Edition of the *PMBOK® Guide*.

Therefore, regardless of the nature of your project, this book is likely to be of great help in making it a success.

1.5. Changing Technology

As the reader is surely aware, the technology that supports the various management functions is changing literally almost daily. The scope of this book does not include a deep dive into various technologies. To do so would require a new edition as often as every six months. Consequently, this book does not refer to the latest tools and technologies that are being developed and integrated into the project management profession. I leave the use and employment of specific technologies to the reader according to his or her own environment and resources. That is also part of the tailoring process.

1.6. Structure

I developed the organization and structure of the material presented in this book to organize the vast information and make it easy to understand. Following the chapter on Basic Concepts regarding project management, there is a chapter for each of the Functions listed in the Table of Contents. Figure 1.1 displays the overall arrangement of elements and how they relate to each other.

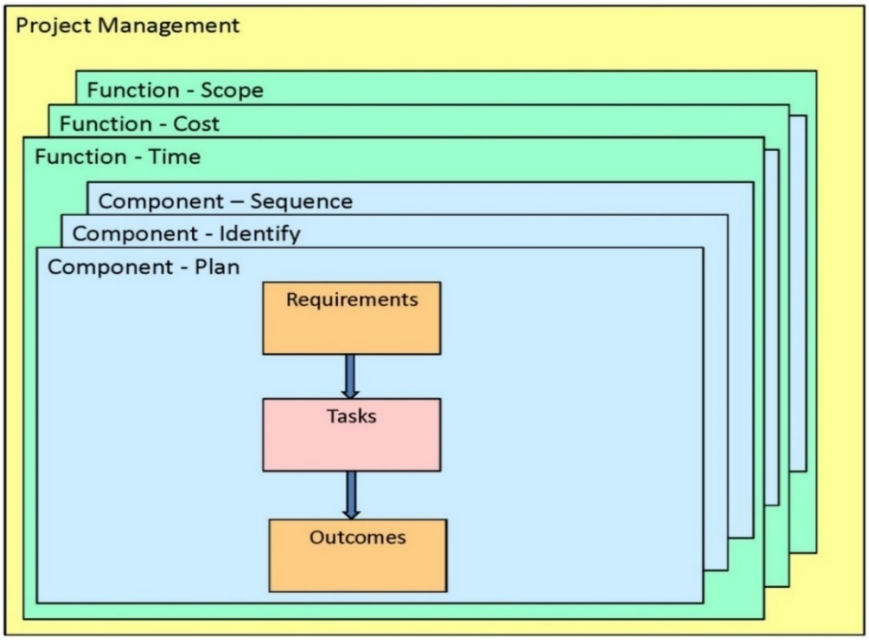

Figure 1.1 - Structure

Each Function contains several Components, such as Planning, Identifying Activities, Sequencing Activities, etc. Within each Component there are several Tasks, such as Meetings, Data Gathering, Decision Making, etc. The Tasks, in turn, have several Requirements, i.e. the artifacts, documents and information required to perform that Task and produce several Outcomes, i.e. new or changed artifacts, documents, or updates to information resulting from the Task. **The Outcomes are identified by A, B, C etc. and the primary Outcomes are listed in all caps font.**

A word about Tasks: There are several Tasks that are part of just about every Component. These include the use of experts, employing interpersonal team skills, and conducting meetings. I do not list these in the discussion of every Components as that would be repetitive and not contribute value by their repetition. Consequently, I discuss them in this section, understanding that they are a part of practically all Components.

1.6.1. Expert Judgment

Expert judgment is obtained by enlisting people into the project team that have done the specific Component in the past and thereby lend their experience and expertise to the project. It does not necessarily mean that the project needs to hire subject matter experts beyond the experienced staff within the organization. However, in those cases where this experience is not present within the organization, it is quite customary to hire consultants or other experienced staff to bring this experience into the project.

1.6.2. Interpersonal Team Skills

Interpersonal team skills are those skills that motivate people, employ an understanding of emotional intelligence, facilitation, conflict resolution, decision making, influencing people, and leadership. These skills have a generic nature, and individuals employ them accordingly within a Component if they are deemed useful.

1.6.3. Meetings

Meetings, discussed in detail in the Manage Communications Function, are a common Task to achieve efficient execution of decisions and information dissemination. Many of the Components will make use of meetings.

So, as the reader encounters the various Components, he or she should keep in mind that Expert Judgment, Interpersonal Team Skills and Meetings are likely to be Tasks besides those listed in the various Components.

1.6.4. Standard Outcomes

Similar to common Tasks, there are some Standard Outcomes that I do not list in each Component to avoid unnecessary redundancy. Thes include Updates to the Lessons Learned Register and New Change Requests. The Lessons Learned Register should be updated on a continuous basis as lessons become apparent, not just at the end of the project. Therefore, this should happen in all Components.

Change Requests are likely to pop up in many Components as well. These should be addressed as soon as they are identified or proposed.

Chapter 11 covers the integrated management approach to dealing with all these Functions. It may seem strange to the reader to see, for example, the Project Charter and other Integration Components relegated to the end of the book when it should be one of the first artifacts to create for a new project. But I did this intentionally in the hope that the reader will have a better appreciation of this topic after gaining familiarity with the other Functions.

2. Basic Concepts

Let us begin by covering some basic concepts regarding project management before we dive into the 8 specific Functions. This section will give you the overview and foundation for the tasks you perform within the various Functions. We will focus on the following topics:

1. What is a Project?
2. What is Project Management?
3. Organization Structures
4. Strategic Considerations

2.1. What is a Project?

In order to put the whole subject of managing projects into context, we need to have a firm grasp of the definition of a project. That is, what IS a project? It is elegantly defined in PMI's *PMBOK® Guide* as:

"A temporary endeavor
to create a unique
product, service or result."

I like to break it up into the above three "pieces" to distinguish what it is, what it does and what its result will be. Let us look at each piece in detail.

The first piece tells us that projects are temporary endeavors. This means they have an end point; it doesn't go on and on with no idea when the ultimate outcome is expected. Please keep in mind that some organizations or projects may very well not have a set completion date, but will consider the project complete when all objectives have been met. In that case, the end point of the temporary endeavor is not time boxed but rather determined by the achievement of the objectives.

