نسخة أولية

Cover page

مقدمة

الحمد لله الذي علَّم بالقلم، علَّم الإنسان ما لم يعلم، والصلاة والسلام على من بُعث مُعلماً للناس وهادياً وبشيراً، وداعياً إلى الله بإذنه وسراجاً منيراً؛ فأخرج الناس من ظلمات الجهل والغواية، إلى نور العلم والهداية، نبينا ومعلمنا وقدوتنا الأول محمد بن عبد الله وعلى آله وصحبه أجمعين، أما بعد:

تسعى المؤسسة العامة للتدريب التقني والمهني لتأهيل الكوادر الوطنية المدربة القادرة على شغل الوظائف التقنية والفنية والمهنية المتوفرة في سوق العمل السعودي، ويأتي هذا الاهتمام نتيجة للتوجهات السديدة من لدن قادة هذا الوطن التي تصب في مجملها نحو إيجاد وطن متكامل يعتمد ذاتياً على الله ثم على موارده وعلى قوة شبابه المسلح بالعلم والإيمان من أجل الاستمرار قدماً في دفع عجلة التقدم التنموي، لتصل بعون الله تعالى لمصاف الدول المتقدمة صناعياً.

وقد خطت الإدارة العامة للمناهج خطوة إيجابية تتفق مع التجارب الدولية المتقدمة في بناء البرامج التدريبية، وفق أساليب علمية حديثة تحاكي متطلبات سوق العمل بكافة تخصصاته لتلبي تلك المتطلبات، وقد تمثلت هذه الخطوة في مشروع إعداد المعايير المهنية الوطنية ومن بعده مشروع المؤهلات المهنية الوطنية، والذي يمثل كل منهما في زمنه، الركيزة الأساسية في بناء البرامج التدريبية، إذ تعتمد المعايير وكذلك المؤهلات لاحقاً في بنائها على تشكيل لجان تخصصية تمثل سوق العمل والمؤسسة العامة للتدريب التقني والمهني بحيث تتوافق الرؤية العلمية مع الواقع العملي الذي تفرضه متطلبات سوق العمل، لتخرج هذه اللجان في النهاية بنظرة متكاملة لبرنامج تدريبي أكثر التصاقاً بسوق العمل، وأكثر واقعية في تحقيق متطلباته الأساسية.

وتتناول هذه الحقيبة التدريبية **"إدارة المشاريع الهندسية"** لمتدربي برنامج البكالوريوس في الكليات التقنية، موضوعات حيوية تتناول كيفية اكتساب المهارات اللازمة لهذا البرنامج لتكون مهاراتها رافداً لهم في حياتهم العملية بعد تخرجهم من هذا البرنامج. والإدارة العامة للمناهج وهي تضع بين يديك هذه الحقيبة التدريبية تأمل من الله عز وجلً أن تسهم بشكل مباشر في تأصيل المهارات الضرورية اللازمة، بأسلوب مبسط خالٍ من التعقيد.

والله نسأل أن يوفق القائمين على إعدادها والمستفيدين منها لما يحبه ويرضاه؛ إنه سميع مجيب الدعاء.

الإدارة العامة للمناهج

Contents

Preface

The Engineering Project Management Course is intended to help meet the requirements of industry by educating undergraduate engineering students to understand engineering projects, project organizations and project management methods. Students completing this course will be able to work effectively in multidisciplinary engineering projects immediately after completion and to advance more rapidly within the project management organization and profession. The management of projects entails technical knowledge, engineering skills and management skills.

❖ General Objective:

The course introduces trainees to the fundamentals of project management and will give them an overview of the entire project management process. The course support exploring and understanding project management concepts through class discussions and examinations.

❖ Detailed Objectives:

Trainee will be able to:

1. Understand the importance of project management.
2. Understand the role of the project manager.
3. Describe the process of project integration management.
4. Understand the importance of project scope management and use various techniques to manage scope.
5. Understand the importance of project schedule management and how to use various techniques to develop and manage schedule.
6. Understand project cost management and how to estimate it.
7. Understand the importance of project quality management and how to use various techniques to manage time.
8. Describe resource management and its role in project management.
9. Understand project communications management and its role in project management.
10. Understand risk management and techniques to manage risk in projects.
11. Understand the importance of procurement.
12. Describe stakeholder's management and its role in project management.

Chapter 1

Introduction

General Objective of the Chapter:

Trainee will be able to understand the importance of project management.

Detailed Objectives:

1. The trainee should be familiar with the historical development of the concept of project management.
2. Trainee will be able to understand the fundamental elements of project management such us:

- Projects
- The Importance of Project Management
- Relationships of Project, Program. Portfolio and Operation Management
- Project and development life cycles
- Project Phase
- Phase Gate
- Project Management Process
- Project Management Process Groups
- Project Management Data and Information

1.1. History of Project Management

Sometime during the third millennium B.C., workers on the Great Pyramid of Cheops set the last stone in place. Certainly, they must have felt jubilant, for this event represented a milestone of sorts in one of humanity' s grandest undertakings. Although much of the ancient Egyptians' technology is still a mystery, the enormity and quality of the finished product remain a marvel. Despite the lack of sophisticated machinery, they were able to raise and fit some 2,300,000 stone blocks, weighing 2 to 70 tons apiece, into a structure the height of a modern 40-story building. Each facing stone was set against the next with an accuracy of 0.04 inch, and the base, which covers 13 acres, deviates less than 1 inch from level (Figure 1.1).

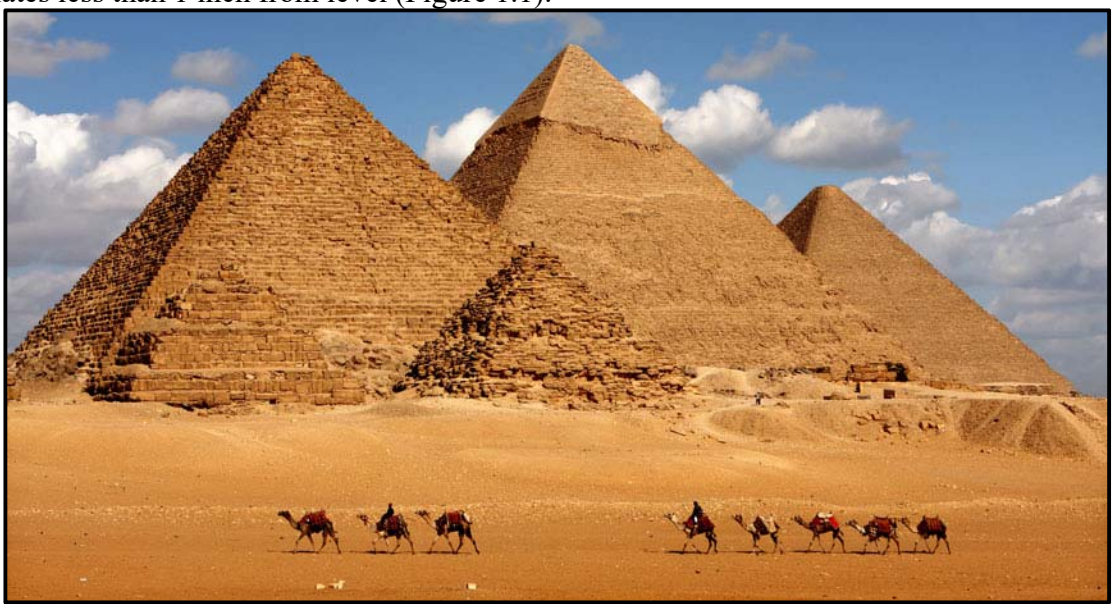

Figure 1.1. The Great Pyramid of Cheops, an early (circa 2500 B.C.) large-scale project.

Building the Great Pyramid is what we today would call a large-scale project, and stands representative of numerous projects from early recorded history that required massive human works and managerial competency.

With later civilizations, we can cite the Great Wall China which is yet another wonder of the world that was built since the Qin Dynasty (221BC-206BC). Available historical data, shows or indicate that the labor force was organized into three groups consisting of soldiers, the common people and criminals. The overall command was Emperor Qin Shihuang who ordered millions of people to finish this project. This shows emergence of organization, and command structure in project execution (Figure 1.2).

Figure 1.2. The Great Wall China, an early (221B.C-206B.C) large-scale project

In late 19th century, in the United States, large-scale government projects were the impetus for making important decisions that became the basis for project management methodology such as the transcontinental railroad, which began construction in the 1860s. Suddenly, business leaders found themselves faced with the daunting task of organizing the manual labor of thousands of workers and the processing and assembly of unprecedented quantities of raw material.

Near the turn of the century, Frederick Taylor began his detailed studies of work. He applied scientific reasoning to work by showing that labor can be analyzed and improved by focusing on its elementary parts that introduced the concept of working more efficiently, rather than working harder and longer.

Taylor's associate, Henry Gantt, studied in great detail the order of operations in work and is most famous for developing the Gantt Chart in the 1910s. A Gantt chart is a popular type of bar chart that illustrates a project schedule and have become a common technique for representing the phases and activities of a project work breakdown structure, so they can be understood by a wide audience (Figure 1.3). Although now considered a common charting technique, Gantt charts were considered quite revolutionary at the time they were introduced. Gantt charts were employed on major infrastructure projects including the Hoover Dam and the Interstate highway system and are still accepted today as an important tool in project.

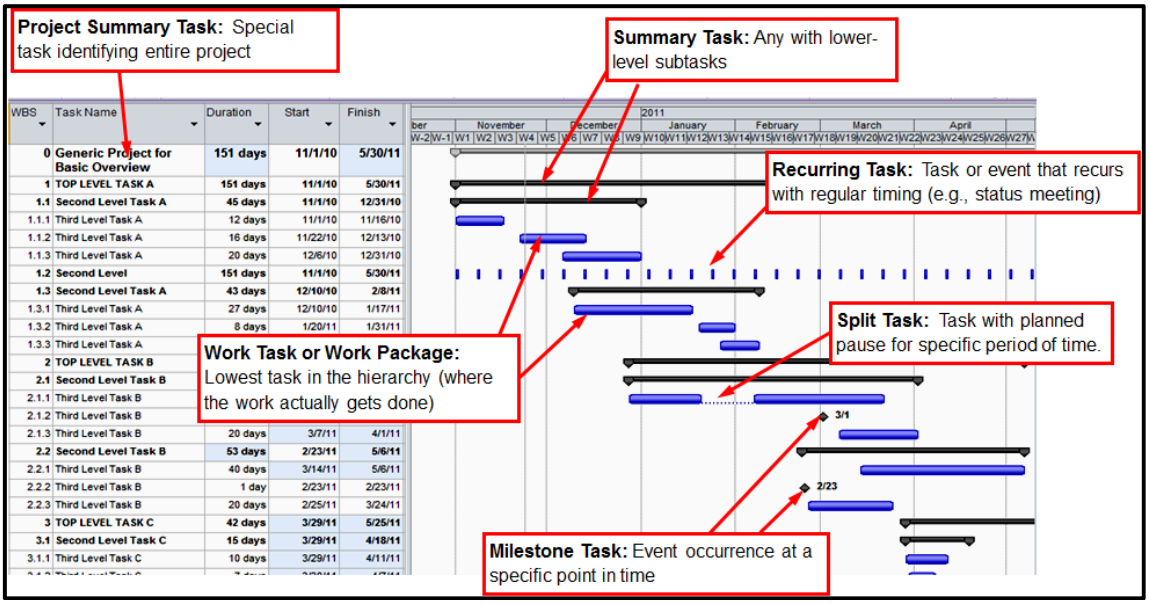

Figure 1.3. An example of a Gantt chart showing the relationship between a series of tasks

By the mid Twentieth century, projects were managed on an ad hoc basis using mostly Gantt Charts, and informal techniques and tools. During that time, the Manhattan project was initiated and its complexity was only possible because of project management methods. The Manhattan project was the codename given to the Allied effort to develop the first nuclear weapons during World War II. It involved over thirty different project sites in the US and Canada, and thousands of personnel from US, Canada and UK. Born out of a small research program that began in 1939, the Manhattan Project would eventually employ 130,000 people and cost a total of nearly 2 billion USD and result in the creation of multiple production and research sites operated in secret. The project succeeded in developing and detonating three nuclear weapons in 1945.

The 1950s marked the beginning of the modern Project Management era. Two mathematical project scheduling models were developed:

1. The Program Evaluation and Review Technique or PERT, developed by Booz-Allen & Hamilton as part of the United States Navy's (in conjunction with the Lockheed Corporation) Polaris missile submarine program. Pert is basically a method for analyzing the tasks involved for completing a given project, especially the time needed to complete each task, and identifying the minimum time needed to complete the total project (Figure 1.4).
2. The Critical Path Method (CPM) developed in a joint venture by both DuPont Corporation and Remington Rand Corporation for managing plant maintenance projects. The critical path determines the oat, or schedule flexibility, for each activity by calculating the earliest start date, earliest finish date, latest start date, and latest finish date for each activity. The critical path is generally the longest full path on the project. Any activity with a oat time that equals zero is considered a critical path task. CPM can help you figure out how long your complex project will take to complete and which activities are critical; meaning they have to be done on time or else the whole project will take longer. These mathematical techniques quickly spread into many private enterprises.

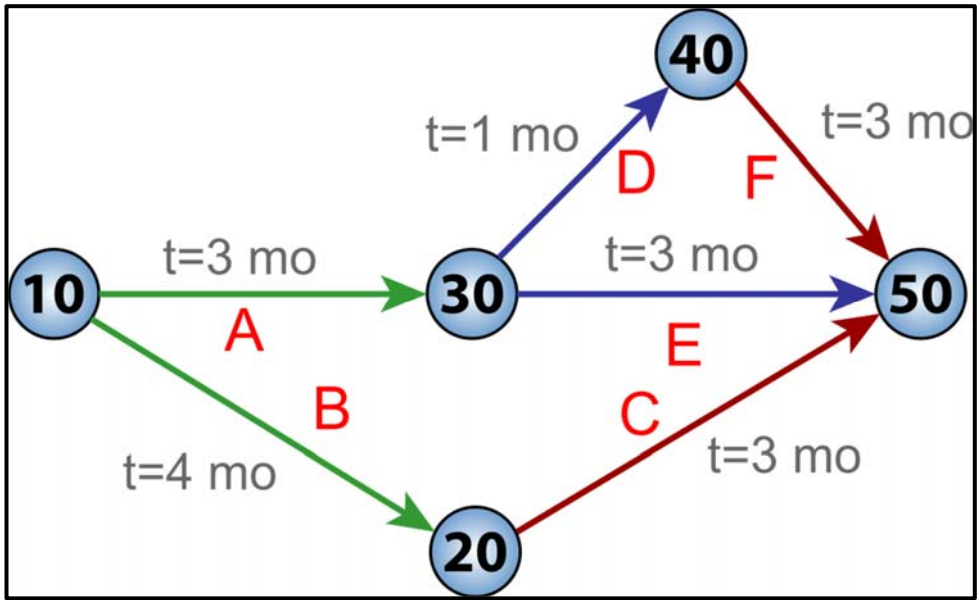

Figure 1.4. An example of a PERT network chart for a seven-month project with five milestones.

Project management in its present form began to take root a few decades ago. In the early 1960s, industrial and business organizations began to understand the benefits of organizing work around projects. They understood the critical need to communicate and integrate work across multiple departments and professions. The Project Management Institute (PMI) was founded in 1969 by five volunteers. Their initial goal was to establish an organization where members could share their experiences in project management and to discuss issues. Today, PMI is a non-prot project management professional association and the most widely recognized organization in terms of promoting project management best practices. PMI was formed to serve the interests of the project management industry. The premise of PMI is that the tools and techniques of project management are common even among the widespread application of projects from the software to the construction industry. PMI first began offering the PMP certification exam in 1984. Although it took a while for people to take notice, now more than 260,000 individuals around the world hold the PMP designation. To help keep project management terms and concepts clear and consistent, PMI introduced the Project Management Body of Knowledge (PMBOK) Guide in 1987. They updated it in 1996, 2000, 2004, 2009 and most recently in 2017 as the sixth edition. At present, there are more than 1 million copies of the PMBOK Guide in circulation. The highly regarded Institute of Electrical and Electronics Engineers (IEEE) have adopted it as their project management standard. In 1999 PMI was accredited as an American National Standards Institute (ANSI) standards developer and also has the distinction of being the first organization to have its certification program attain International Organization for Standardization (ISO) 9001 recognition. In 2008, the organization reported more than 260,000 members in over 171 countries. PMI also has offices in Washington, D.C., and Beijing, China, as well as Regional Service Centers in Singapore, Brussels (Belgium) and New Delhi (India). Recently, an office was opened in Mumbai (India).

As long as humankind does things, there will be projects. Many projects of the future will be similar to those in the past. Others will be different either in terms of increased scale of effort or more

advanced technology. Representative of the latter are three recent projects—the English Channel tunnel (Chunnel), the international space station, and SpaceShipOne. The Chunnel required tremendous resources and took a decade to complete. The international space station (Figure 1.5) has required development of new technologies and the efforts of the US, Russian, European, Canadian, and Japanese space agencies. SpaceShipOne is the venture of a small California company aimed at developing a vehicle and launch system for future space tourism.

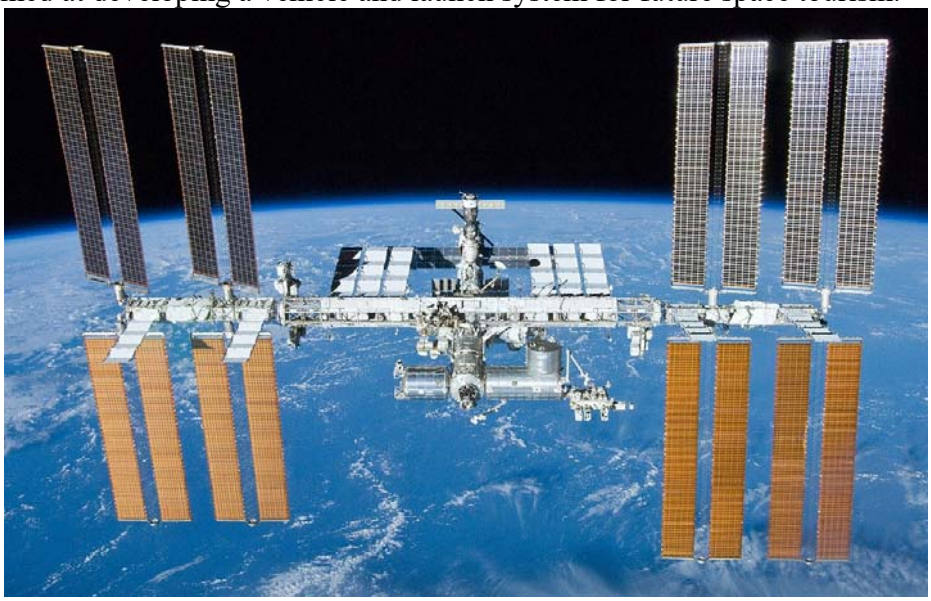

Figure 1.5. The international space station, a modern large-scale project.