However, when one of the key performance indicators (KPI) of a project is timely completion, that is not possible without a firm completion date. Now please keep in mind that a project completion date can change during the project performance time, but that is only to be done with a formally approved change to the project objectives or constraints. For example, the completion date might be moved out when it becomes obvious that the original date simply cannot be achieved. Perhaps the project team turns out not to be as experienced and proficient as planned. Perhaps a supplier of some component faces challenges beyond their control and delivers a critical item later than needed. And, of course, if the scope of the project is changed, there is a great likelihood of requiring more time to get the added work done.

So, if you are working on something that has a firm, or planned, completion date, or a defined set of objectives to be met at some point, you have passed the first test to determining what a project is.

The second piece tells us that projects create something that is unique. Perhaps a better choice of terms is "specific", as uniqueness is often confused with "the only kind" of whatever it is. In this definition however, uniqueness refers to a specific item, even though it may be identical to another item. Consider a real estate developer who decides to build residences on a large tract. He decides to manage each building as a project in his overall program of the entire tract. There are only a few choices of floor plans, architectural styles, paint options, interior finish options, flooring, etc. Several of the residences might wind up exactly identical, to the point when you look at them or enter them, you cannot tell one from the other. And yet they would be unique in this project definition context. "This" house is not "that" house; they are specific instances, each separate from the other.

The third piece tells us that project outcomes are classified as either a product, a service, or a result. That pretty much covers everything. Whatever you create is either a product, that is, something tangible whether physical or virtual/digital; a service, such as consulting, engineering, research, software development and the like; or a result, such as a new business process, a company relocation, a new organization structure, the conversion of a live classroom course into an online course.

The key to remember is that the product, service, or result is something of value. Value delivery is heavily emphasized in the 7th Edition of the *PM*BOK® Guide. After completion of the project, the client, end user, or organization will have something of greater value than existed before the project was undertaken. Examples include a new generating station to produce the needed electricity to power all the new electric cars coming onto the market; a new software application to satisfy some business need for the organization's operations; a research study to produce new knowledge and information; an event to celebrate some major milestone like a wedding or birthday.

So, summarizing this into a simple concept, if you are creating something specific by a certain deadline or achievement of objectives, you are working on a project. This is an important concept to understand as we delve into the specific Functions of project management in the coming chapters. If you can keep this definition in focus, it will help you with the Tasks to meet the project objectives.

2.2. What is project management?

Now that we understand what makes an endeavor a project, we can look at this profession that we call project management. Simply stated, project management is the engagement in a profession of specific activities that will enhance the probability of a successful outcome from your project, this temporary endeavor to create something.

So, first off, is project management necessary to perform a project? The answer is "No". Consider the pyramids in Egypt. They certainly were projects. I don't know for sure, but I am doubtful that project management as a profession existed back when the pyramids were being constructed, and yet, there they are. Did they get completed by some desired point in time? I don't know.

Even in our modern times, projects get done all the time without formal project management. Some companies simply do not believe that project management is worth the effort and they get things done, anyway. When I started in my career in the mid-60s, there was no widely known concept of project management. It wasn't until the latter 60s that companies started to recognize that there was a need to manage these endeavors better. Without it, there was a lack of focus within a company performing a project and customers had a difficult time pinpointing someone in the organization who could address their concerns.

The Project Management Institute was founded in 1969 as a result of this realization and it started to formulate ideas and principles, thus providing a focus on managing projects better.

The ancient Roman chariot races illustrate one of the more vivid illustrations of the benefit of project management. What a grand spectacle those races must have been. I would surmise that if there were no charioteers, somehow the teams of horses would manage to cross the finish line anyway. But nobody can make a solid argument that the races would be finished in the shortest time. Indeed, the likely winner would be the most skilled charioteer, as long as he had a capable team of horses. [1]

And, similarly, the experience and guidance of a project manager contributes mightily to achieving success in project execution. He or she makes sure the team keeps focused on the goal,

[1] Right image from the Movie "Ben Hur" MGM, 1959, used with permission

like the charioteer using the reins to steer the team of horses; he or she uses their resources to best advantage, like the charioteer judging the energy and endurance of the horses and urging them to sprint under the right conditions; he or she assigns the team members to the position best suited to their skills and strength, like the charioteer placing the focused and leading horse on the inside and the stronger horse on the outside.

A moment ago, I asked the reader to consider whether project management as a profession was necessary to perform a project. A similar, but separate, question is whether a project manager is necessary. Again, the answer is "No". Until the later 60s, the position of project manager was relatively unknown and rare, and yet projects did somehow get completed. In those days, was there a concern about finishing the work by some deadline? Yes. Was there concern about finishing the work within some budget? Yes. Was there concern about all the intended work being performed? Yes. Did performing organizations have concerns about risks derailing project objectives? Yes. How about all the other areas and functions of project management, like quality, communications, stakeholder engagement, procurement management and resource applications?

All of these functions were indeed concerns and addressed somehow, even though there was no project manager. When I teach project management, one of the early questions I ask is whether the project manager contributes anything to getting the project done. The natural tendency is to say "Yes". Today, one would be hard pressed to think that the project manager doesn't contribute something. I ask my students, for example, does the charioteer contribute anything to getting the chariot across the finish line as fast as possible? The answer is "No". He does not produce a single erg of energy to push the chariot faster. As a matter of fact, the horses probably thought, "If we could only dump this extra load of dead weight, we'd get to run faster." Just imagine if the charioteer were to try to guide the horses (i.e. manage) the team while also pushing the chariot (i.e. producing actual work to reach the goal).

Similarly, a project manager does not (certainly should not) do anything to contribute to the project scope, i.e. the work that is required to produce the product, service or result. Like the charioteer, he or she needs to focus only on managing or guiding them. The real benefit is that the project manager provides the guidance and direction for the team, even at the cost of the extra "burden." This topic of the project manager's role will be discussed in more detail within the Function of Human Resource Management.

Now that we can affirm that project management and the engagement of a project manager have distinct benefits, let us consider what project management actually is. I like to illustrate it with another analogy. Consider the ever present and generally forgotten room thermostat that the reader is likely aware of, if not familiar with. The illustration in Figure 2.1a shows the primary components of the thermostat and heating/cooling system.

The "deliverable" or "result" of a heating/cooling system is a certain room temperature established by a "stakeholder." This desired outcome is entered on the thermostat by moving the dial, the slider, or the digital temperature setting. Once this "goal" is established, the thermostat performs its function by measuring the actual condition, i.e. the room temperature, via the feedback loop using a temperature sensor. The actual room temperature is compared to the "objective", and corrective action is taken to return the room temperature to the desired value.

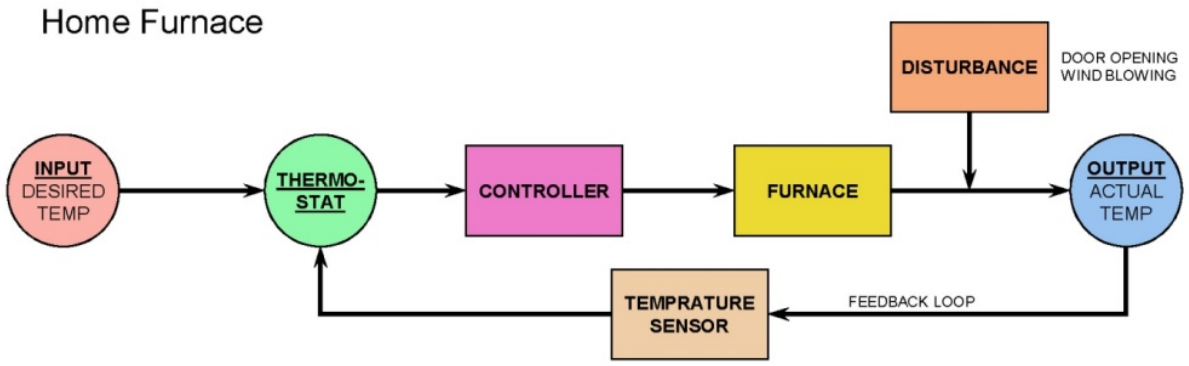

Figure 2.1a – How a thermostat works

Even though the thermostat and the heating/cooling system bring the room temperature to the desired value, things happen; we have disturbances, such as windows and doors opening, outside temperature changing, day vs. night, wind blowing, etc. that cause the room temperature to drift away from the desired goal. And, like a well-tuned process, the system does not allow the temperature to drift unacceptably far off the set point.

Project management works in exactly the same manner as your home's heating/cooling system. As shown in Figure 2.1b, we have the same components. A stakeholder establishes the desired goal of the project. This desired outcome is documented in a project charter or statement of work, or similar document. Once this goal has been established, the project manager and his/her team

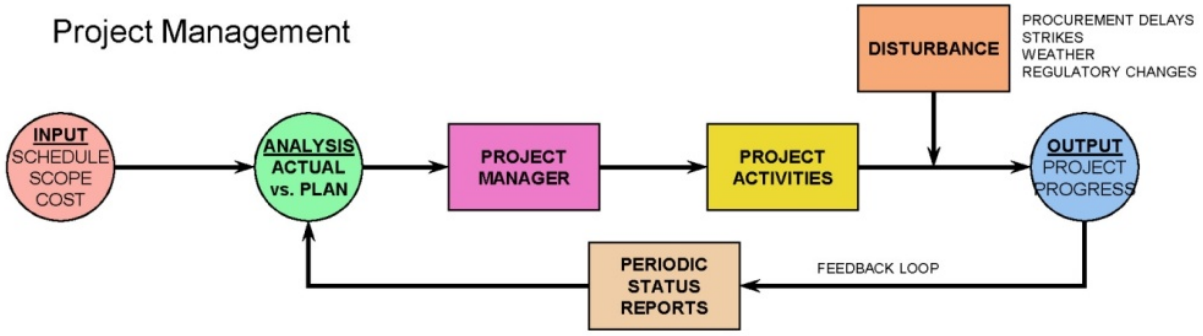

Figure 2.1b – How project management works

measures or analyzes the actual condition of the project, i.e. the schedule, cost, scope, and other key performance indicators (KPI) via the feedback loop using a periodic status review process, such as the update meeting, or in an agile environment the sprint retrospective. The actual schedule progress, actual expended cost and completion of product/service/result deliverables and artifacts are compared to the goal, that is, the baseline for schedule, cost and scope. Corrective action is taken to return the project's actual condition to the desired value.

Just like the room temperature example, on projects, we have disturbances that drive the project off target. Things like strikes, weather conditions, team member performance, the

economy, miscommunications, risks, etc. can cause delays, increased costs, shortfall in technical performance, etc. that interfere with the project objectives. And, like a well-tuned process, the team does not allow the project objectives to drift unacceptably far off the set point.

Specifically, project management comprises several distinct Functions, including the following (The numbers refer to the corresponding chapter in this book):

3. Managing Human Resources
4. Managing Communications & Stakeholders
5. Managing Procurement
6. Managing Quality
7. Managing Risks
8. Managing Scope
9. Managing Time
10. Managing Cost
11. Project Management Integration

We will cover each of these in a separate chapter in this book. I chose specifically the sequence of topics as they build on each other, providing some basis for the following topics. As we will discover in the chapter on Project Management Integration, the Functions are all interconnected. Things occurring in one Function are likely to impact many of the other Functions.

I am hard pressed to identify any project management practices that would not fall under one of these Functions. Therefore, people consider this book to provide a comprehensive exposition on the subject of project management.

2.3. Organization Structures

There has been a rather interesting connection between organization structures and project management. The concept of a “project structure”, a “matrix structure” and a project management office were essentially unheard of in the 1960s. And yet, projects did somehow get accomplished.

I started my career as an engineer right after college and joined an engineering and construction firm. We “did” projects, specifically designing and building electric power plants, by what might be considered “folk lore.” Everyone on a project team either had done one before or learned on the job what needed to be done, guided by his or her peers and supervisors.

The organization structure was the classic organization, headed by “the boss” and built around a pyramid structure, where the primary organizational units were the functional departments. These departments were each responsible for some technical aspect of the projects, such as mechanical, civil, electrical, HVAC, instrumentation & controls, for example. See Figure 2.2.

Each department assigned members to work on particular projects. This “team” then more or less huddled to figure out what needs to be done. This worked because there were always some

9. Function - Managing Time

9.1. Overview

Time management is essential if the project objective is to get it done by a certain date. Generally, this is the case as the definition of a project is “a temporary endeavor”. Some projects, however, have a higher priority than completion by a certain date. In those cases, time management still has a significant role, as it is tied intimately to the resource function.

In the context of projects, there are three primary elements of time management:

- The duration of tasks, aka activities
- The sequence of the activities
- Interactions with elements outside the project

Estimating the duration of activities is probably the most challenging aspect unless experience and industry standards are available to guide the project team. For projects that have not been done before, or for which there is no historical information, these durations are typically limited to the best guess. While that may not sound very reassuring, it does, however, provide at least the beginning of the historical information. As I always say, “Any estimate is better than none, no matter how far off it is”. At least you will learn how far off it was, and that is valuable information in itself.