1.2. Fundamental Elements

This section describes fundamental elements necessary for working in and understanding the discipline of project management.

1.2.1. Projects

The Project Management Institute (PMI) provides the following definition of a project:
A project is a **temporary endeavor** undertaken to create a **unique product, service, or result**.

- **Unique product, service, or result.** Fulfillment of project objectives may produce one or more of the following deliverables:
  - A unique product that can be either a component of another item, an enhancement or correction to an item, or a new end item in itself (e.g., the correction of a defect in an end item);
  - A unique service or a capability to perform a service (e.g., a business function that supports production or distribution);
  - A unique result, such as an outcome or document (e.g., a research project that develops knowledge that can be used to determine whether a trend exists or a new process will benefit society).

Projects are undertaken at all organizational levels. A project can involve a single individual or a group. A project can involve a single organizational unit or multiple organizational units from multiple organizations.

Examples of projects include but are not limited to:

- Developing a new pharmaceutical compound for market,
- Expanding a tour guide service,
- Exploring for oil in a region,
- Modifying a computer software program used in an organization,
- Constructing a building.

- **Temporary endeavor.** The temporary nature of projects indicates that a project has a definite beginning and end. Temporary does not necessarily mean a project has a short duration. The end of the project is reached when one or more of the following is true:
  - The project's objectives have been achieved;
  - The objectives will not or cannot be met;
  - Funding is exhausted or no longer available for allocation to the project;
  - The need for the project no longer exists (e.g., the customer no longer wants the project completed, a change in strategy or priority ends the project, the organizational management provides direction to end the project);
  - The human or physical resources are no longer available; or
  - The project is terminated for legal cause or convenience.

1.2.2. The Importance of Project Management

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. Project management is accomplished through the appropriate application and integration of the project management processes identified for the project. Project management enables organizations to execute projects effectively and efficiently.
Effective project management helps individuals, groups, and public and private organizations to:

- Meet business objectives;
- Satisfy stakeholder expectations;
- Be more predictable;
- Increase chances of success;
- Deliver the right products at the right time;
- Resolve problems and issues;
- Respond to risks in a timely manner;
- Optimize the use of organizational resources;
- Identify, recover, or terminate failing projects;
- Manage constraints (e.g., scope, quality, schedule, costs, resources);
- Balance the influence of constraints on the project (e.g., increased scope may increase cost or schedule); and
- Manage change in a better manner.

Poorly managed projects or the absence of project management may result in:

- Missed deadlines,
- Cost overruns,
- Poor quality,
- Rework,
- Uncontrolled expansion of the project,

- Loss of reputation for the organization,
- Unsatisfied stakeholders, and
- Failure in achieving the objectives for which the project was undertaken.

I.2.3. Relationship of Project, Program, Portfolio, And Operations Management

1.2.3.1 OVERVIEW

Using project management processes, tools, and techniques puts in place a sound foundation for organizations to achieve their goals and objectives. A project may be managed in three separate scenarios: as a stand-alone project (outside of a portfolio or program), within a program, or within a portfolio. Project managers interact with portfolio and program managers when a project is within a program or portfolio. For example, multiple projects may be needed to accomplish a set of goals and objectives for an organization. In those situations, projects may be grouped together into a program. A program is defined as a group of related projects, subsidiary programs, and program activities managed in a coordinated manner to obtain benefits not available from managing them individually. Programs are not large projects. A very large project may be referred to as a megaproject. As a guideline, megaprojects cost US$1billion or more, affect 1 million or more people, and run for years.

Some organizations may employ the use of a project portfolio to effectively manage multiple programs and projects that are underway at any given time. A portfolio is defined as projects, programs, subsidiary portfolios, and operations managed as a group to achieve strategic objectives. Figure 1.6 illustrates an example of how portfolios, programs, projects, and operations are related in a specific situation.

Program management and portfolio management differ from project management in their life cycles, activities, objectives, focus, and benefits. However, portfolios, programs, projects, and operations often engage with the same stakeholders and may need to use the same resources (see Figure I.6), which may result in a conflict in the organization. This type of a situation increases the need for coordination within the organization through the use of portfolio, program, and project management to achieve a workable balance in the organization.

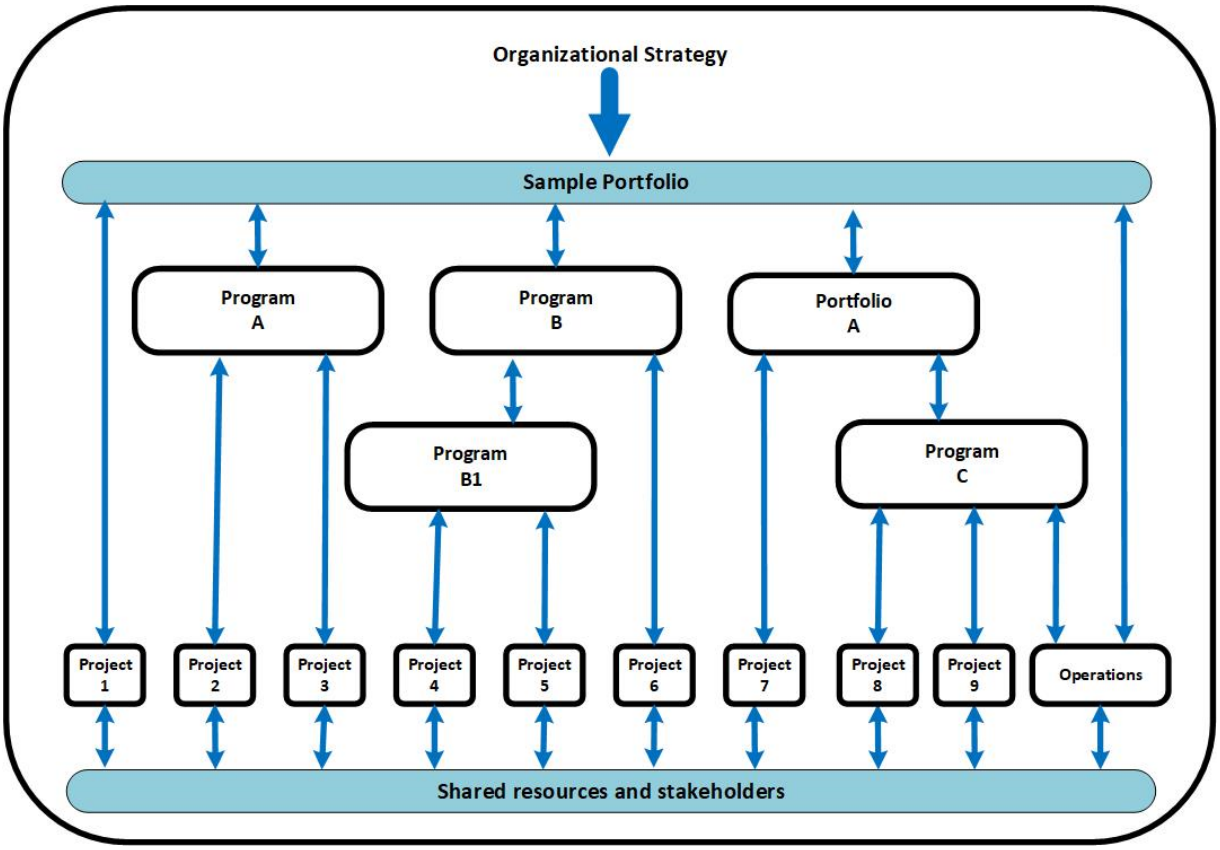

Figure 1.6. Portfolio, Programs, Projects and Operations.

Looking at project, program, and portfolio management from an organizational perspective:

- Program and project management focus on doing programs and projects the "right" way; and
- Portfolio management focuses on doing the "right" programs and projects.

Table 1.1 gives a comparative overview of portfolios, programs, and projects.

Table 1.1. comparative overview of portfolios, programs, and projects.

Organizational Project Management			
	Projects	**Programs**	**Portfolios**
Scope	Projects have defined objectives. Scope is progressively elaborated throughout the project life cycle.	Programs have a larger scope and provide more significant benefits.	Portfolios have an organizational scope that changes with the strategic objectives of the organization.
Change	Project managers expect change and implement processes to keep change managed and controlled.	Program managers expect change from both inside and outside the program and are prepared to manage it.	Portfolio managers continuously monitor changes in the broader internal and external environment.
Planning	Project managers progressively elaborate high-level information into detailed plans throughout the project life cycle.	Program managers develop the overall program plan and create high-level plans to guide detailed planning at the component level.	Portfolio managers create and maintain necessary processes and communication relative to the aggregate portfolio.
Management	Project managers manage the project team to meet the project objectives.	Program managers manage the program staff and the project managers; they provide vision and overall leadership.	Portfolio managers may manage or coordinate portfolio management staff, or program and project staff that may have reporting responsibilities into the aggregate portfolio.
Success	Success is measured by product and project quality, timeliness, budget compliance, and degree of customer satisfaction.	Success is measured by the degree to which the program satisfies the needs and benefits for which it was undertaken.	Success is measured in terms of the aggregate investment performance and benefit realization of the portfolio.
Monitoring	Project managers monitor and control the work of producing the products, services, or results that the project was undertaken to produce.	Program managers monitor the progress of program components to ensure the overall goals, schedules, budget, and benefits of the program will be met.	Portfolio managers monitor strategic changes and aggregate resource allocation, performance results, and risk of the portfolio.

1.2.3.2 PROGRAM MANAGEMENT

Program management is defined as the application of knowledge, skills, and principles to a program to achieve the program objectives and to obtain benefits and control not available by managing program components individually. A program component refers to projects and other programs within a program. Actions related to these program and project-level interdependencies may include:

- Aligning with the organizational or strategic direction that affects program and project goals and objectives;
- Allocating the program scope into program components;
- Managing interdependencies among the components of the program to best serve the program;
- Managing program risks that may impact multiple projects in the program;
- Resolving constraints and conflicts that affect multiple projects within the program;
- Resolving issues between component projects and the program level.

1.2.3.3 PORTFOLIO MANAGEMENT

Portfolio management is defined as the centralized management of one or more portfolios to achieve strategic objectives. The programs or projects of the portfolio may not necessarily be interdependent or directly related. The aim of portfolio management is to:

- Guide organizational investment decisions.
- Select the optimal mix of programs and projects to meet strategic objectives.
- Provide decision-making transparency.
- Prioritize team and physical resource allocation.
- Increase the likelihood of realizing the desired return on investment.
- Centralize the management of the aggregate risk profile of all components.

1.2.3.4 OPERATIONS MANAGEMENT

Operations management is concerned with the ongoing production of goods and/or services. It ensures that business operations continue efficiently by using the optimal resources needed to meet customer demands. It is concerned with managing processes that transform inputs (e.g., materials, components, energy, and labor) into outputs (e.g., products, goods, and/or services).

1.2.3.5 OPERATIONS AND PROJECT MANAGEMENT

Changes in business or organizational operations may be the focus of a project—especially when there are substantial changes to business operations as a result of a new product or service delivery. Ongoing operations are outside of the scope of a project; however, there are intersecting points where the two areas cross.

Projects can intersect with operations at various points during the product life cycle, such as;

- When developing a new product, upgrading a product, or expanding outputs;
- While improving operations or the product development process;
- At the end of the product life cycle; and
- At each closeout phase.

1.2.3.6 ORGANIZATIONAL PROJECT MANAGEMENT (OPM) AND STRATEGIES

Portfolios, programs, and projects are aligned with or driven by organizational strategies and differ in the way each contributes to the achievement of strategic goals:

- Portfolio management aligns portfolios with organizational strategies by selecting the right programs or projects, prioritizing the work, and providing the needed resources.
- Program management harmonizes its program components and controls interdependencies in order to realize specified benefits.
- Project management enables the achievement of organizational goals and objectives.

Within portfolios or programs, projects are a means of achieving organizational goals and objectives. This is often accomplished in the context of a strategic plan that is the primary factor guiding investments in projects. Alignment with the organization's strategic business goals can be achieved through the systematic management of portfolios, programs, and projects through the application of organizational project management (OPM). OPM is defined as a framework in which portfolio, program, and project management are integrated with organizational enablers in order to achieve strategic objectives. The purpose of OPM is to ensure that the organization undertakes the right projects and allocates critical resources appropriately. OPM also helps to ensure that all levels in the organization understand the strategic vision, the initiatives that support the vision, the objectives, and the deliverables. Figure 1.7 shows the organizational environment where strategy, portfolio, programs, projects, and operations interact.

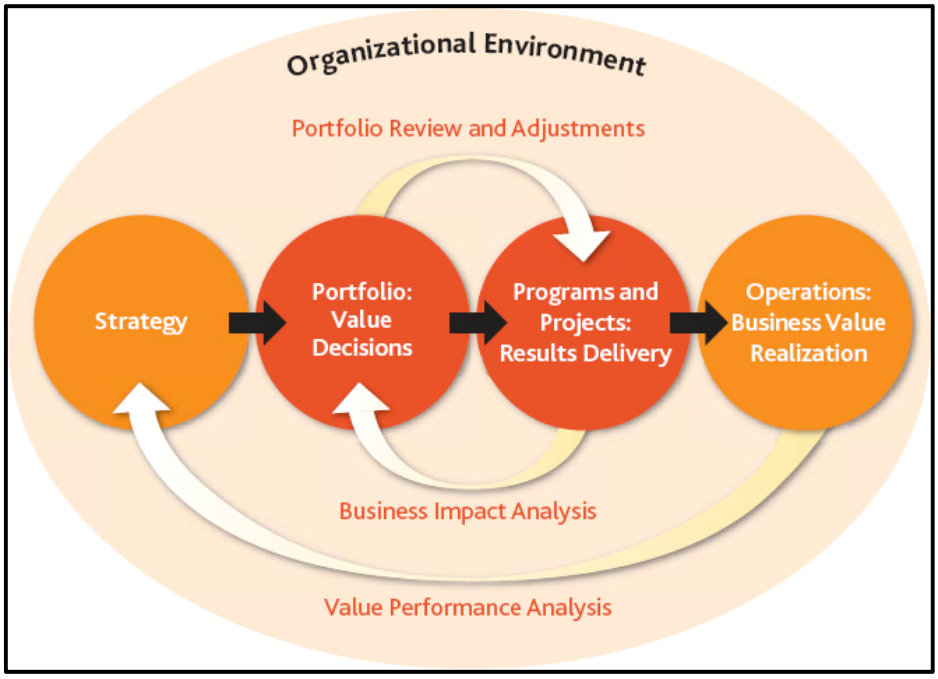

Figure 1.7. Organizational project management (OPM).

1.2.4. Project and Development Life Cycles

A project life cycle is the series of phases that a project passes through from its start to its completion. It provides the basic framework for managing the project. This basic framework applies regardless of the specific project work involved. The phases may be sequential, iterative, or overlapping. All projects can be mapped to the generic life cycle shown in Figure 1.8.

Project life cycles can be predictive or adaptive. Within a project life cycle, there are generally one or more phases that are associated with the development of the product, service, or result. These are called a development life cycle. Development life cycles can be predictive, iterative, incremental, adaptive, or a hybrid model. It is up to the project management team to determine the best life cycle for each project. The project life cycle needs to be flexible enough to deal with the variety of factors included in the project. Life cycle flexibility may be accomplished by:

- Identifying the process or processes needed to be performed in each phase,
- Performing the process or processes identified in the appropriate phase,
- Adjusting the various attributes of a phase (e.g., name, duration, exit criteria, and entrance criteria).

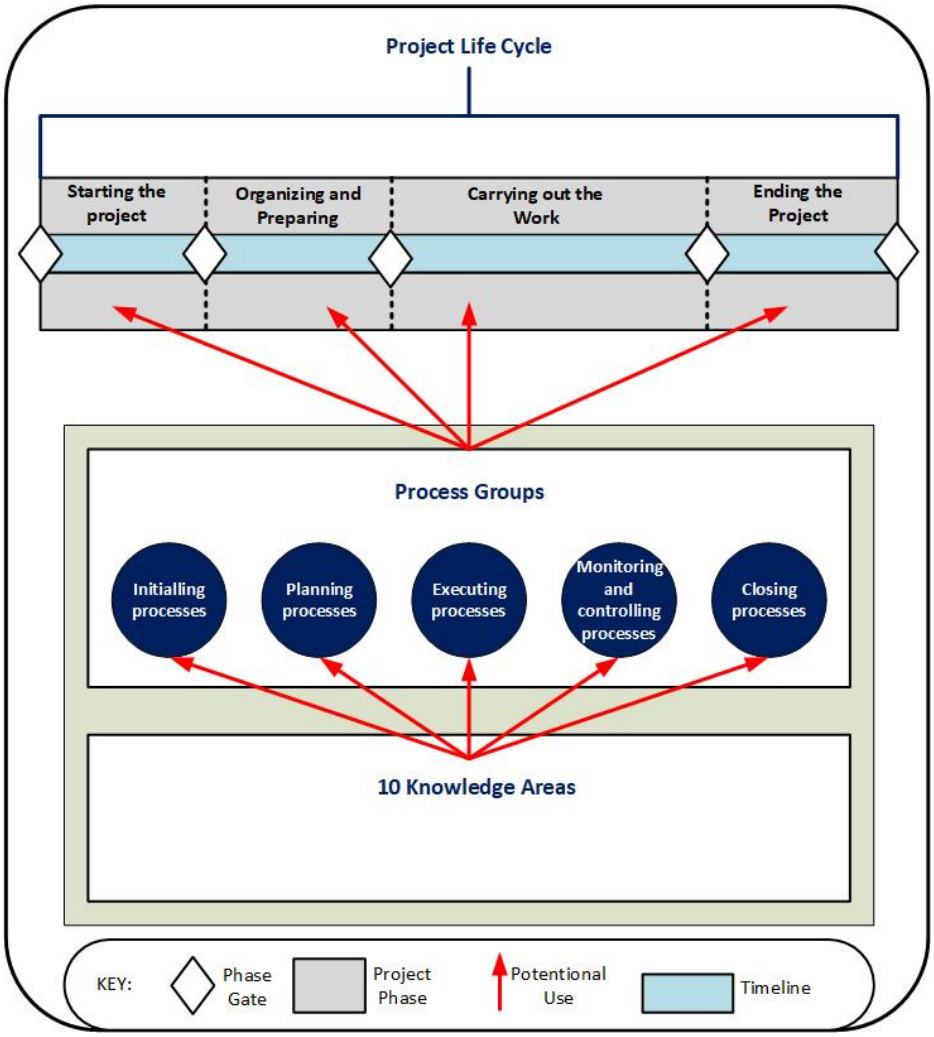

Figure 1.8. Project Generic Life Cycle.