Determining the sequence of the activities is less challenging if we understand the nature of the work. While it is possible to erect the structural steel before the foundations under it are in place, we do not consider it very practical and thus we plan to do it in the more efficient sequence. It is, however, impossible to test the software until after the coding has been done, at least incrementally.

As long as the nature of the work is understood and the outsourcing, i.e. the Make-or-Buy decision, is established, determining the interactions with outside elements is also not challenging. The external interactions might require, for example, understanding the regulatory environment, which might put constraints on the timing or sequencing of the work.

As we examine the benefits of managing time, we recognize:

- It allows you to finish the project on time
- It helps you do things in proper sequence.
- It lets you determine the interactions with other organizations and stakeholders
- It provides the basis for the timing and scheduling of resources required to perform the work
- It allows you to track impacts on your execution plan
- It allows you to address risks related to the timely completion of the work
- It allows you to perform what-if analysis, especially in an environment of risk
- It can tell you if you have enough time to meet the project objectives

When we consider the first and last bullets in the list above, the question naturally arises: who sets the project deadline? Are they qualified enough to make it realistic? And what do we do if we think there is not enough time?

When I teach time management, I ask my students who would take a contract to erect a 6-story office building in six months. Occasionally I get a student willing to take it on, but mostly they think that is not enough time. I then ask them how about a 15-story building in one week? Of course, they think that is absolutely impossible. I then show them a video of a project by the Broad Group, a Chinese company, that is a time-lapse video. Sure enough, from flat grade to occupancy takes 196 hours.

I then challenge my students to adopt the philosophy that you always have enough time. I ask them to keep in mind that if it seems there is not enough time, it merely means that you have not yet thought of how to achieve it. I have found this to be true throughout my career and the following Tale from the Trenches illustrates that you have enough time; you just have to abandon “business as usual” mentality and think outside the box.

Tale from the Trenches

While I was project manager on a waste wood burning power plant where even one day late delivery of the completed project had potentially devastating consequences, I got word from the boiler manufacturer that they had to give our steam drum to another customer and the replacement for our project would be three months late. That was a simply unacceptable situation since the steam drum was on the critical path of the project schedule. But we had to deal with it.

I notified the construction manager and asked him to consider our options. Normally, this would be a showstopper and our client would suffer huge financial damages. In the true spirit of "you always have enough time", the construction manager developed an alternative totally unconventional method of erecting the boiler.

The picture in Figure 9.1 shows the drum in its installed position. (See red arrow) Traditionally, it is raised inside the structural steel cage before the tubing to be installed inside the cage blocks the path.

With the delayed delivery, the construction manager devised a means to install the tubing, obstructing the normal path for the drum, to stay on schedule and then raise the drum outside the steel cage and then thread it laterally into position.

Figure 9.1 – Typical Steam Drum Installation

To put time management into perspective, let us look at Figure 9.2. It illustrates how the three parts of the triple constraint, scope, time and cost are combined into a single process.

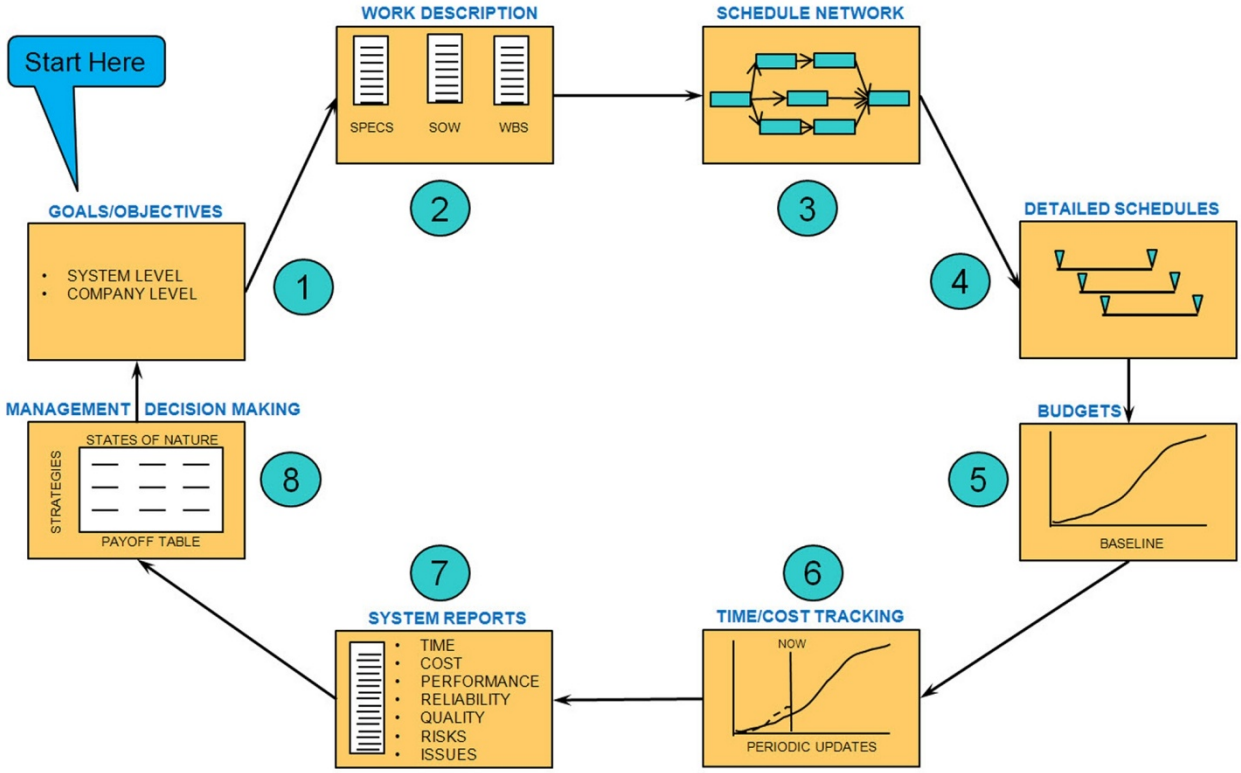

Figure 9.2 – Time Management Overview

The process is cyclical in nature as we follow the numbers around the process.