1.2.5. Project Phase

A project phase is a collection of logically related project activities that culminates in the completion of one or more deliverables. The phases in a life cycle can be described by a variety of attributes. Attributes may be measurable and unique to a specific phase. Attributes may include but are not limited to:

- Name (e.g., Phase A, Phase B, Phase 1, Phase 2, proposal phase),
- Number (e.g., three phases in the project, five phases in the project), Duration (e.g., 1 week, 1 month, 1 quarter),
- Resource requirements (e.g., people, buildings, equipment),
- Entrance criteria for a project to move into that phase (e.g., specified approvals documented, specified documents completed), and
- Exit criteria for a project to complete a phase (e.g., documented approvals, completed documents, completed deliverables).

Projects may be separated into distinct phases or subcomponents. These phases or subcomponents are generally given names that indicate the type of work done in that phase. Examples of phase names include but are not limited to:

- Concept development,
- Feasibility study,
- Customer requirements,
- Solution development,
- Design,
- Prototype,
- Build.

The project phases may be established based on various factors including, but not limited to:

- Management needs;
- Nature of the project;
- Unique characteristics of the organization, industry, or technology.

1.2.6. Phase Gate

A phase gate, is held at the end of a phase. The project's performance and progress are compared to project and business documents including but not limited to:

- Project business case,
- Project charter,
- Project management plan, and
- Benefits management plan.

A decision (e.g., go/no-go decision) is made as a result of this comparison to:

- Continue to the next phase,
- Continue to the next phase with modification,
- End the project,
- Remain in the phase, or
- Repeat the phase or elements of it.

Depending on the organization, industry, or type of work, phase gates may be referred to by other terms such as, phase review, stage gate, kill point, and phase entrance or phase exit.

1.2.7. Project Management Processes

The project life cycle is managed by executing a series of project management activities known as project management processes. Every project management process produces one or more outputs from one or more inputs by using appropriate project management tools and techniques. The output can be a deliverable or an outcome. Outcomes are an end result of a process. Project management processes apply globally across industries. Project management processes are logically linked by the outputs they produce. Processes may contain overlapping activities that occur throughout the project. The output of one process generally results in either:

- An input to another process, or
- A deliverable of the project or project phase.

Figure 1.9 shows an example of how inputs, tools and techniques, and outputs relate to each other within a process, and with other processes.

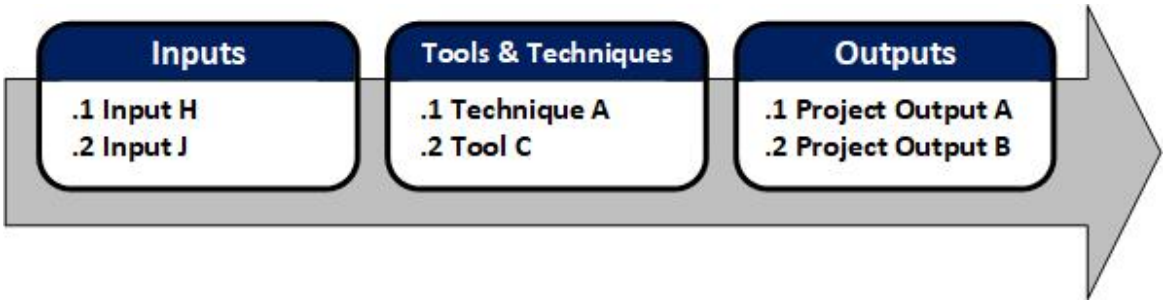

Figure 1.9. Example Process: Inputs, Tools & Techniques and Outputs.

The number of process iterations and interactions between processes varies based on the needs of the project. Processes generally fall into one of three categories:

- **Processes used once or at predefined points in the project.** The processes Develop Project Charter and Close Project or Phase are examples.
- **Processes that are performed periodically as needed.** The process Acquire Resources is performed as resources are needed. The process Conduct Procurements is performed prior to needing the procured item.
- **Processes that are performed continuously throughout the project.** The process Define Activities may occur throughout the project life cycle, especially if the project uses rolling wave planning or an adaptive development approach. Many of the monitoring and control processes are ongoing from the start of the project, until it is closed out.

1.2.8. Project Management Process Groups

A Project Management Process Group is a logical grouping of project management processes to achieve specific project objectives. Process Groups are independent of project phases. Project management processes are grouped into the following five Project Management Process Groups:

- **Initiating Process Group.** Those processes performed to define a new project or a new phase of an existing project by obtaining authorization to start the project or phase.
- **Planning Process Group.** Those processes required to establish the scope of the project, refine the objectives, and define the course of action required to attain the objectives that the project was undertaken to achieve.
- **Executing Process Group.** Those processes performed to complete the work defined in the project management plan to satisfy the project requirements.
- **Monitoring and Controlling Process Group.** Those processes required to track, review, and regulate the progress and performance of the project; identify any areas in which changes to the plan are required; and initiate the corresponding changes.
- **Closing Process Group.** Those processes performed to formally complete or close the project, phase, or contract.

1.2.9. Project Management Data and Information

Throughout the life cycle of a project, a significant amount of data is collected, analyzed, and transformed. Project data are collected as a result of various processes and are shared within the project team. The collected data are analyzed in context, aggregated, and transformed to become project information during various processes. Information is communicated verbally or stored and distributed in various formats as reports.

Project data are regularly collected and analyzed throughout the project life cycle. The following definitions identify key terminology regarding project data and information:

- **Work performance data.** The raw observations and measurements identified during activities performed to carry out the project work. Examples include reported percent of work physically completed, quality and technical performance measures, start and finish dates of schedule activities, number of change requests, number of defects, actual costs, actual durations, etc. Project data are usually recorded in a Project Management Information System (PMIS) and in project documents.
- **Work performance information.** The performance data collected from various controlling processes, analyzed in context and integrated based on relationships across areas. Examples of performance information are status of deliverables, implementation status for change requests, and forecast estimates to complete.
- **Work performance reports.** The physical or electronic representation of work performance information compiled in project documents, which is intended to generate decisions or raise issues, actions, or awareness. Examples include status reports, memos, justifications, information notes, electronic dashboards, recommendations, and updates.

Figure 1.10 shows the flow of project information across the various processes used in managing the project.

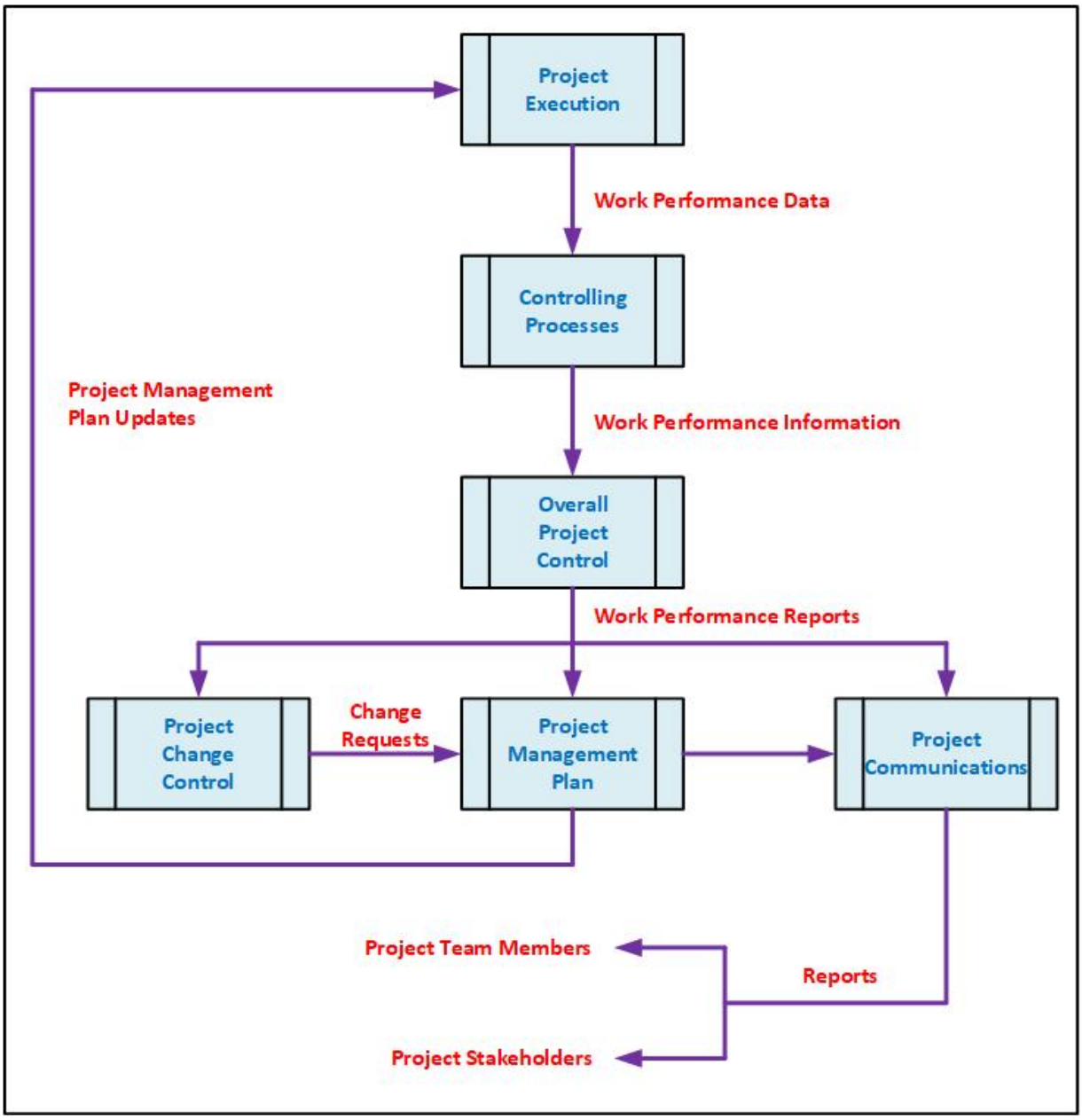

Figure 1.10. Project Data, Information and Report Flow.

Questions

1. Cites two monuments which prove that the concept of project management was an early concept.
2. Gives the Two mathematical project scheduling models which have marked the beginning of the modern Project Management era in the 1950s.
3. Project management in its present form began to take root in the early:
   A. 1940s
   B. 1950s
   C. 1960s
   D. 1970s
4. The Project Management Institute (PMI) was founded in:
   A. 1959
   B. 1969
   C. 1979
   D. 1989
5. Select the characteristic related to the project from the choices given below.
   A. project can create a service or capability to perform a service.
   B. It has a definite beginning and an end.
   C. A project is a temporary endeavor undertaken to create a unique product.
   D. All of the above.
6. The following are characteristics of a project, except:
   A. It is temporary in nature.
   B. It is continuous.
   C. It is unique.
   D. It has a definitive end.
7. Which of the following is NOT a characteristic of a project?
   A. Temporary
   B. Strategic
   C. Specific result
   D. Progressively elaborated
8. All of the following are characteristics of a project EXCEPT:
   A. It is temporary.
   B. It has a definite beginning and end.
   C. It has interrelated activities.
   D. It repeats itself every month
9. Which of the following is NOT a type of project management office?
   A. Directive
   B. Value-driven
   C. Supportive
   D. Controlling

10. When is a project considered successful?
A. All deliverables have been completed.
B. The phase completion has been approved.
C. Stakeholder expectations have been met.
D. The customer has provided final payment.

11. A project management office (PMO) is responsible for the following activities, except:
A. Measuring project performance and suggesting corrective action
B. Assuring efficient use of resources toward a specific business goal
C. Evaluating completed project for adherence to project plan
D. Maintaining and archiving project documentation for future use

12. Which of the following is NOT a responsibility of a project manager?
A. Managing stakeholder expectations
B. Managing project constraints
C. Gathering product requirements
D. Sponsoring the project

13. A project management office (PMO) is responsible for the following activities, except:
A. Measuring project performance and suggesting corrective action
B. Assuring efficient use of resources toward a specific business goal
C. Evaluating completed project for adherence to project plan
D. Maintaining and archiving project documentation for future use

14. A portfolio is a:
A. Group of related projects
B. Group of related programs
C. Group of related projects and programs that are managed together
D. Group of projects or programs that may not necessarily be related

15. An energy company is investing in a series of initiatives to look for alternative energy sources so that the company can be competitive in 10 years. The initiatives are tracked and managed together because this goal is vital to the success of the company. This is an example of:
A. A portfolio
B. A program
C. A project
D. A enterprise environmental factor

Chapter 2

The Environment in Which Projects Operate

General Objective of the Chapter:

Trainee will be able to understand the environment in which projects operate**.**

Detailed Objectives:

1. Trainee will be able to identify and understand Enterprise Environmental Factors (EEFs), including:
- EEFs Internal to the Organization
- EEFs External to the Organization
2. Trainee will be able to identify and understand the Organizational Process Assets, including:
- Process, Policies and Procedures
- Organization Knowledge Repositories
3. Trainee will be able to identify and understand the Organizational Systems, including:
- Organizational Governance Frameworks
- Management Elements
- Organizational Structure Types

2.1. Overview

Projects exist and operate in environments that may have an influence on them. These influences can have a favorable or unfavorable impact on the project. Two major categories of influences are enterprise environmental factors (EEFs) and organizational process assets (OPAs).

EEFs originate from the environment outside of the project and often outside of the enterprise. EEFs may have an impact at the organizational, portfolio, program, or project level.

OPAs are internal to the organization. These may arise from the organization itself, a portfolio, a program, another project, or a combination of these. Figure 2.1 shows the breakdown of project influences into EEFs and OPAs.

In addition to EEFs and OPAs, organizational systems play a significant role in the life cycle of the project.

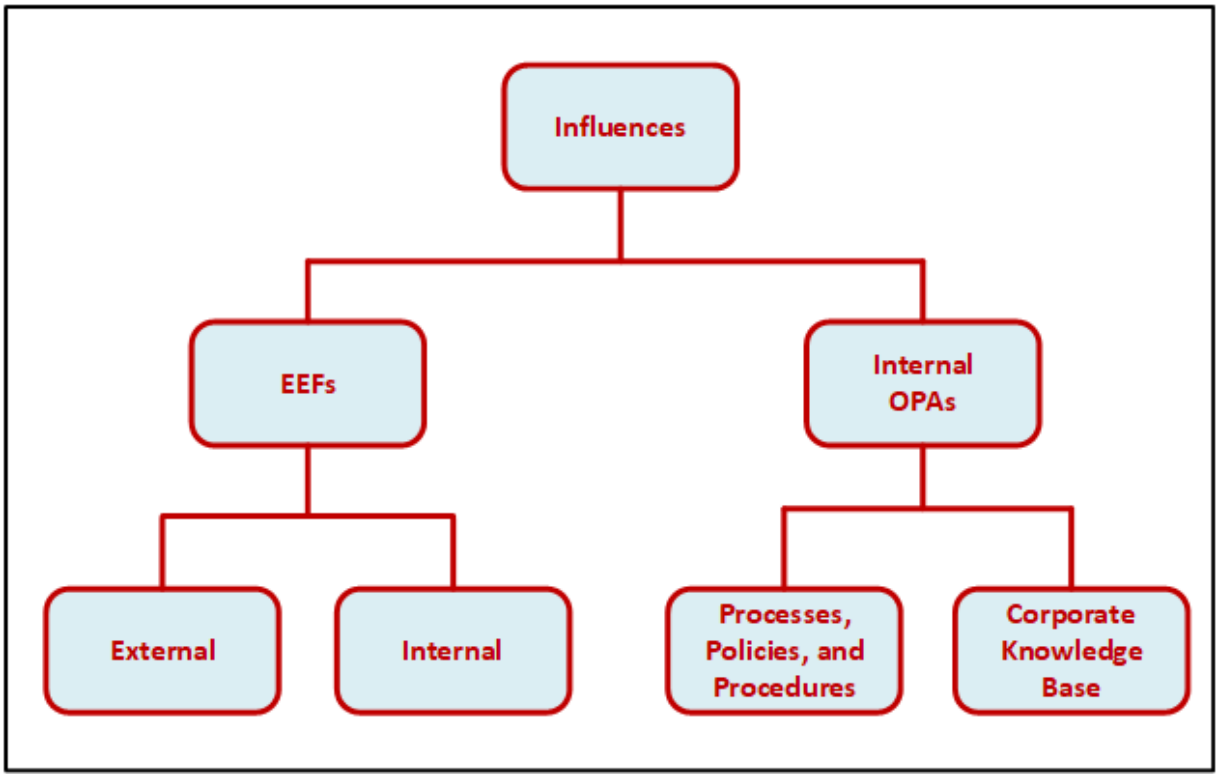

Figure 2.1. Project Influences.

2.2. Enterprise Environmental Factors

Enterprise environmental factors (EEFs) refer to conditions, not under the control of the project team, that influence, constrain, or direct the project. These conditions can be internal and/or external to the organization. EEFs are considered as inputs to many project management processes, specifically for most planning processes. These factors may enhance or constrain project management options. In addition, these factors may have a positive or negative influence on the outcome.

2.2.1 EEFs Internal to the Organization

The following EEFs are internal to the organization:

- **Organizational culture, structure, and governance.** Examples include vision, mission, values, beliefs, cultural norms, leadership style, hierarchy and authority relationships, organizational style, ethics, and code of conduct.
- **Geographic distribution of facilities and resources.** Examples include factory locations, virtual teams, shared systems, and cloud computing. Infrastructure. Examples include existing facilities, equipment, organizational telecommunications channels, information technology hardware, availability, and capacity.
- **Information technology software.** Examples include scheduling software tools, configuration management systems, web interfaces to other online automated systems, and work authorization systems.
- **Resource availability.** Examples include contracting and purchasing constraints, approved providers and subcontractors, and collaboration agreements.
- **Employee capability.** Examples include existing human resources expertise, skills, competencies, and specialized knowledge.

2.2.2 EEFs External to the Organization

The following EEFs are external to the organization:

- **Marketplace conditions.** Examples include competitors, market share brand recognition, and trademarks.
- **Social and cultural influences and issues.** Examples include political climate, codes of conduct, ethics, and perceptions.
- **Legal restrictions.** Examples include country or local laws and regulations related to security, data protection, business conduct, employment, and procurement.
- **Commercial databases.** Examples include benchmarking results, standardized cost estimating data, industry risk study information, and risk databases.
- **Academic research.** Examples include industry studies, publications, and benchmarking results.
- **Government or industry standards.** Examples include regulatory agency regulations and standards related to products, production, environment, quality, and workmanship.
- **Financial considerations.** Examples include currency exchange rates, interest rates, inflation rates, tariffs, and geographic location.
- **Physical environmental elements.** Examples include working conditions, weather, and constraints.