1. We start with the development of goals and objectives for the project.
2. That is followed by a detailed description and definition of the project scope, including the specifications, statement of work and WBS.
3. Once the work to be done has been defined, the detailed steps, i.e. activities, are developed in a project scheduling tool.
4. After the schedule model, such as the schedule network, has been created, the tool can generate various schedules for review and analysis.
5. By loading the resources on the activities, the time-phased budget is established, representing the baseline schedule and budget baseline.
6. After the first iteration of this process, we are ready to track the progress of the activities and the actual cost charged to the project.
7. This allows us to generate reports of various kinds for analysis and review.
8. Upon analysis of the current state of the project, management makes decisions, taking risk factors into account.

At this point, we recycle to review the goals and objectives in case they have changed and follow the process around over and over. In Step 2, we might encounter approved changes that would need to be worked into the work description and WBS, resulting in adjustments to the schedule, resources and a revised baseline.

9.1.1. Scheduling Tools

Scheduling tools as we know them today started to be developed in the 1960s. The US Navy and DuPont Company, independent of each other, developed a network model using the Critical Path Method (CPM). Their approach differed essentially only in the manner of diagramming the network, although the Navy extended the simple CPM algorithm with the Program Evaluation & Review Technique (PERT). Prior to the network method, scheduling was done essentially in a Gantt Chart. While the Gantt Chart provided clear visibility, it did not have any provision for showing the impacts on the scheduled activities other than manually revising the bar chart. It is a manual scheduling tool. I invite the reader to browse for a more detailed narrative of the history of scheduling tools.

Currently, the most common scheduling tools are the Gantt Chart (for relatively simple projects), the network diagram using the CPM algorithm, milestone charts and the Horse blanket (a line of balance diagram). Other methods are typically offshoots from these methods. By far, the most common tool is the network diagram. Appendix C provides a detailed coverage of this.

Network diagrams provide significant advantages, which attests to the longevity of this method. These include:

- Provides automatic updating of the schedule when activity parameters, such as the duration, sequence, working calendar and resources, are changed.
- Provides visibility; it is essentially a flowchart of the entire project execution plan. The visibility allows for quick assessment of the current status and potential impediments.
- Displays which activities are crucial to be done, i.e. prioritizes activities based on urgency; this is the Critical Path (See full discussion of the Critical Path in Appendix C.
- Provides the basis for resource planning and allocation. By extension, it provides for a time-based presentation of the project cost, both budgeted and incurred.
- Supports capital expenditure requirements
- Provides a basis for planning and forecasting into the future
- Provides a tool for alternative analyses to support time and cost-related risk management
- Provides the basis for analyzing delay impacts on the project
- Provides for easy integration of project changes into the work flow
- Highlights where there might be spare time (float or slack) in the sequence of activities
- Displays actual progress of the project work and comparison with the plan
- Provides a structure for reporting, especially if it is tied to the WBS

It is worthwhile to look at the PERT method. This method allows for simplified injection of uncertainty into the scheduling durations. Instead of assigning a single, deterministic duration to each activity, with PERT, we assign each activity three durations: a most likely duration, an optimistic duration assuming everything goes just fine, and a pessimistic duration assuming that

things will take longer than hoped for. The PERT method then uses the following formula to establish a most likely duration for each activity:

$$De = \frac{O + 4L + P}{6}$$

The Optimistic and Pessimistic durations factor the Expected duration. For example, if we estimated the most likely duration at 10 days, but the Optimistic duration as short as 8 days and the Pessimistic duration as long as 14, the Expected duration would be 10.3 days, calculated as follows.

$$De = \frac{8 + 4 * 10 + 14}{6}$$

The Expected duration is slightly longer in this instance than the Most Likely duration because the Pessimistic duration is further from the Most Likely than the Optimistic.

I discussed Monte Carlo Simulation in Section 7.5.2.1 and I repeat the main points regarding time management here. It makes use of these three duration estimates but adds more sophisticated statistical calculations to determine the Expected duration. Figure 9.3 illustrates a typical output chart from a Monte Carlo simulation run. The Monte Carlo simulation calculates the project duration many, many times, perhaps a thousand times, and plots the resulting finish dates. The chart in Figure 9.3 is a histogram, aka a frequency distribution, of the number of times each date on the X-Axis resulted from the simulation.

In this chart, each bar is one date. The simulation shows that the project has zero probability of finishing prior to Aril 27th and is certain to finish by June 6th. The black curve shows a cumulative plot of the simulation results. This curve is very handy then to determine the likely probability of finishing by a certain date on the X-Axis. For example, if we project up from the X-Axis at May 22nd, the curve is at 80%, meaning that the project has an 80% probability of finishing by May 22nd.

It is important to recognize the basis of this simulation. If the activity duration uncertainty(s) is not known, then it is best to avoid spending doubtfully useful time on this. Also, it is generally not practical to apply the 3-point duration estimates to all activities; that is likely to result in a completion date that is considerably past the desired completion date and the distribution curve is likely to be very wide, i.e. the standard deviation of the distribution would be quite high.

From my personal experience, I have never used Monte Carlo simulation on my projects. My approach was always that it is too much “rocket science” and by the time we analyzed the uncertainty, things changed and time and progress advanced. On my projects, the probability of finishing on time is always 100% because my teams and I keep an eye out for schedule impacts and have recovery plans ready to put into place. That has served me well and is in line with the philosophy that you always have enough time.

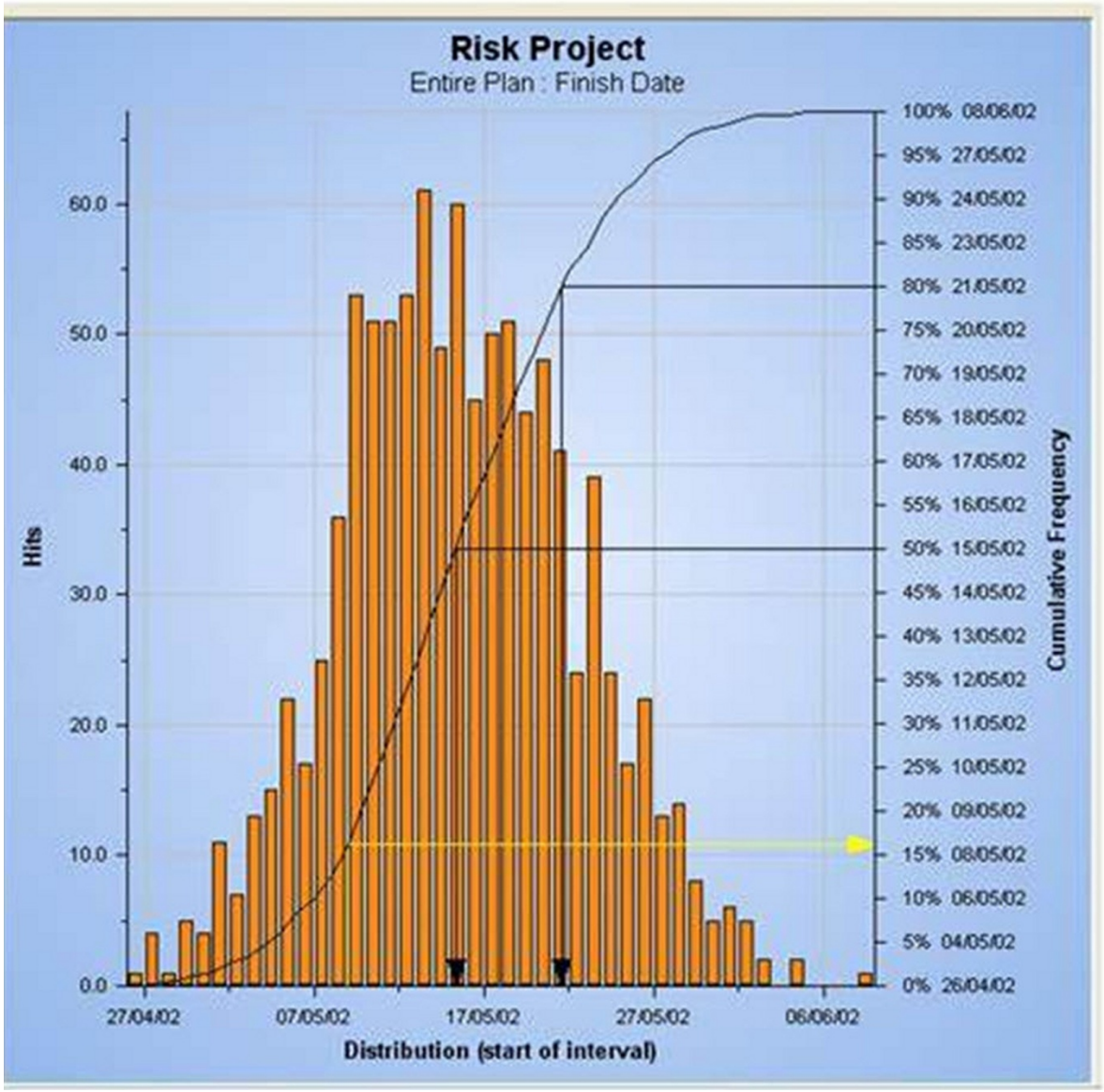

Figure 9.3 – Monte Carlo Simulation Output

Appendix C contains detailed information on the CPM details, how it works, and what benefits it provides.

A Horse blanket schedule is a graphical presentation of repetitive activities plotted on a time line. Figure 9.4 illustrates what it might look like.

A. APPENDIX A

A.1. Scaling the *PMBOK® Guide*

A.1.1. The 20 Minute Project

My students constantly ask: "But I'm not building a power plant or flying to the moon. What will this book do for ME?" And, of course, the big worry is that the *PMBOK® Guide* is way too complex for most projects. So, I illustrate that the material in this book, as well as the *PMBOK® Guide*, totally applies to any project, even to the smallest project I can think of, buying groceries.

In the following scenario, all caps words represent either a Knowledge Area or an artifact from the *PMBOK® Guide*, as well as a Function in this book. This will help show the connection between this simple project and the "complexity" of the Guide.

First off, do we have a PROJECT? It certainly is; we have a temporary endeavor, assuming the husband returns home with the groceries, and there is an objective: bringing groceries home; and there is added value as a result of conducting this project.

Was there a BUSINESS CASE for this project? There certainly was; the value expected to be delivered was a refrigerator and pantry full of food.

Was there a PROJECT CHARTER? There certainly was; the PROJECT SPONSOR (i.e. the wife, lol) authorized her husband to engage in this project, giving him authority to spend COMPANY RESOURCES and do what is necessary to deliver a successful result.

So, we have the genesis of our project. We have a PROJECT MANAGER, a PROJECT TEAM, which happens to be the same as the project manager, and we have various STAKEHOLDERS. Let us consider the project management Functions, aka the Knowledge Areas.

Do we have a defined SCOPE? We certainly have; using the shopping list as a SCOPE STATEMENT or REQUIREMENTS DOCUMENT, it is clear what the PROJECT OBJECTIVE is.

Is there a project SCHEDULE? There certainly is; the husband is to be back home within 20 minutes.

Is there a BUDGET? There certainly is; following an ESTIMATE, a budget of $20.00 was established, including a CONTINGENCY of $3.00 for additional items and price uncertainty.

Is there a MANAGEMENT RESERVE? There certainly is; since the husband was going to use a credit card, his wife should be consulted via phone in case the store had, unknown to them, raised prices well beyond the couple's expectations and perhaps received authority to use more money than was in the PROJECT BUDGET.

Are there RESOURCE REQUIREMENTS and availability? There certainly are; We considered the husband to be available, pre-empting any other activities he might have been planning on. This was a STRATEGIC MANAGEMENT DECISION.

Is there a PROCUREMENT MANAGEMENT process in play? There certainly is; following a MAKE-BUY ANALISYS, the couple decided to outsource the bread, milk, bananas, eggs and orange juice instead of producing these items themselves. Is there a PURCHASE ORDER? There certainly is; by implication of the filled shopping cart, the store agrees to supply the items, and the husband agrees to pay.

Is there an INVOICE? There certainly is; the cashier showed the husband the itemized list and prices with a total amount and the husband used his ACCOUNTS PAYABLE process (his wallet) to make payment.

Are there STAKEHOLDERS involved? There certainly are; besides the couple, there are the store's staff, other drivers on the streets, at a minimum.

Are there COMMUNICATION issues to be dealt with? There certainly are; does the husband truly understand the project objectives or is his mind still on the football game he had been watching? Is the shopping list legible or full of abbreviations?

Are there quality concerns? There certainly are; the milk is to be as fresh as possible and the date is the QUANTITATIVE METRIC used for that. The bananas should not be too ripe and the color of the skin is the QUALITATIVE METRIC used for that. The eggs are to be checked for any broken ones, which are considered to be a defect and the source point inspection in the store (think FACTORY TEST) is the QUALITY TOOL to be used for that.

Is there a QUALITY TEST designed to be performed prior to acceptance? There certainly is; the wife admonished her husband to be sure to jiggle each egg in the carton because broken ones would stick to the carton.