2.3. Organizational Process Assets

Organizational process assets (OPAs) are the plans, processes, policies, procedures, and knowledge bases specific to and used by the performing organization. These assets influence the management of the project. OPAs include any artifact, practice, or knowledge from any or all of the performing organizations involved in the project that can be used to execute or govern the project. The OPAs also include the organization's lessons learned from previous projects and historical information. OPAs may include completed schedules, risk data, and earned value data. OPAs are inputs to many

project management processes. Since OPAs are internal to the organization, the project team members may be able to update and add to the organizational process assets as necessary throughout the project. They may be grouped into two categories:

- Processes, policies, and procedures; and
- Organizational knowledge bases.

2.3.1. Processes, Policies, and Procedures

The organization's processes and procedures for conducting project work include but are not limited to:

- **Initiating and Planning:**
  - Guidelines and criteria for tailoring the organization's set of standard processes and procedures to satisfy the specific needs of the project;
  - Specific organizational standards such as policies (e.g., human resources policies, health and safety policies, security and confidentiality policies, quality policies, procurement policies, and environmental policies);
  - Product and project life cycles, and methods and procedures (e.g., project management methods, estimation metrics, process audits, improvement targets, checklists, and standardized process definitions for use in the organization);
  - Templates (e.g., project management plans, project documents, project registers, report formats, contract templates, risk categories, risk statement templates, probability and impact definitions, probability and impact matrices, and stakeholder register templates); and
  - Preapproved supplier lists and various types of contractual agreements (e.g., fixed-price, cost-reimbursable, and time and material contracts).
- **Executing, Monitoring, and Controlling:**
  - Change control procedures, including the steps by which performing organization standards, policies, plans, and procedures or any project documents will be modified, and how any changes will be approved and validated;
  - Traceability matrices; Financial controls procedures (e.g., time reporting, required expenditure and disbursement reviews, accounting codes, and standard contract provisions);
  - Issue and defect management procedures (e.g., defining issue and defect controls, identifying and resolving issues and defects, and tracking action items);
  - Resource availability control and assignment management;
  - Organizational communication requirements (e.g., specific communication technology available, authorized communication media, record retention policies, videoconferencing, collaborative tools, and security requirements);
  - Procedures for prioritizing, approving, and issuing work authorizations; Templates (e.g., risk register, issue log, and change log);
  - Standardized guidelines, work instructions, proposal evaluation criteria, and performance measurement criteria; and
  - Product, service, or result verification and validation procedures. Closing. Project closure guidelines or requirements (e.g., final project audits, project evaluations,

deliverable acceptance, contract closure, resource reassignment, and knowledge transfer to production and/or operations).

2.3.2. Organization Knowledge Repositories

The organizational knowledge repositories for storing and retrieving information include but are not limited to:

- Configuration management knowledge repositories containing the versions of software and hardware components and baselines of all performing organization standards, policies, procedures, and any project documents;
- Financial data repositories containing information such as labor hours, incurred costs, budgets, and any project cost overruns;
- Historical information and lessons learned knowledge repositories (e.g., project records and documents, all project closure information and documentation, information regarding both the results of previous project selection decisions and previous project performance information, and information from risk management activities);
- Issue and defect management data repositories containing issue and defect status, control information, issue and defect resolution, and action item results;
- Data repositories for metrics used to collect and make available measurement data on processes and products; and
- Project files from previous projects (e.g., scope, cost, schedule, and performance measurement baselines, project calendars, project schedule network diagrams, risk registers, risk reports, and stakeholder registers).

2.4. Organizational Systems

2.4.1. Overview

Projects operate within the constraints imposed by the organization through their structure and governance framework. To operate effectively and efficiently, the project manager needs to understand where responsibility, accountability, and authority reside within the organization. This understanding will help the project manager effectively use his or her power, influence, competence, leadership, and political capabilities to successfully complete the project. The interaction of multiple factors within an individual organization creates a unique system that impacts the project operating in that system. The resulting organizational system determines the power, influence, interests, competence, and political capabilities of the people who are able to act within the system. The system factors include but are not limited to:

- Governance frameworks,
- Management elements, and
- Organizational structure types.

2.4.2 Organizational Governance Frameworks

Recent PMI research reveals that governance refers to organizational or structural arrangements at all levels of an organization designed to determine and influence the behavior of the organization's members. This research suggests that the concept of governance is multidimensional and:

- Includes consideration of people, roles, structures, and policies; and

- Requires providing direction and oversight through data and feedback.

2.4.2.1 GOVERNANCE FRAMEWORK

Governance is the framework within which authority is exercised in organizations. This framework includes but is not limited to:

- Rules,
- Policies,
- Procedures,
- Norms,
- Relationships,
- Systems, and
- Processes.

This framework influences how:

- Objectives of the organization are set and achieved,
- Risk is monitored and assessed, and
- Performance is optimized.

2.4.2.2 GOVERNANCE OF PORTFOLIOS, PROGRAMS, AND PROJECTS

The Governance of Portfolios, Programs, and Projects is allowed through a common governance framework aligning organizational project management (OPM) and portfolio, program, and project management. This framework describes four governance domains of alignment, risk, performance, and communications. Each domain has the following functions: oversight, control, integration, and decision making. Each function has governance supporting processes and activities for stand-alone projects, or projects operating within the portfolio or program environments. Project governance refers to the framework, functions, and processes that guide project management activities in order to create a unique product, service, or result to meet organizational, strategic, and operational goals. There is no one governance framework that is effective in all organizations. A governance framework should be tailored to the organizational culture, types of projects, and the needs of the organization in order to be effective.

2.4.3. Management Elements

Management elements are the components that comprise the key functions or principles of general management in the organization. The general management elements are allocated within the organization according to its governance framework and the organizational structure type selected. The key functions or principles of management include but are not limited to:

- Division of work using specialized skills and availability to perform work;
- Authority given to perform work;
- Responsibility to perform work appropriately assigned based on such attributes as skill and experience;
- Discipline of action (e.g., respect for authority, people, and rules);
- Unity of command (e.g., only one person gives orders for any action or activity to an individual);

- Unity of direction (e.g., one plan and one head for a group of activities with the same objective);
- General goals of the organization take precedence over individual goals;
- Paid fairly for work performed;
- Optimal use of resources; and
- Clear communication channels.

Performance of these management elements are assigned to selected individuals within the organization. These individuals may perform the noted functions within various organizational structures.

2.4.4. Organizational Structure Types

Determination of the appropriate organizational structure type is a result of the study of tradeoffs between two key variables. The variables are the organizational structure types available for use and how to optimize them for a given organization. There is not a one-size-fits-all structure for any given organization.

2.4.4.1. ORGANIZATIONAL STRUCTURE TYPES

Organizational structures take many forms or types. Table 2.1 compares several types of organizational structures and their influence on projects.

Table 2.1. Influences of Organizational structures on projects.

Organizational Structure Types	Project Characteristics					
	Work Groups Arranged by:	**Project Manager's Authority**	**Project Manager's Role**	**Resource Availability**	**Who Manges the Project Budget?**	**Project Management Administrative Staff**
Organic or Simple	Flexible: people working side-by-side	Little or none	Part-time: may or not may be a designated job role like coordinator	Little or none	Owner or operator	Little or none
Functional (Centralized)	Job being done (e.g., engineering, manufacturing)	Little or none	Part-time: may or not may be a designated job role like coordinator	Little or none	Functional Manager	Part-time
Multi-divisional (may replicate functions for each division with little centralization)	One of; product; production processes; portfolio; program; geographic region; customer type	Little or none	Part-time: may or not may be a designated job role like coordinator	Little or none	Functional Manager	Part-time
Matrix-strong	By job function, with project as a function	Moderate to high	Full-time designated job role	Moderate to high	Project manager	Full-time
Matrix-weak	job function	Low	Part-time; done as a part of another job and not a designated	Low	Functional Manager	Part-time

			job role like coordinator			
Matrix-balanced	job function	Low to moderate	Part-time; done as a part of another job and not a designated job role like coordinator	Low to moderate	Mixed	Part-time
Project-oriented (composite, hybrid)	Project	High to almost total	Full-time designated job role	High to almost total	Project manager	Full-time
Virtual	Network structure with nodes at points of contact with other people	Low to moderate	Full-time or part-time	Low to moderate	Mixed	Could be full-time or part-time
Hybrid	Mix of other types	Mixed	Mixed	Mixed	Mixed	Mixed
PMO*	Mix of other types	High to almost total	Full-time designated job role	High to almost total	Project manager	Full-time
*PMO refers to portfolio, program, or project management office or organization						

2.4.4.2 FACTORS IN ORGANIZATION STRUCTURE SELECTION

Each organization considers numerous factors for inclusion in its organizational structure. Each factor may carry a different level of importance in the final analysis. The combination of the factor, its value, and relative importance provides the organization's decision makers with the right information for inclusion in the analysis. Factors to consider in selecting an organizational structure include but are not limited to:

- Degree of alignment with organizational objectives,
- Specialization capabilities,
- Span of control, efficiency, and effectiveness,
- Clear path for escalation of decisions,
- Clear line and scope of authority,
- Delegation capabilities, Accountability assignment,
- Responsibility assignment,
- Adaptability of design,
- Simplicity of design,
- Efficiency of performance,
- Cost considerations,
- Physical locations (e.g., collocated, regional, and virtual), and
- Clear communication (e.g., policies, status of work, and organization's vision).

Questions

1. The Two major categories of influences which can have a favorable or unfavorable impact on the project are:
   A
   :……
   ……
   B:
   ……
   ……
2. The following EEFs are internal to the organization, except:
   A. Organizational culture, structure, and governance.
   B. Geographic distribution of facilities and resources.
   C. Marketplace conditions.
   D. Resource availability.
3. The following EEFs are external to the organization, except:
   A. Social and cultural influences and issues.
   B. Employee capability.
   C. Legal restrictions.
   D. Government or industry standards.
4. Organizational process assets (OPAs) may be grouped into two categories:
   A
   :……
   ……
   B:
   ……
   ……
5. Match the type of structure to the correct characteristics or descriptions.

Functional	Weak Matrix	Balanced Matrix	Strong Matrix	Projectized or Pure Project

Characteristic/description

1. Project manager has little to no authority
2. Project expeditor
3. Project manager has some authority
4. Project manager has high to total authority
5. There is equal authority between project manager and functional manager.

6. Project manager has a moderate to high level of authority
7. Project coordinator
8. One clearly defined manager
9. Staff members are grouped by specialty.
10. Project work is done independently.
11. Team members are often co-located.
12. Resources report directly to the project manager.
13. The project manager has no control of the project budget.
14. The project manager has full control of the project budget.

6. The following tasks are part of Initiating and Planning Group, except:
A. Guidelines and criteria for tailoring the organization's set of standard processes and procedures to satisfy the specific needs of the project.
B. Specific organizational standards such as policies.
C. Traceability matrices; Financial controls procedures.
D. Product and project life cycles, and methods and procedures.

7. The following tasks are part of Executing, Monitoring, and Controlling group, except:
A. Preapproved supplier lists and various types of contractual agreements.
B. Issue and defect management procedures.
C. Resource availability control and assignment management.
D. Organizational communication requirements.

8. The Project Manager’s Authority in a Functional (Centralized) Organizational Structure is:
A. Little or none.
B. Moderate to high.
C. Low.
D. High to almost total.

9. The Project Manager’s Authority in a Matrix-strong Organizational Structure is:
A. Little or none.
B. Moderate to high.
C. Low.
D. High to almost total.

10. The Project Manager’s Authority in a Matrix- weak Organizational Structure is:
A. Little or none.
B. Moderate to high.
C. Low.
D. High to almost total.

11. The Project Manager’s Authority in a Project-oriented Organizational Structure is:
A. Little or none.
B. Moderate to high.
C. Low.
D. High to almost total.

12. The Budget Management in a Functional (Centralized) Organizational Structure is provided by:

A. Owner or operator.
B. Functional Manager.
C. Project manager.
D. Mixed.

13. The Budget Management in a Matrix-strong Organizational Structure is provided by:
A. Owner or operator.
B. Functional Manager.
C. Project manager.
D. Mixed.

14. The Budget Management in a Matrix- weak Organizational Structure is provided by:
A. Owner or operator.
B. Functional Manager.
C. Project manager.
D. Mixed.

15. The Budget Management in a Project-oriented Organizational Structure is provided by:
A. Owner or operator.
B. Functional Manager.
C. Project manager.
D. Mixed.

Chapter 3

The Role of the Project Manager

General Objective of the Chapter:

Trainee will be able to understand The Role of the Project Manager**.**

Detailed Objectives:

1. Trainee will be able to understand and describe the definition of a Project Manager.
2. Trainee will be able to identify and understand the Project Manager Sphere of Influence, including:

- The Project
- The Organization
- The Industry
- Professional Discipline
- Across Discipline

3. Trainee will be able to understand and describe the Project Manager Competences, including:

- Technical Project Management Skills
- Strategic and Business Management Skills
- Leadership Skills
- Comparison of Leadership and Management

4. Trainee will be able to understand the Performing Integration, including:

- Performing Integration at the Process Level
- Integration at Cognitive Level
- Integration at Context Level
- Integration at Complexity

3.1. Overview

The project manager plays a critical role in the leadership of a project team in order to achieve the project's objectives. This role is clearly visible throughout the project. Many project managers become involved in a project from its initiation through closing. However, in some organizations, a project manager may be involved in evaluation and analysis activities prior to project initiation. These activities may include consulting with executive and business unit leaders on ideas for advancing strategic objectives, improving organizational performance, or meeting customer needs. In some organizational settings, the project manager may also be called upon to manage or assist in business analysis, business case development, and aspects of portfolio management for a project. A project manager may also be involved in follow-on activities related to realizing business benefits from the project. The role of a project manager may vary from organization to organization. Ultimately, the project management role is tailored to fit the organization in the same way that the project management processes are tailored to fit the project.

3.2. Definition of a Project Manager

The role of a project manager is distinct from that of a functional manager or operations manager. Typically, the functional manager focuses on providing management oversight for a functional or business unit. Operations managers are responsible for ensuring that business operations are efficient. The project manager is the person assigned by the performing organization to lead the team that is responsible for achieving the project objectives.

3.3. The Project Manager Sphere of Influence

3.3.1. Overview

Project managers fulfill numerous roles within their sphere of influence. These roles reflect the project manager's capabilities and are representative of the value and contributions of the project management profession. The roles of the project manager in the various spheres of influence shown in Figure 3.1.

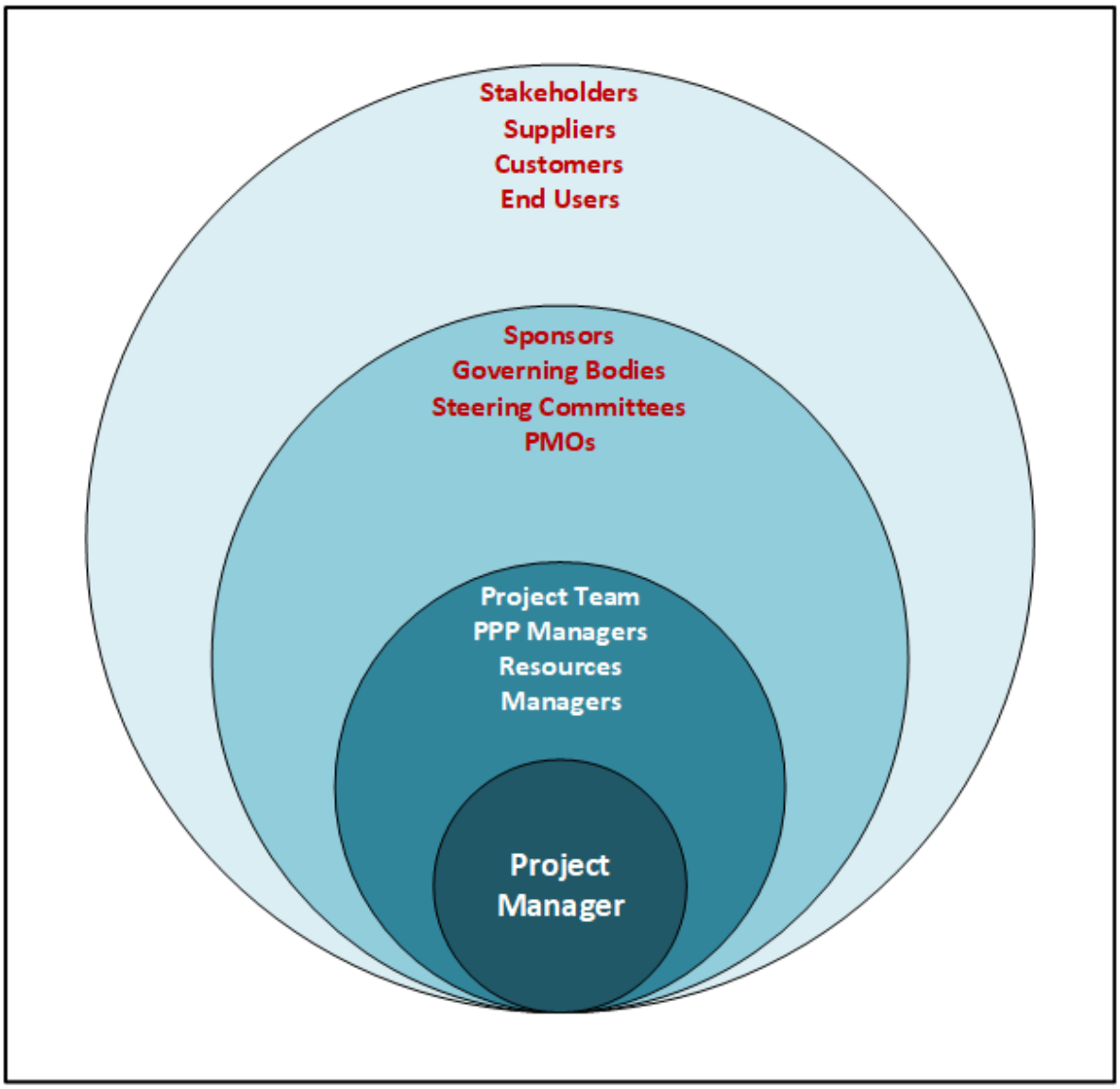

Figure 3.1. Example Project Manager's Sphere of Influence.

3.3.2. The Project

The project manager leads the project team to meet the project's objectives and stakeholders' expectations. The project manager works to balance the competing constraints on the project with the resources available. The project manager also performs communication roles between the project sponsor, team members, and other stakeholders. This includes providing direction and presenting the vision of success for the project. The project manager uses soft skills (e.g., interpersonal skills and the ability to manage people) to balance the conflicting and competing goals of the project stakeholders in order to achieve consensus. In this context, consensus means that the relevant stakeholders support the project decisions and actions even when there is not 100% agreement.

The ability to communicate with stakeholders, including the team and sponsors applies across multiple aspects of the project including, but not limited to, the following:

- Developing finely tuned skills using multiple methods (e.g., verbal, written, and nonverbal);
- Creating, maintaining, and adhering to communications plans and schedules;
- Communicating predictably and consistently;
- Seeking to understand the project stakeholders' communication needs (communication may be the only deliverable that some stakeholders received until the project's end product or service is completed);
- Making communications concise, clear, complete, simple, relevant, and tailored;
- Including important positive and negative news; and
- Incorporating feedback channels.

3.3.3. The Organization

The project manager proactively interacts with other project managers. Other independent projects or projects that are part of the same program may impact a project due to but not limited to the following:

- Demands on the same resources,
- Priorities of funding, Receipt or distribution of deliverables, and
- Alignment of project goals and objectives with those of the organization.

Interacting with other project managers helps to create a positive influence for fulfilling the various needs of the project. These needs may be in the form of human, technical, or financial resources and deliverables required by the team for project completion. The project manager seeks ways to develop relationships that assist the team in achieving the goals and objectives of the project. In addition, the project manager maintains a strong advocacy role within the organization. The project manager proactively interacts with managers within the organization during the course of the project. The project manager also works with the project sponsor to address internal political and strategic issues that may impact the team or the viability or quality of the project.

The project manager also works to:

- Demonstrate the value of project management,
- Increase acceptance of project management in the organization, and
- Advance the efficacy of the PMO when one exists in the organization.

3.3.4. The Industry

The project manager stays informed about current industry trends. The project manager takes this information and sees how it may impact or apply to the current projects. These trends include but are not limited to:

- Product and technology development;
- New and changing market niches;
- Standards (e.g., project management, quality management, information security management);

- Technical support tools;
- Economic forces that impact the immediate project;
- Influences affecting the project management discipline; and
- Process improvement and sustainability strategies.

3.3.5. Professional Discipline

Continuing knowledge transfer and integration is very important for the project manager. This professional development is ongoing in the project management profession and in other areas where the project manager maintains subject matter expertise. This knowledge transfer and integration includes but is not limited to:

- Contribution of knowledge and expertise to others within the profession at the local, national, and global levels (e.g., communities of practice, international organizations);
- Participation in training, continuing education, and development: In the project management profession (e.g., universities, PMI);
- In a related profession (e.g., systems engineering, configuration management); and
- In other professions (e.g., information technology, aerospace).

3.3.6. Across Disciplines

A professional project manager may choose to orient and educate other professionals regarding the value of a project management approach to the organization. The project manager may serve as an informal ambassador by educating the organization as to the advantages of project management with regard to timeliness, quality, innovation, and resource management.

3.4. Project Manager Competences

3.4.1. Overview

Recent PMI studies applied the Project Manager Competency Development (PMCD) Framework to the skills needed by project managers through the use of The PMI Talent Triangle® shown in Figure 3.2. The talent triangle focuses on three key skill sets:

- **Technical project management.** The knowledge, skills, and behaviors related to specific domains of project, program, and portfolio management. The technical aspects of performing one's role.
- **Leadership.** The knowledge, skills, and behaviors needed to guide, motivate, and direct a team, to help an organization achieve its business goals.
- **Strategic and business management.** The knowledge of and expertise in the industry and organization that enhanced performance and better delivers business outcomes.

Figure 3.2. The PMI Talent Triangle

3.4.2. Technical Project Management Skills

Technical project management skills are defined as the skills to effectively apply project management knowledge to deliver the desired outcomes for programs or projects. There are numerous technical project management skills. Project managers frequently rely on expert judgment to perform well. Being aware of personal expertise and where to find others with the needed expertise are important for success as a project manager. According to research. the top project managers consistently demonstrated several key skills including, but not limited to, the ability to:

- Focus on the critical technical project management elements for each project they manage. This focus is as simple as having the right artifacts readily available. At the top of the list were the following:
  - Critical success factors for the project,
  - Schedule,
  - Selected financial reports, and
  - Issue log.
- Tailor both traditional and agile tools, techniques, and methods for each project.
- Make time to plan thoroughly and prioritize diligently.
- Manage project elements, including, but not limited to, schedule, cost, resources, and risks.

3.4.3. Strategic and Business Management Skills

Strategic and business management skills involve the ability to see the high-level overview of the organization and effectively negotiate and implement decisions and actions that support strategic alignment and innovation. This ability may include a working knowledge of other functions such as finance, marketing, and operations. Strategic and business management skills may also include developing and applying pertinent product and industry expertise. This business knowledge is also known as domain knowledge. Project managers should be knowledgeable enough about the business to be able to:

- Explain to others the essential business aspects of a project;
- Work with the project sponsor, team, and subject matter experts to develop an appropriate project delivery strategy; and
- Implement that strategy in a way that maximizes the business value of the project.

In order to make the best decisions regarding the successful delivery of their projects, project managers should seek out and consider the expertise of the operational managers who run the business in their organization. These managers should know the work performed in their organization and how project plans will affect that work. The more the project manager is able to know about the project's subject matter, the better. At a minimum, the project manager should be knowledgeable enough to explain to others the following aspects of the organization:

- Strategy;
- Mission; Goals and objectives;
- Products and services;
- Operations (e.g., location, type, technology);
- The market and the market condition, such as customers, state of the market (i.e., growing or shrinking), and time-to-market factors, etc.; and
- Competition (e.g., what, who, position in the market place)

The project manager should apply the following knowledge and information about the organization to the project to ensure alignment:

- Strategy,
- Mission, Goals and objectives,
- Priority,
- Tactics, and
- Products or services (e.g., deliverables).

Strategic and business skills help the project manager to determine which business factors should be considered for their project. The project manager determines how these business and strategic factors could affect the project while understanding the interrelationship between the project and the organization. These factors include but are not limited to:

- Risks and issues,
- Financial implications,
- Cost versus benefits analysis (e.g., net present value, return on investment), including the various options considered,

- Business value,
- Benefits realization expectations and strategies, and
- Scope, budget, schedule, and quality.

Through the application of this business knowledge, a project manager has the ability to make the appropriate decisions and recommendations for a project. As conditions change, the project manager should be continuously working with the project sponsor to keep the business and the project strategies aligned.

3.4.4. Leadership Skills

Leadership skills involve the ability to guide, motivate, and direct a team. These skills may include demonstrating essential capabilities such as negotiation, resilience, communication, problem solving, critical thinking, and interpersonal skills. Projects are becoming increasingly more complicated with more and more businesses executing their strategy through projects. Project management is more than just working with numbers, templates, charts, graphs, and computing systems. A common denominator in all projects is people. People can be counted, but they are not numbers.

3.4.4.1. DEALING WITH PEOPLE

A large part of the project manager's role involves dealing with people. The project manager should study people's behaviors and motivations. The project manager should strive to be a good leader, because leadership is crucial to the success of projects in organizations. A project manager applies leadership skills and qualities when working with all project stakeholders, including the project team, the steering team, and project sponsors.

3.4.4.2 QUALITIES AND SKILLS OF A LEADER

Research shows that the qualities and skills of a leader include but are not limited to:

- Being a visionary (e.g., help to describe the products, goals, and objectives of the project; able to dream and translate those dreams for others);
- Being optimistic and positive;
- Being collaborative;
- Managing relationships and conflict by:
    - Building trust;
    - Satisfying concerns;
    - Seeking consensus;
    - Balancing competing and opposing goals;
    - Applying persuasion, negotiation, compromise, and conflict resolution skills;
    - Developing and nurturing personal and professional networks;
    - Taking a long-term view that relationships are just as important as the project; and
    - Continuously developing and applying political acumen.
- Communicating by:
    - Spending sufficient time communicating (research shows that top project managers spend about 90% of their time on a project in communicating);
    - Managing expectations;

    - Accepting feedback graciously;
    - Giving feedback constructively; and
    - Asking and listening.
- Being respectful (helping others retain their autonomy), courteous, friendly, kind, honest, trustworthy, loyal, and ethical;
- Exhibiting integrity and being culturally sensitive, courageous, a problem solver, and decisive;
- Giving credit to others where due;
- Being a life-long learner who is results- and action-oriented;
- Focusing on the important things, including:
    - Continuously prioritizing work by reviewing and adjusting as necessary;
    - Finding and using a prioritization method that works for them and the project;
    - Differentiating high-level strategic priorities, especially those related to critical success factors for the project;
    - Maintaining vigilance on primary project constraints;
    - Remaining flexible on tactical priorities; and
    - Being able to sift through massive amounts of information to obtain the most important information.
- Having a holistic and systemic view of the project, taking into account internal and external factors equally;
- Being able to apply critical thinking (e.g., application of analytical methods to reach decisions) and identify him or herself as a change agent.
- Being able to build effective teams, be service-oriented, and have fun and share humor effectively with team members.

3.4.5. Comparison of Leadership and Management

The words *leadership* and *management* are often used interchangeably. However, they are not synonymous. The word *management* is more closely associated with directing another person to get from one point to another using a known set of expected behaviors. In contrast, *leadership* involves working with others through discussion or debate in order to guide them from one point to another. The method that a project manager chooses to employ reveals a distinct difference in behavior, self-perception, and project role. Table 3.1 compares management and leadership on several important levels.

Table 3.1. Team Management and Team Leadership Compared

Management	Leadership
Direct using positional power	Guide, influence, and collaborate using relational power
Maintain	Develop
Administrate	Innovate
Focus on systems and structure	Focus on relationships with people
Rely on control	Inspire trust

Focus on near-term goals	Focus on long-range vision
Ask how and when	Ask what and why
Focus on bottom line	Focus on the horizon
Accept status quo	Challenge status quo
Do things right	Do the right things
Focus on operational issues and problem solving	Focus on vision, alignement, motivation, and inspiration

3.5. Performing Integration

The role of the project manager is twofold when performing integration on the project:

- Project managers play a key role in working with the project sponsor to understand the strategic objectives and ensure the alignment of the project objectives and results with those of the portfolio, program, and business areas. In this way, project managers contribute to the integration and execution of the strategy.
- Project managers are responsible for guiding the team to work together to focus on what is really essential at the project level. This is achieved through the integration of processes, knowledge, and people.

3.5.1. Performing Integration at The Process Level

Project management may be seen as a set of processes and activities that are undertaken to achieve the project objectives. Some of these processes may take place once (e.g., the initial creation of the project charter), but many others overlap and occur several times throughout the project. One example of this process overlap and multiple occurrences is a change in a requirement that impacts scope, schedule, or budget and requires a change request. Several project management processes such as the Control Scope process and the Perform Integrated Change Control process may involve a change request. The Perform Integrated Change Control process occurs throughout the project for integrating change requests. Although there is no stated definition on how to integrate the project processes, it is clear that a project has a small chance of meeting its objective when the project manager fails to integrate the project processes where they interact.

3.5.2. Integration at The Cognitive Level

There are many different ways to manage a project, and the method selected typically depends on the specific characteristics of the project including its size, how complicated the project or organization may be, and the culture of the performing organization. It is clear that the personal skills and abilities of the project manager are closely related to the way in which the project is managed. The project manager should strive to become proficient in all of the Project Management Knowledge Areas. In concert with proficiency in these Knowledge Areas, the project manager applies experience, insight, leadership, and technical and business management skills to the project. Finally, it is through the project manager's ability to integrate the processes in these Knowledge Areas that makes it possible to achieve the desired project results.

3.5.3. Integration at The Context Level

There have been many changes in the context in which business and projects take place today compared to a few decades ago. New technologies have been introduced. Social networks, multicultural aspects, virtual teams, and new values are part of the new reality of projects. An example is knowledge and people integration in the context of a large cross-functional project implementation involving multiple organizations. The project manager considers the implications of this context in communications planning and knowledge management for guiding the project team. Project managers need to be cognizant of the project context and these new aspects when managing the integration. Then project managers can decide how to best use these new elements of the environment in their projects to achieve success.

3.5.4. Integration and Complexity

Some projects may be referred to as complex and considered difficult to manage. In simple terms, complex and complicated are concepts often used to describe what is considered to be intricate or complicated. Complexity within projects is a result of the organization's system behavior, human behavior, and the uncertainty at work in the organization or its environment. There is three dimensions of complexity are defined as:

- **System behavior.** The interdependencies of components and systems.
- **Human behavior.** The interplay between diverse individuals and groups.
- **Ambiguity.** Uncertainty of emerging issues and lack of understanding or confusion.

Complexity itself is a perception of an individual based on personal experience, observation, and skill. Rather than being complex, a project is more accurately described as containing complexity. Portfolios, programs, and projects may contain elements of complexity. When approaching the integration of a project, the project manager should consider elements that are both inside and outside of the project. The project manager should examine the characteristics or properties of the project. Complexity as a characteristic or property of a project is typically defined as:

- Containing multiple parts,
- Possessing a number of connections between the parts,
- Exhibiting dynamic interactions between the parts, and
- Exhibiting behavior produced as a result of those interactions that cannot be explained as the simple sum of the parts (e.g., emergent behavior).

Examining these various items that appear to make the project complex should help the project manager identify key areas when planning, managing, and controlling the project to ensure integration.

Questions

1. All of the following statements are true, except:
   A. It is the job of the project manager to ensure that information is explicit, clear, and complete.
   B. A project manager must possess a strong knowledge of finance and accounting principles.
   C. Organizational and planning skills are an important skill set for a project manager to possess.
   D. Power is a technique that the project manager may use to influence people.
2. Complete the following statements using the terms: **The project manager, The functional manager, The operation manager**:
   A. …… is responsible for ensuring that business operations are efficient.
   B. …… is the person assigned by the performing organization to lead the team that is responsible for achieving the project objectives.
   C. …… focuses on providing management oversight for a functional or business unit.
3. The person who should be in control of the project during project planning is the:
   A. Project manager.
   B. Team member.
   C. Functional manager.
   D. Sponsor.
4. The talent triangle focuses on the following key skill sets, except:
   A. Technical project management.
   B. Functional management.
   C. Leadership.
   D. Strategic and business management.
5. The word management:
   A. involves working with others through discussion or debate in order to guide them from one point to another.
   B. is more closely associated with directing another person to get from one point to another using a known set of expected behaviors.
   C. includes promoting change, new approaches, and work to understand people ‘s beliefs to gain their commitment.
   D. consist of believing in vision and goals, has strong values, and works to make sure that his attendants are in the right direction.
6. The following skills are required to leadership, except:
   A. Guide, influence, and collaborate using relational power.
   B. Innovate.
   C. Focus on systems and structure.

D. Ask what and why.

7. The following skills are required to management, except:
A. Direct using positional power.
B. Focus on long-range vision.
C. Maintain.
D. Administrate.

8. A project manager needs five areas of expertise to be successful. Which one is not one of the five areas of expertise?
A. Application area knowledge
B. An understanding of the project environment
C. PMP or CAPM certification
D. Interpersonal skills

9. A project manager is having trouble with his project because one of his team members is not performing, which is causing him to miss an important date he promised to a stakeholder. He discovers that the team member knew about the project problem, but didn't tell him because the team members are all afraid of his bad temper. Which BEST describes how the project manager can avoid this situation in the future?
A. Increasing his knowledge of the PMBOK® Guide
B. Measuring personal performance
C. Improving his personal skills
D. Managing stakeholder expectations

10. Which of the following is NOT a responsibility of a project manager?
A. Managing stakeholder expectations
B. Managing project constraints
C. Gathering product requirements
D. Sponsoring the project

11. Which of the following is NOT an interpersonal skill?
A. Motivation
B. Brainstorming
C. Team building
D. Coaching

12. You're managing a project to remodel a kitchen. You use earned value calculations to figure out that you're going to run $500 over budget if your project continues at the current rate. Which of the following core characteristics of a project manager are you using to find the problem?
A. Knowledge
B. Performance
C. Personal
D. None of the above

13. You're managing a project to build a new accounting system. One of the accountants in another department really likes the current system and is refusing to be trained on the new one. What is the BEST way to handle this situation?
A. Refuse to work with him because he's being difficult
B. Appeal to the accountant's manager and ask to have him required to take training

C. Get a special dispensation so that the accountant doesn't have to go to the training
D. Work with him to understand his concerns and do what you can to help alleviate them without compromising your project

14. Sally and Joe are two project managers working in the corporate offices of a popular fast food franchise. They are both studying for their PMP® certification, and they have a spirited debate over who is responsible for managing and performing project Integration. Sally claims it is the project sponsor, while Joe adamantly insists it is the project manager. Who is correct?
A. Both
B. Sally
C. Joe
D. Neither

15. Ralph is a project manager for Storm Health. He has struggled since joining the company, and his manager has noticed a gap in a critical PM skill. In a recent kick-off meeting, he struggled to answer questions on how the project aligns with the organization's goals, insisting it wasn't relevant. What critical skill should Ralph improve?
A. Business management and strategic skills
B. Technical project management skills
C. Communication skills
D. Leadership skills

Chapter 4

Project Integration Management

General Objective of the Chapter:

Trainee will be able to describe the process of Project Integration Management**.**

Detailed Objectives:

1. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Develop Project Charter process.
2. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Develop Project Management Plan process.
3. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Direct and Manage Project Work process.
4. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Manage Project Knowledge process.
5. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Monitor and Control Project Work process.
6. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Perform Integrated Change Control process.
7. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Close Project or Phase process.

4.1. Overview

Project Integration Management includes the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups. In the project management context, integration includes characteristics of unification, consolidation, communication, and interrelationship. These actions should be applied from the start of the project through completion.

4.2. Develop Project Charter

Develop Project Charter is the process of developing a document that formally authorizes the existence of a project and provides the project manager with the authority to apply organizational resources to project activities. The key benefits of this process are that it provides a direct link between the project and the strategic objectives of the organization, creates a formal record of the project, and shows the organizational commitment to the project. This process is performed once or at predefined points in the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 4.1. Figure 4.2 depicts the data flow diagram for the process.

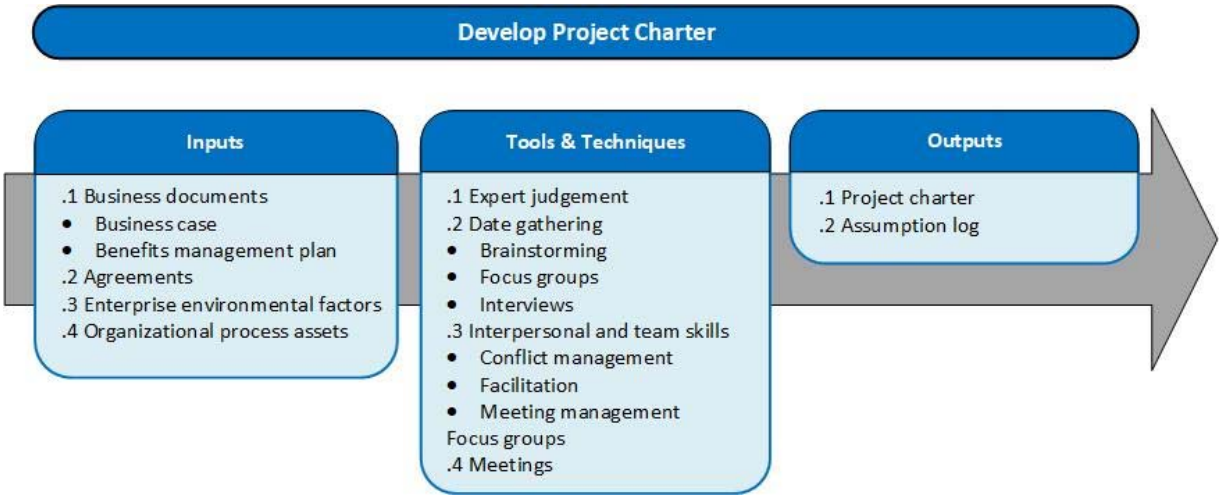

Figure 4.1. Develop Project Charter: Inputs, Tools and Techniques, and Outputs.