Are there any RISKS to be concerned about? There certainly are; another driver might run a red light on the husband's way to the store. The store might be out of acceptable bananas. The prices might be much higher than expected. The normal road might be blocked due to police activity, requiring the husband to make a detour that would take an extra ten minutes.

Is there a possibility of SCOPE CREEP? There certainly is; the husband might decide to add beer to the shopping list without consulting the appropriate STAKEHOLDER.

Is there a possibility of a SCOPE CHANGE? There certainly is; while at the store, the husband receives a call from his wife to add an item to the shopping list, resulting in an authorized SCOPE CHANGE, including an increase in the budget. The above mentioned CONTINGENCY would cover that.

Is there an AGILE delivery process involved? There certainly might be; the couple might decide that the ultimate REQUIREMENTS, i.e. the shopping list, would be established sometime while the husband was at the store. SPRINTS would be in two minute TIME BOXES, and the REQUIREMENTS to be "developed" would be the specific items to be placed into the shopping cart. Each SPRINT would start with a SPRINT PLANNING MEETING to determine which REQUIREMENT (item on the shopping list) is to be found next; and followed by a SPRINT REVIEW MEETING to determine which items made it into the shopping cart. A SPRINT RETROSPECTIVE might determine that there could be a more efficient route to navigate the aisles.

Is there a review of the project to determine its success? There certainly is; the wife reviews the items, frowns at the beer, but gives her husband a solid hug and a kiss and says, "Thank you dear. I left the football game on for you."

My goodness, did you ever think that going shopping would be this complicated? Do you now realize that all the stuff in this book and in the *PMBOK® Guide* is scalable? And on top of that, you can tailor the project management practices to the needs of your project. No need for a voluminous scope statement, no need for a CPM schedule, no need for a lot of detailed management plans; I think you get the idea. So, no matter how large and complex or how brief and simple your project might be, the materials in this book and in the *PMBOK® Guide* apply. And needless to say, you would simplify and tailor the processes to suit.

C. APPENDIX C

C.1. CPM Scheduling

Critical Path Method scheduling, as the name implies, creates a schedule model that allows the practitioner to establish the critical path(s) in a project schedule network. Some people confuse CPM with PERT. In actuality, they both use the CPM algorithm to calculate the dates. What distinguishes PERT from ordinary CPM is the use of a simple probabilistic calculation for the expected durations of the activities, allowing the consideration of uncertainty regarding duration estimates..

This appendix covers the CPM calculation for the Early and Late Dates, the Total Float and Free Float. The importance of understanding this material is that it provides the rationale and explanation of the dates in the schedule, which can be confusing because of the large number of activities and myriad of connections, i.e. dependencies, between the activities.

C.2. Components of a Schedule

A CPM schedule comprises activities and connections between the activities which determine the sequence of the work. In current times and for many decades now, the Precedence Diagramming Method (PDM) has gained favor because it's easier to understand. Very few scheduling practitioners use the Arrow Diagramming Method (ADM) any more. This appendix is based on the PDM format.

C.2.1. Activities & Milestones

Activities are the things we do to get the project done. This is where the work is located. Activities have durations, typically at least one day or one hour, depending on the timescale of your project. Relationships interconnect them to establish the sequence of the work. We load resources onto activities to provide the timing of the use of the resources.

Milestones are events. They have no duration, not even a nano-second. Hence, they cannot contain resources. Some practitioners add resources to a milestone to show a point in time when a payment is to be made, for example. A better way to deal with that issue is to add the resource to an activity and set the "accrual" to either the start or end of the activity.

We use milestones for two primary purposes. One is to highlight a point in time, some event, in the project schedule. Another is to allow the reporting of the project timeline in a high-level summary manner by displaying only the milestones, i.e. key dates.

C.2.2. Relationships (Precedences)

There are 4 types of relationships, AKA Precedences and Dependencies, with which to connect activities:

- Finish to Start – the Successor can start after the Predecessor is finished
- Start to Start – the Successor can start at the same time as the Predecessor
- Finish to Finish – the Successor must finish at the same time as the Predecessor finishes
- Start to Finish – the Successor must finish when the Predecessor starts

These relationships make the connections between the activities. Unless a lead or lag is applied to a relationship, it does not take any time. Lagsare durations of time between the activities and might be used to account for a lapse of time while no work is going on, such as allowing concrete to cure or paint to dry before proceeding with the next activity. A Lead is a negative time duration, i.e. the end point of the relationship occurs before the start point. It might be used to allow the successor activity to start before its predecessor is completely finished. These uses require knowledge of the nature of the work and where the leads and lags are appropriate. Figure C.1 illustrates the four relationships.

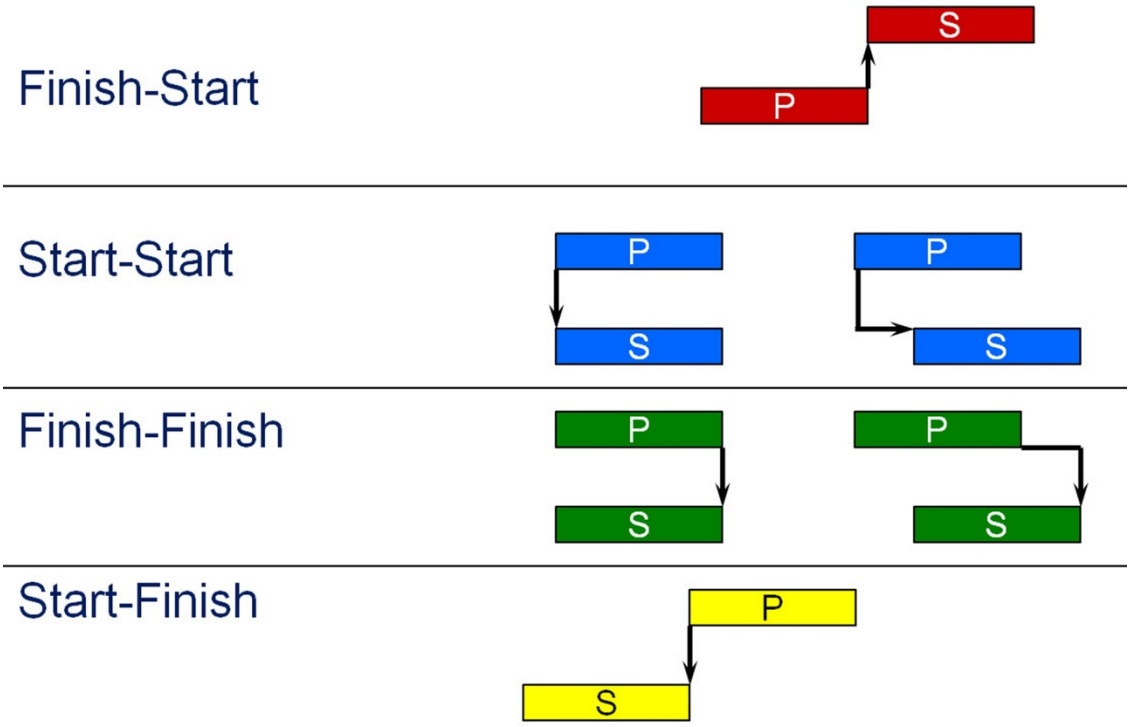

Figure C.1 – Relationships

The most common one is the Finish to Start relationship. The Successor can start after the Predecessor has finished. The vast majority of activities are connected with this type of relationship.