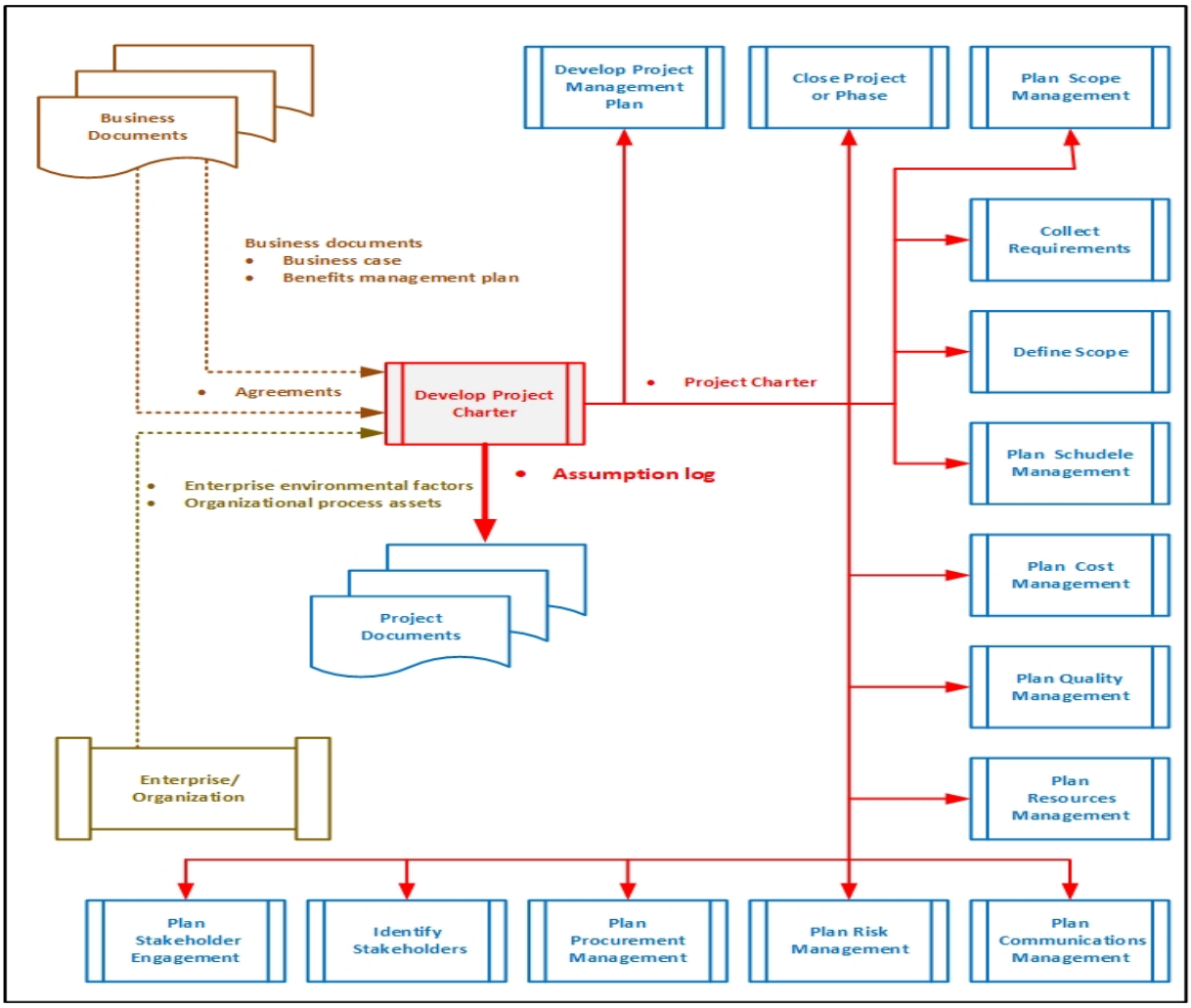

Figure 4.2. Develop Project Charter: Data Flow Diagram.

The project charter establishes a partnership between the performing and requesting organizations. In the case of external projects, a formal contract is typically the preferred way to establish an agreement. A project charter may still be used to establish internal agreements within an organization to ensure proper delivery under the contract. The approved project charter formally initiates the project. A project manager is identified and assigned as early in the project as is feasible, preferably while the project charter is being developed and always prior to the start of planning. The project charter can be developed by the sponsor or the project manager in collaboration with the initiating entity.

4.3. Develop Project Management Plan

Develop Project Management Plan is the process of defining, preparing, and coordinating all plan components and consolidating them into an integrated project management plan. The key benefit of this process is the production of a comprehensive document that defines the basis of all project work and how the work will be performed. This process is performed once or at predefined points

in the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 4.3. Figure 4.5 depicts the data flow diagram for the process.

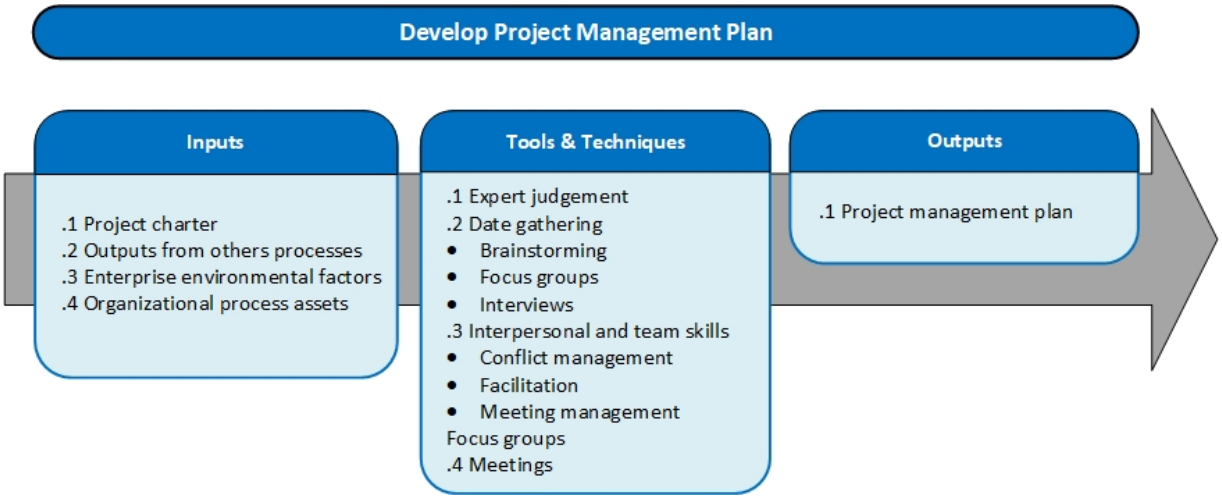

Figure 4.3. Develop Project Management Plan: Inputs, Tools and Techniques, and Outputs.

The project management plan is the document that describes how the project will be executed, monitored and controlled, and closed. It integrates and consolidates all of the subsidiary management plans and baselines, and other information necessary to manage the project. The needs of the project determine which components of the project management plan are needed.

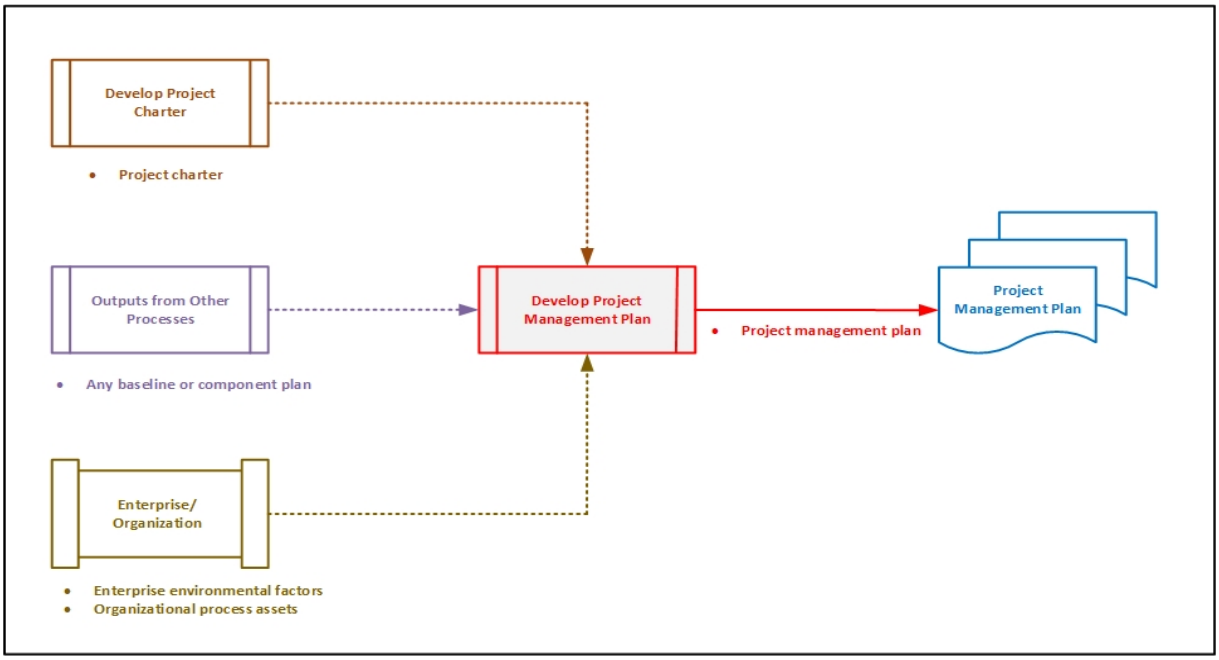

Figure 4.4. Develop Project Management Plan: Data Flow Diagram.

While the project management plan is one of the primary documents used to manage the project, other project documents are also used. These other documents are not part of the project management plan; however, they are necessary to manage the project effectively. Table 4.1 is a representative list of the project management plan components and project documents.

Table 4.1. Project Management Plan and Project Documents.

Project Management Plan	Project Documents	
1. Scope management plan	1. Activity attributes	19. Quality control measerments
2. Requirement management plan	2. Activity list	20. Quality metrics
3. Schudele management plan	3. Assumption log	21. Quality reports
4. Cost management plan	4. Basis of estimates	22. Requirements documentation
5. Quality management plan	5. Change log	23. Requirements traceability matrix
6. Resource management plan	6. Cost estimates	24. Resource breakdown structure
7. Communications management plan	7. Cost forecasts	25. Resource calander
8. Risk management plan	8. Duration estimates	26. Resource requirement
9. Procurement management plan	9. Issue log	27. Risk register
10. Stakeholder engagement plan	10. Lessons learned register	28. Risk report
11. Change management plan	11. Milestone list	29. Schudele data
12. Configuration management plan	12. Physical resource assignements	30. Schudele forecasts
13. Scope baseline	13. Project calenders	31. Stakeholder register
14. Schudele baseline	14. Project communications	32. Team charter
15. Cost baseline	15. Project schudele	33. Test and evaluation documents
16. Performance measerment baseline	16. Project schudele network diagram	
17. Project lifecycle descripton	17. Project scope statement	
18. Developpement approach	18. Project team assignements	

4.4. Direct and Manage Project Work

Direct and Manage Project Work is the process of leading and performing the work defined in the project management plan and implementing approved changes to achieve the project's objectives. The key benefit of this process is that it provides overall management of the project work and deliverables, thus improving the probability of project success. This process is performed throughout the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 4.5. Figure 4.6 depicts the data flow diagram for the process.

Direct and Manage Project Work involves executing the planned project activities to complete project deliverables and accomplish established objectives. Available resources are allocated, their efficient use is managed, and changes in project plans stemming from analyzing work performance data and information are carried out.

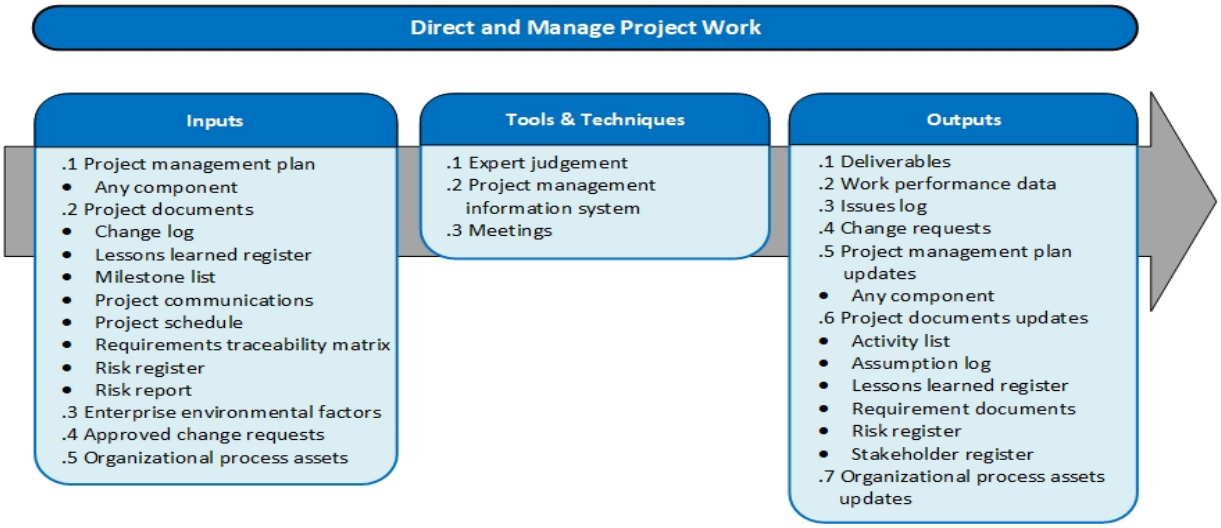

Figure 4.5. Direct and Manage Project Work: Inputs, Tools and Techniques, and Outputs.

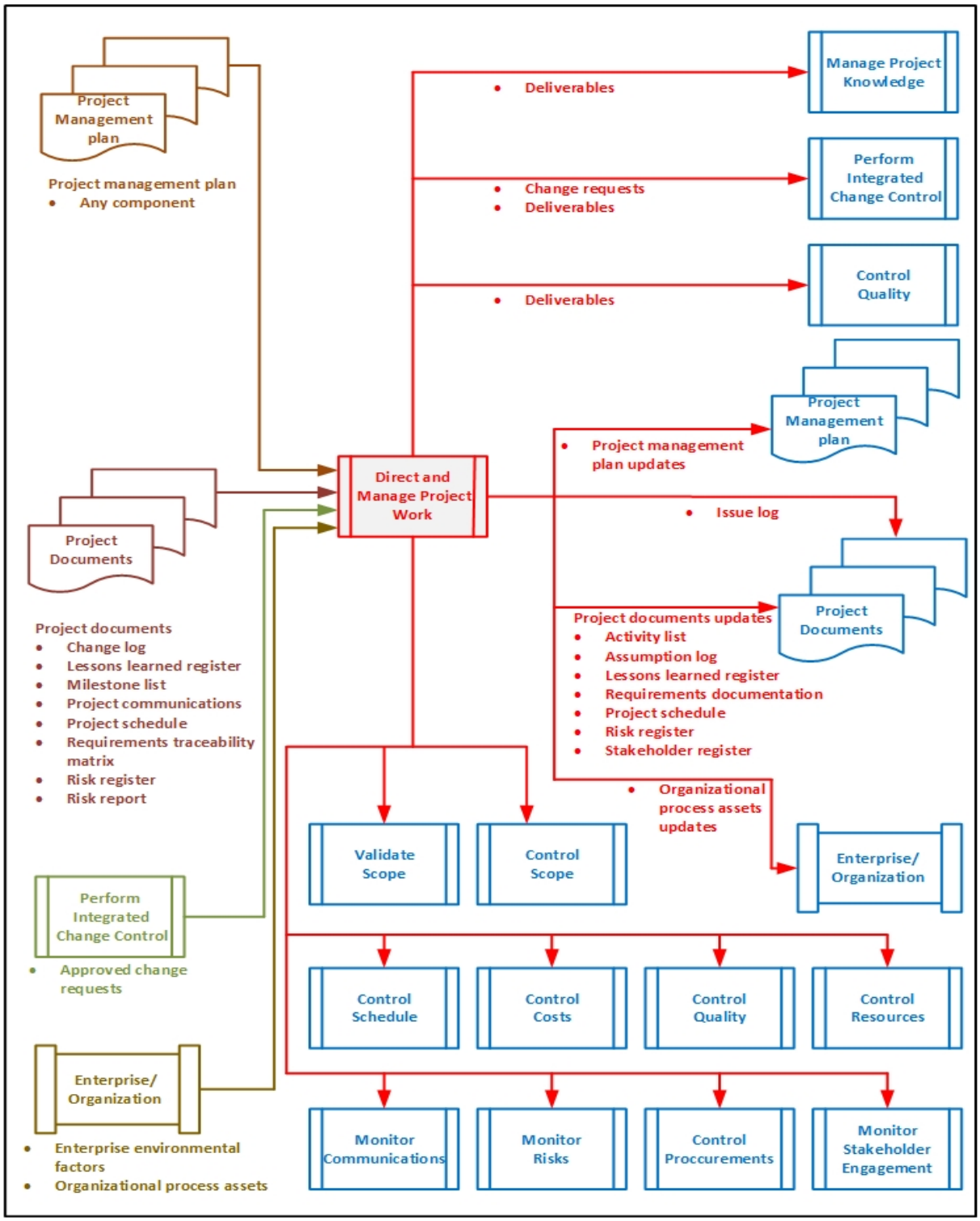

Figure 4.6. Direct and Manage Project Work: Data Flow Diagram.

4.5. Manage Project Knowledge

Manage Project Knowledge is the process of using existing knowledge and creating new knowledge to achieve the project's objectives and contribute to organizational learning. The key benefits of this process are that prior organizational knowledge is leveraged to produce or improve the project outcomes, and knowledge created by the project is available to support organizational operations and future projects or phases. This process is performed throughout the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 4.7. Figure 4.8 depicts the data flow diagram for the process.

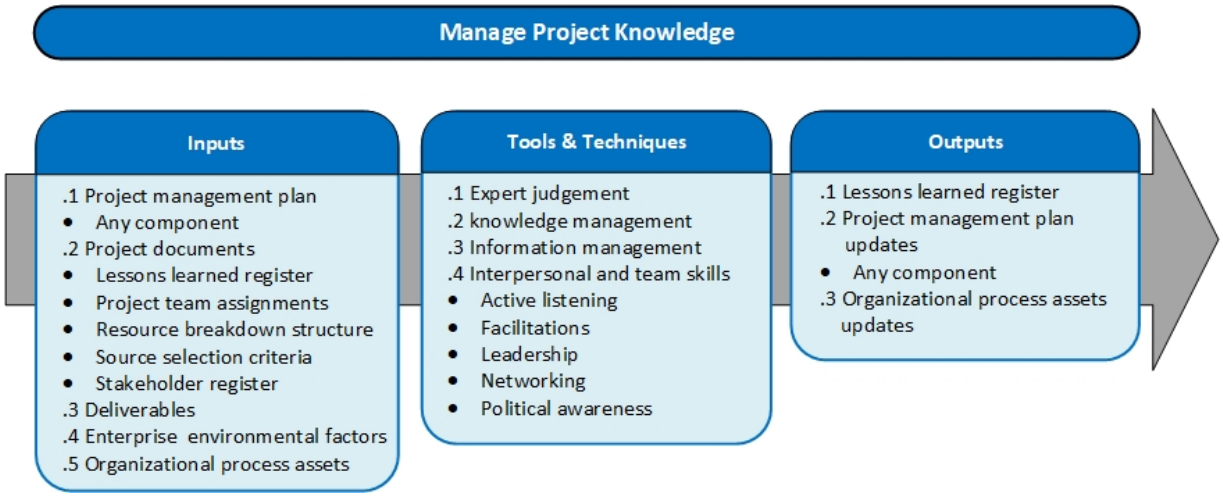

Figure 4.7. Manage Project Knowledge: Inputs, Tools and Techniques, and Outputs.

Knowledge is commonly split into "explicit" (knowledge that can be readily codified using words, pictures, and numbers) and "tacit" (knowledge that is personal and difficult to express, such as beliefs, insights, experience, and "know-how"). Knowledge management is concerned with managing both tacit and explicit knowledge for two purposes: reusing existing knowledge and creating new knowledge. The key activities that underpin both purposes are knowledge sharing and knowledge integration (of knowledge from different domains, contextual knowledge, and project management knowledge).

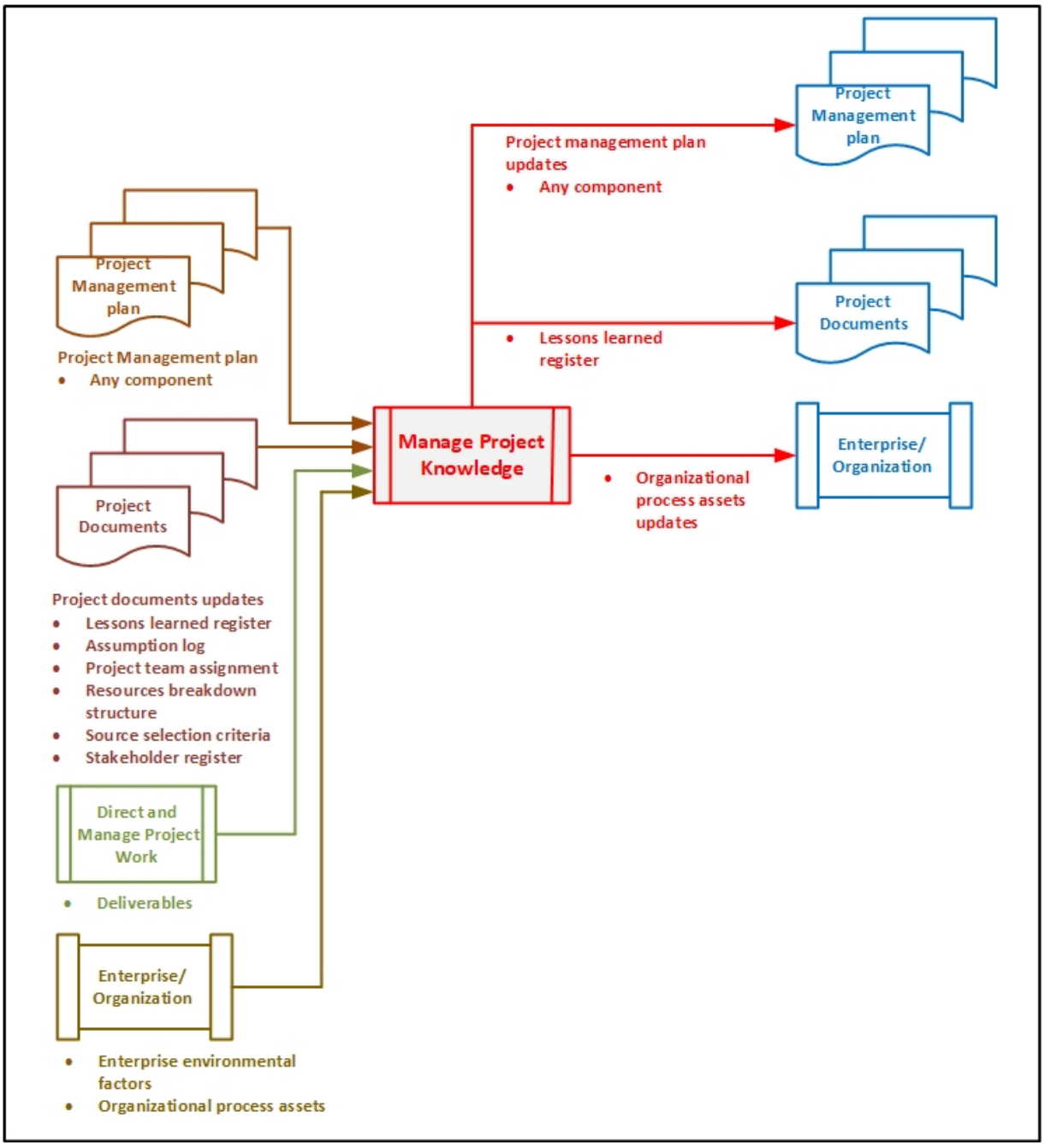

Figure 4.8. Manage Project Knowledge: Data Flow Diagram.

4.6. Monitor and Control Project Work

Monitor and Control Project Work is the process of tracking, reviewing, and reporting the overall progress to meet the performance objectives defined in the project management plan. The key benefits of this process are that it allows stakeholders to understand the current state of the project, to recognize the actions taken to address any performance issues, and to have visibility into the

future project status with cost and schedule forecasts. This process is performed throughout the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 4.9. Figure 4.10 depicts the data flow diagram for the process.

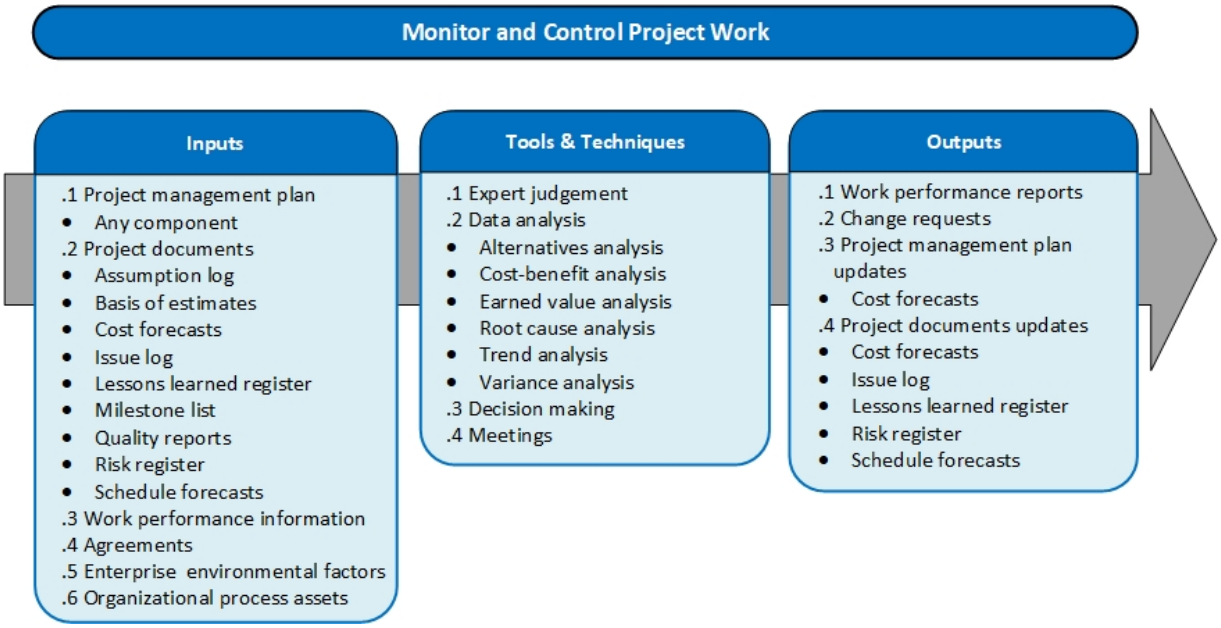

Figure 4.9. Monitor and Control Project Work: Inputs, Tools and Techniques, and Outputs.

Monitoring is an aspect of project management performed throughout the project. Monitoring includes collecting, measuring, and assessing measurements and trends to effect process improvements. Continuous monitoring gives the project management team insight into the health of the project and identifies any areas that may require special attention. Control includes determining corrective or preventive actions or replanning and following up on action plans to determine whether the actions taken resolved the performance issue.

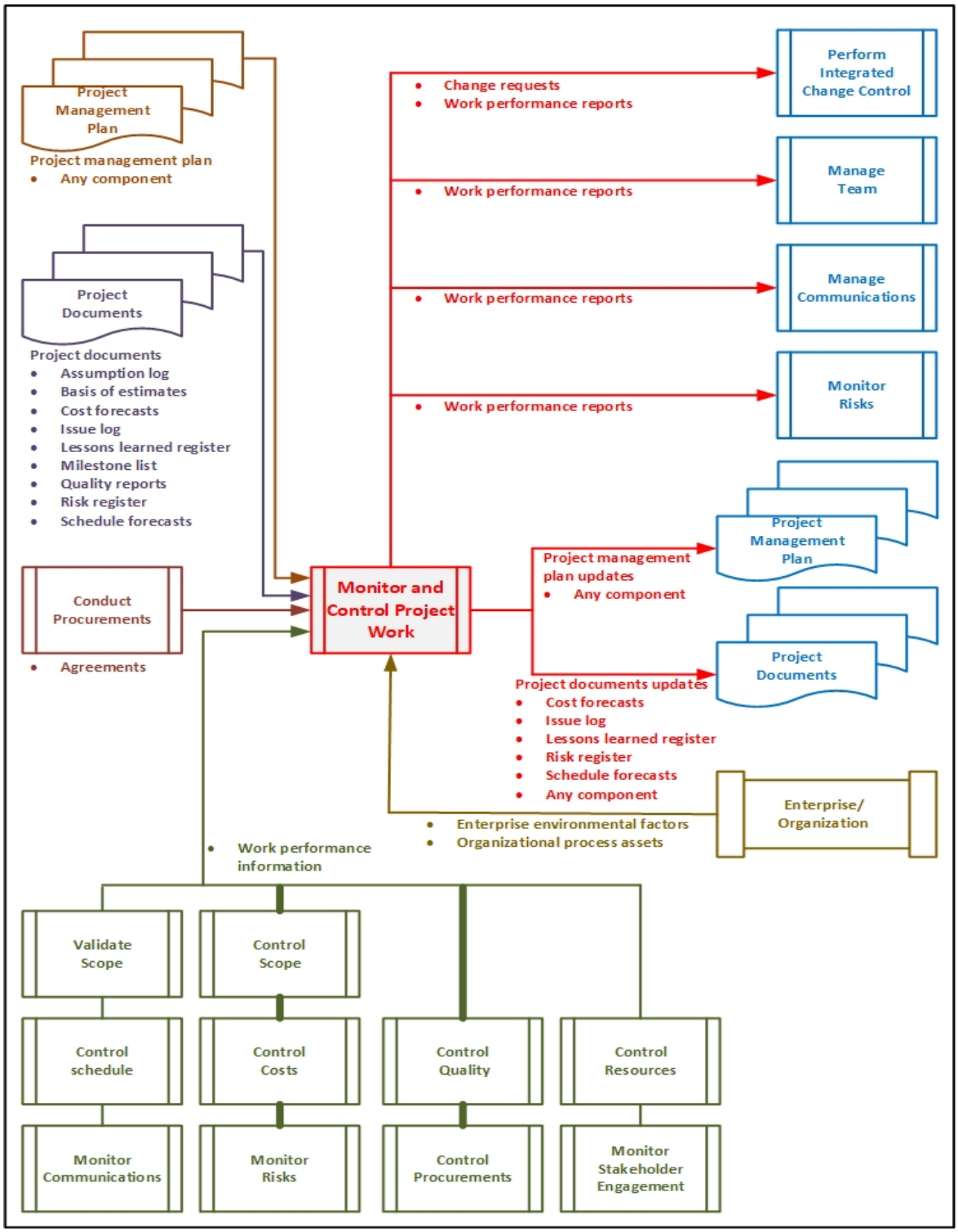

Figure 4.10. Monitor and Control Project Work: Data Flow Diagram.

4.7. Perform Integrated Change Control

Perform Integrated Change Control is the process of reviewing all change requests; approving changes and managing changes to deliverables, project documents, and the project management plan; and communicating the decisions. This process reviews all requests for changes to project documents, deliverables, or the project management plan and determines the resolution of the change requests. The key benefit of this process is that it allows for documented changes within the project to be considered in an integrated manner while addressing overall project risk, which often arises from changes made without consideration of the overall project objectives or plans. This process is performed throughout the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 4.11. Figure 4.12 depicts the data flow diagram for the process.

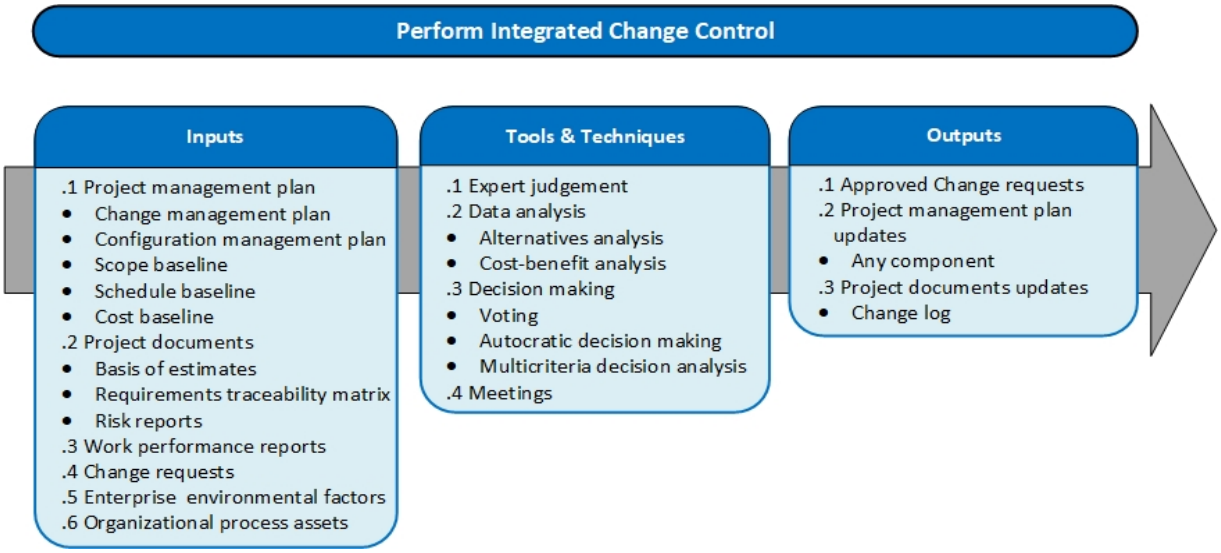

Figure 4.11. Perform Integrated Change Control: Inputs, Tools and Techniques, and Outputs.

The Perform Integrated Change Control process is conducted from project start through completion and is the ultimate responsibility of the project manager. Change requests can impact the project scope and the product scope, as well as any project management plan component or any project document. Changes may be requested by any stakeholder involved with the project and may occur at any time throughout the project life cycle. The applied level of change control is dependent upon the application area, complexity of the specific project, contract requirements, and the context and environment in which the project is performed.

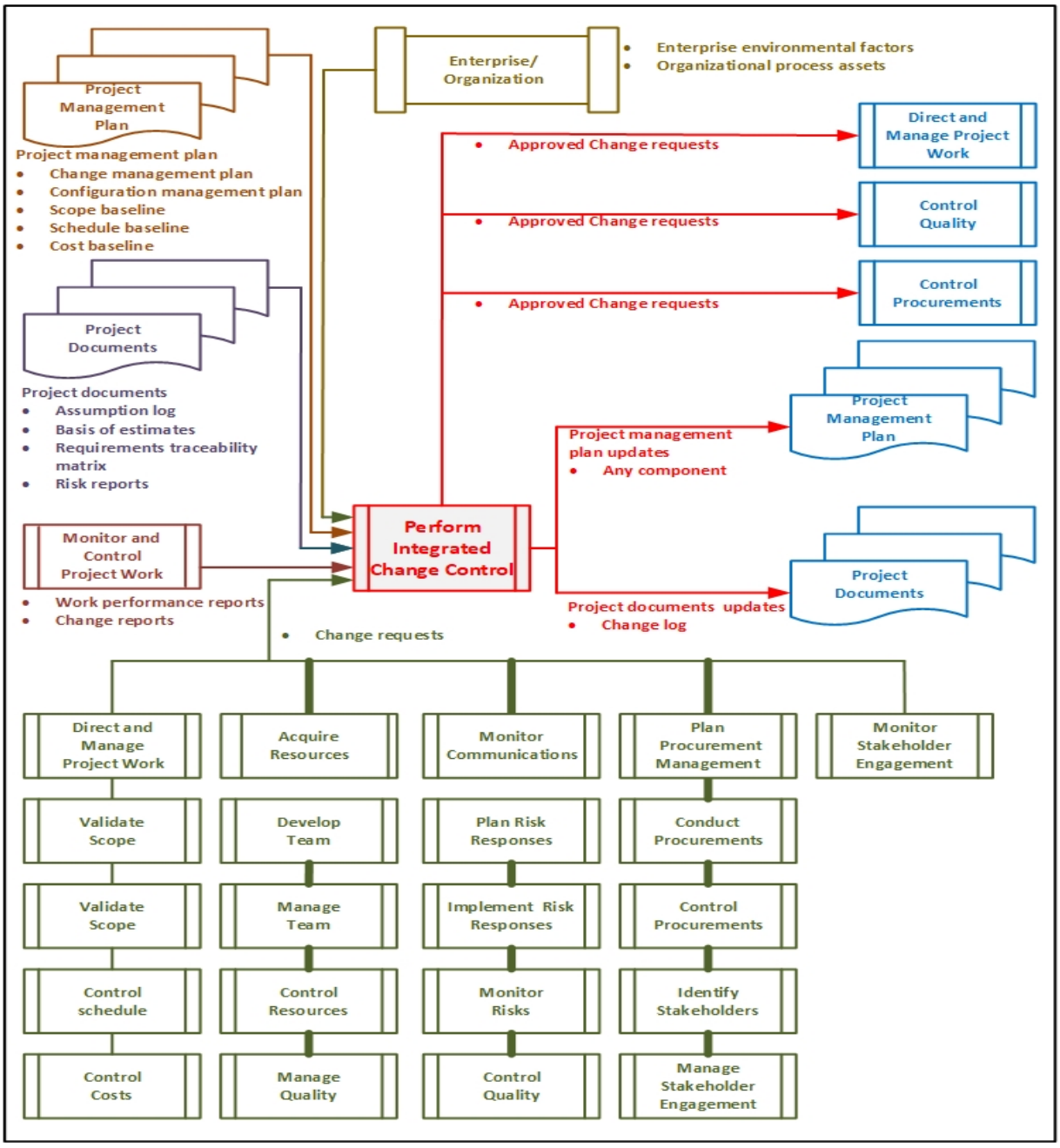

Figure 4.12. Perform Integrated Change Control: Data Flow Diagram.