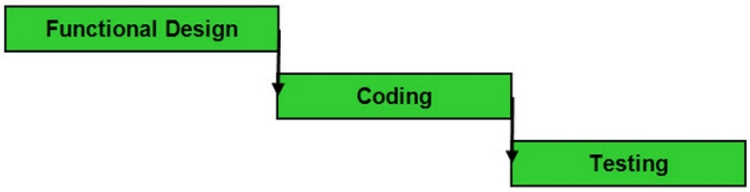

Figure C.2a – Finish to Start Example

The Start to Start relationship allows the Successor to start at the same time as the Predecessor, but it may not start any earlier unless a Lead is added to it. This example shows the addition of lags to provide some time spacing between the activities.

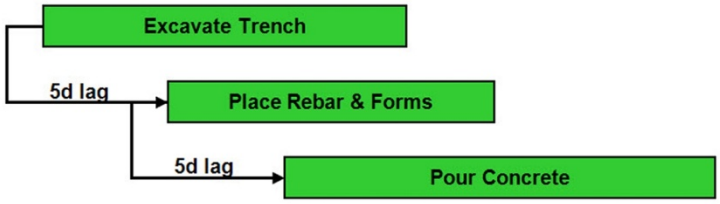

Figure C.2b – Start to Start Example

Suppose we need to excavate a 2 mile long trench and pour a concrete foundation in the trench's bottom. Rather than waiting for all 2 miles to be excavated, we allow the placing of the rebar and forms to start 5 days after the start of the excavation while the trench excavation continues. Similarly, we start the concrete pouring before all 2 miles of rebar and forms are completed. We can create a similar effect by dividing the activities into two, one five days long and another for the remainder of the required duration. That would create a tie-point for relationships at the 5-day mark, but it would add extra activities that would require reporting and maintenance. The lags reduce the clutter and scheduling effort.

The Finish to Finish relationship is similar to the Start to Start, but it is applied to the ends of the activities. The Successor can finish when the Predecessor finishes. This example shows the addition of lags for similar reasons as the prior example. Here we continue the project from the previous example by

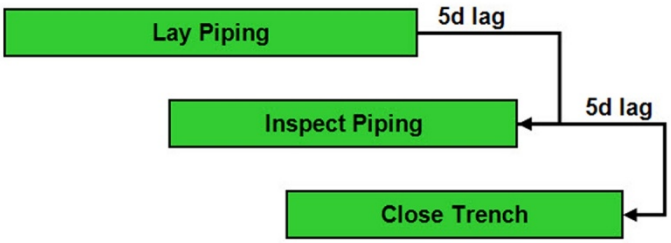

Figure C.2c – Finish to Finish Example

laying piping, inspecting the piping, and then covering the trench. We give the inspectors 5 days after the last pipe is laid to finish their inspection and the backhoe 5 days to cover the last part of the trench. As in the previous example, we could break the activities into separate parts to provide tie-points for the relationships 5 days before the end of the work.

The Start to Finish relationship is quite rare and harder to understand. Before we dive into that one, let us understand one of the most vital concepts of CPM scheduling. Looking at Figure C,1, the reader will notice that all four relationships have one thing in common: In every case, the

relationship arrow points from the Predecessor to the Successor. This means that the Predecessor's date(s) determines the date(s) of the Successor. As the term Dependencies implies, the dates of the Successor depend on the Predecessor.

Suppose we are developing our construction schedule, which includes the installation of an elevator. Notice that the relationship to the Fab and Deliver activity points from the Install activity to the Fab and Deliver activity, even though it occurs prior to the installation activity. That tells us that the Fab and Deliver activity depends on the Install activity. This works well in the planning stage in this example. We want the construction schedule to establish the delivery date of the elevator. As we are developing the construction schedule, the Install activity might move around on our timeline; this relationship will drag the Fab and Deliver activity along to support the construction schedule. Once the planning is done, we will want to turn this relationship around to a Finish to Start type; the installation cannot begin until the elevator is actually delivered and we will want to see any impact on our construction schedule from a change in the manufacturer's delivery date.

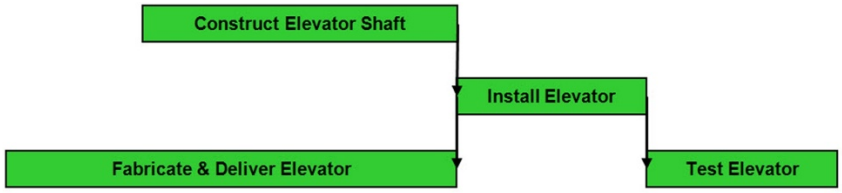

Figure C.2d – Start to Finish Example

Notice in this relationship, the Successor occurs earlier in time than the Predecessor. The terms Predecessor and Successor have nothing to do with chronology; they are merely references to a logical sequence of activities.

C.2.3. Constraints

Constraints are manually entered dates on the start or finish date of an activity. They override (even interfere with) the CPM algorithm, as we shall see shortly. The most common ones are Start No Earlier Than a certain date and Finish No Later Than a certain date.

Additional constraints are Must Start (or Finish) On a certain date, Start No Later Than, and Finish No Earlier Than, for example.

When you apply a constraint, you are injecting manual scheduling into the CPM schedule and that requires careful attention to, and maintenance of, those manual dates. I always advise that the reason for a constraint should be documented in the Notes Field of the relevant activity. I have been guilty of ignoring this advice myself and always rued the day in the future when I wanted to remove the constraint but could not remember why I put there in the first place.

C.2.4. Resources

Resources are the cost component of a project. These include labor, materials and equipment. By loading the resources into the schedule, we integrate the project cost with the