4.8. Close Project or Phase

Close Project or Phase is the process of finalizing all activities for the project, phase, or contract. The key benefits of this process are the project or phase information is archived, the planned work is completed, and organizational team resources are released to pursue new endeavors. This process is performed once or at predefined points in the project. The inputs, tools and techniques, and

outputs of the process are depicted in Figure 4.13. Figure 4.14 depicts the data flow diagram for the process.

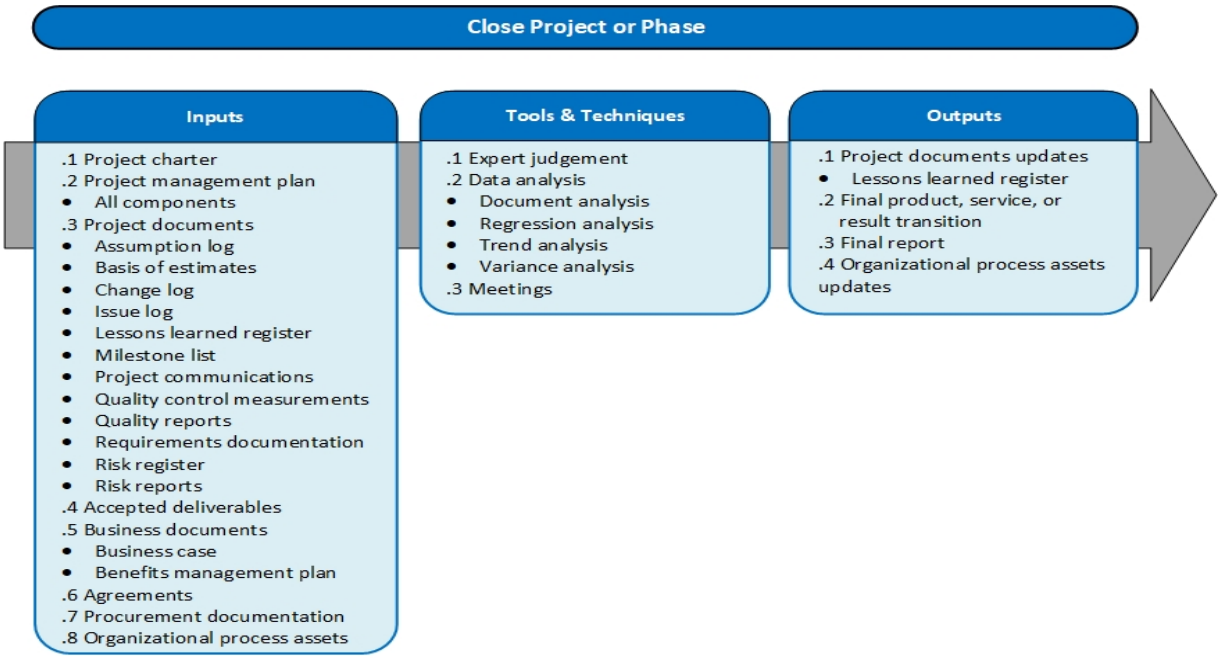

Figure 4.13. Close Project or Phase: Inputs, Tools and Techniques, and Outputs.

When closing the project, the project manager reviews the project management plan to ensure that all project work is completed and that the project has met its objectives. The Close Project or Phase process also establishes the procedures to investigate and document the reasons for actions taken if a project is terminated before completion. In order to successfully achieve this, the project manager needs to engage all the proper stakeholders in the process.

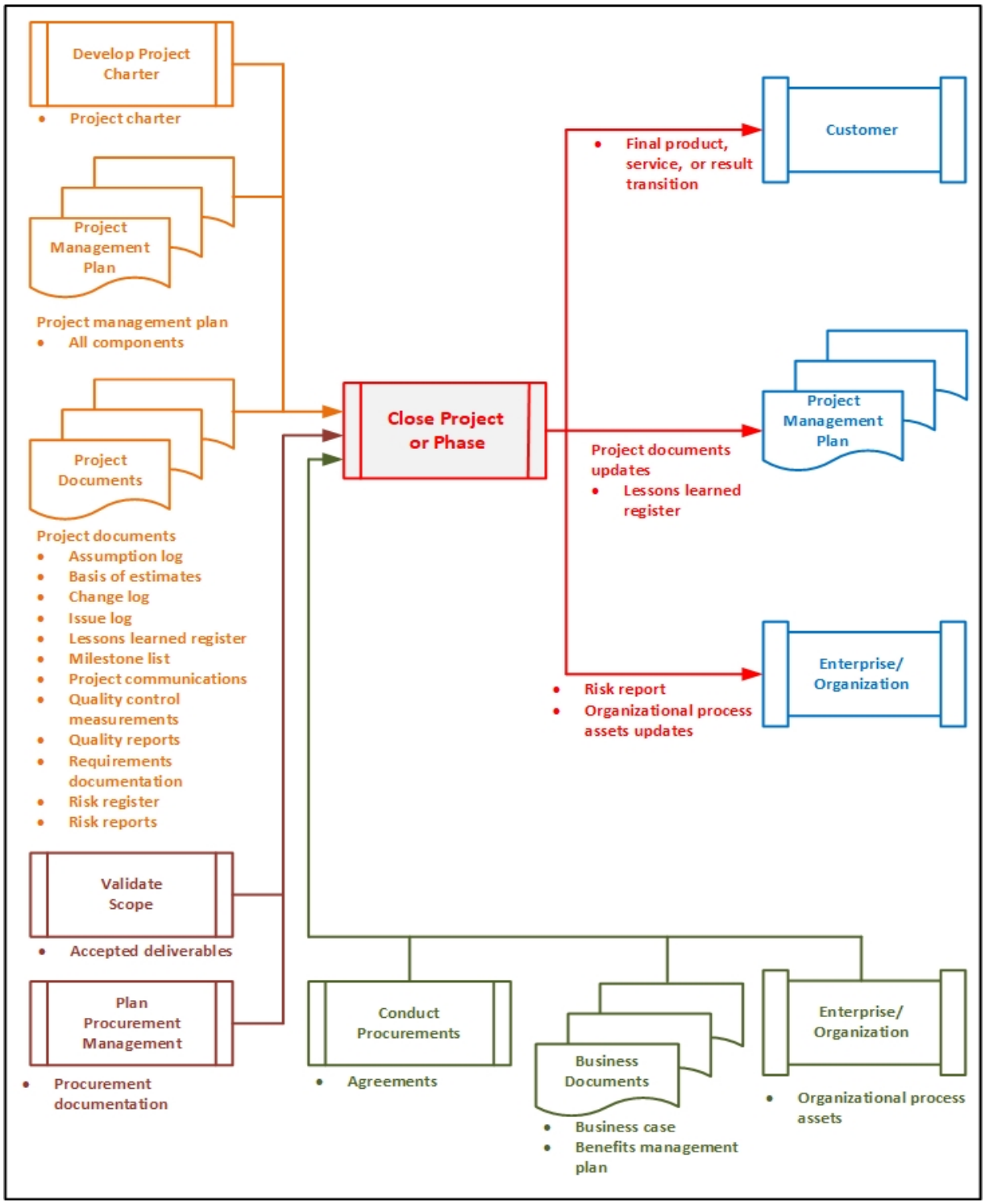

Figure 4.14. Close Project or Phase: Data Flow Diagram.

Questions

1. Which process formally authorizes the project?
   A. Receive project approval
   B. Identify Project Manager
   C. Develop preliminary project statement
   D. Develop project charter
2. Develop project charter is part of which process group?
   A. Initiation
   B. Planning
   C. Executing
   D. Monitoring and Control
3. Which of the following is not a process in the Project Integration Management process group?
   A. Develop project charter
   B. Close project or phase
   C. Identify Project Manager
   D. Monitor and Control Project work
4. Which of the following is not true about project charter?
   A. Project charter is written by the Project Manager.
   B. Project charter defines the purpose of the project
   C. Identify and authorizes the Project Manager
   D. Project charter is authorized by Executive Management
5. Which of the following is not included in a project charter?
   A. Resource management plan
   B. Risks and constraints
   C. Business case
   D. Budget limits
6. ……. is a document that formally recognizes the existence of a project and provides direction on the project's objectives and management.
   A. Project Charter
   B. Business Case
   C. Contract
   D. Project Management Plan
7. Which of the following processes is not part of project integration management?
   A. Developing the project business case
   B. Developing the Project Charter
   C. Developing the Project Management Plan
   D. Closing the project or phase
8. A detailed review of the project documents, results and plans is called ……
   A. Project Integration

B. Project status meeting
C. Management update
D. Lessons learned

9. What tool and technique is used for all processes of project integration management?
A. Project management software
B. Templates
C. Expert judgment
D. All of the above

10. For the project integration effort to be effective, which of the following is needed?
A. An accounting plan
B. Communications with all interested parties
C. A procurement plan
D. A lessons learned

11. What is the purpose of a lessons learned?
A. Document the project results to calculate bonus payments
B. Document the project results to assign blame for failure
C. Document the project results for use on future projects
D. Document the project results for the Internal Revenue Service

12. Who is primarily responsible for project integration?
A. The project sponsor
B. The project manager
C. The project engineer
D. The change review board

13. Outputs of the Monitor and Control Project Work process include all of the following EXCEPT:
A. Project Management Plan Updates
B. Change Requests
C. project document updates
D. Final product, service, or result transition

14. What is the output of Direct and Manage Project Work?
A. Approved change requests
B. Project Management processes
C. Deliverables
D. Forecasts

15. Which of the following is NOT an input to the Develop Project Management Plan process?
A. Outputs of the planning processes
B. Project charter
C. Expert judgment
D. Enterprise environmental factors

Chapter 5

Project Scope Management

General Objective of the Chapter:

Trainee will be able to describe the process of Project Scope Management**.**

Detailed Objectives:

1. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Plan Scope Management process.
2. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Collect Requirements process.
3. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Define Scope process.
4. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Create WBS process.
5. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Validate Scope process.
6. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Control Scope process.

5.1. Overview

Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully. Managing the project scope is primarily concerned with defining and controlling what is and is not included in the project. The Project Scope Management processes are:

- **Plan Scope Management.** The process of creating a scope management plan that documents how the project and product scope will be defined, validated, and controlled.
- **Collect Requirements.** The process of determining, documenting, and managing stakeholder needs and requirements to meet project objectives.
- **Define Scope.** The process of developing a detailed description of the project and product.
- **Create WBS.** The process of subdividing project deliverables and project work into smaller, more manageable components.
- **Validate Scope.** The process of formalizing acceptance of the completed project deliverables.
- **Control Scope.** The process of monitoring the status of the project and product scope and managing changes to the scope baseline.

Figure 5.1 provides an overview of the Project Scope Management processes.

In the project context, the term “scope” can refer to: Product scope. The features and functions that characterize a product, service, or result. Project scope. The work performed to deliver a product, service, or result with the specified features and functions. The term “project scope” is sometimes viewed as including product scope.

Project life cycles can range along a continuum from predictive approaches at one end to adaptive or agile approaches at the other. In a predictive life cycle, the project deliverables are defined at the beginning of the project and any changes to the scope are progressively managed.

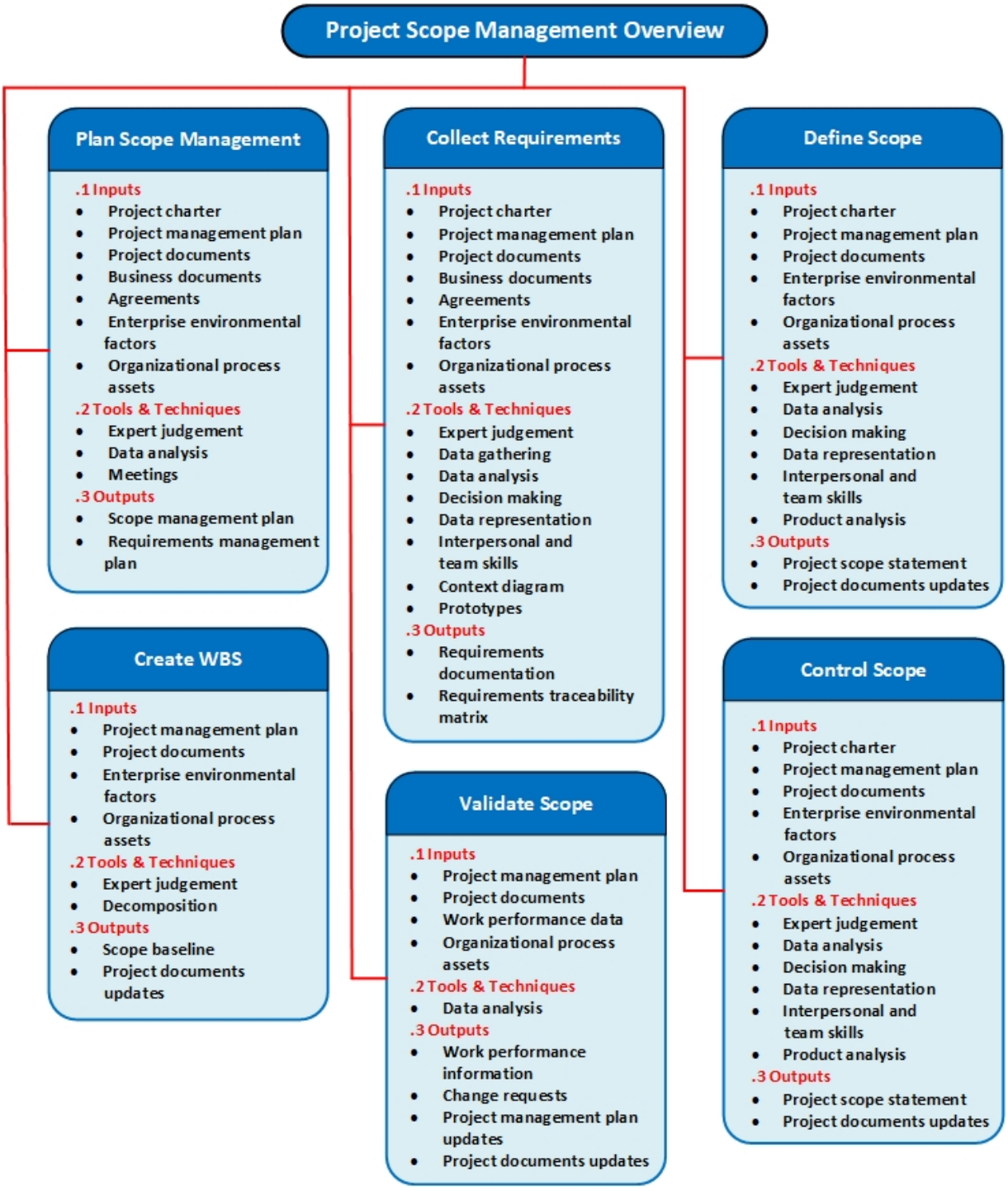

Figure 5.1. Project Scope Management overview.

5.2. Plan Scope Management

Plan Scope Management is the process of creating a scope management plan that documents how the project and product scope will be defined, validated, and controlled. The key benefit of this process is that it provides guidance and direction on how scope will be managed throughout the project. This process is performed once or at predefined points in the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 5.2. Figure 5.3 depicts the data flow diagram of the process.

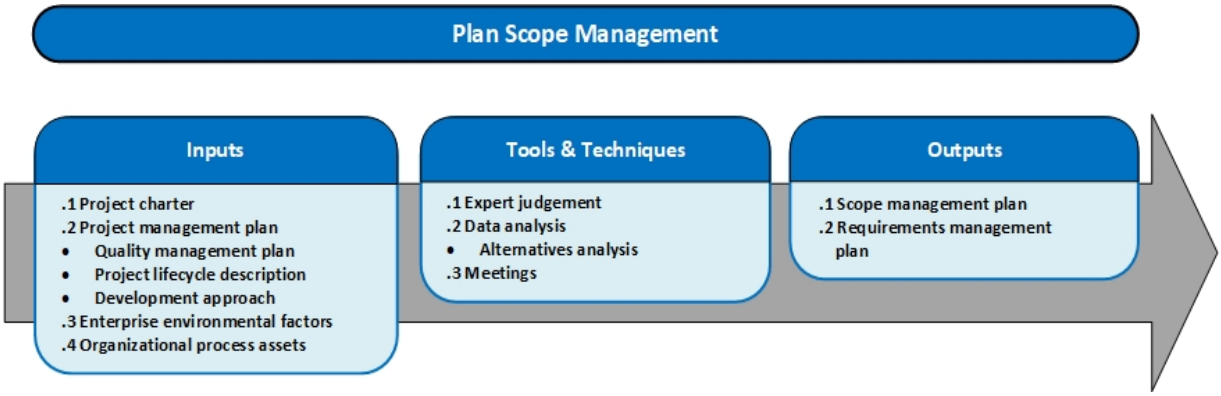

Figure 5.2. Plan Scope Management: Inputs, Tools and Techniques, and Outputs.

The scope management plan is a component of the project or program management plan that describes how the scope will be defined, developed, monitored, controlled, and validated. The development of the scope management plan and the detailing of the project scope begin with the analysis of information contained in the project charter, the latest approved subsidiary plans of the project management plan, historical information contained in the organizational process assets, and any other relevant enterprise environmental factors.

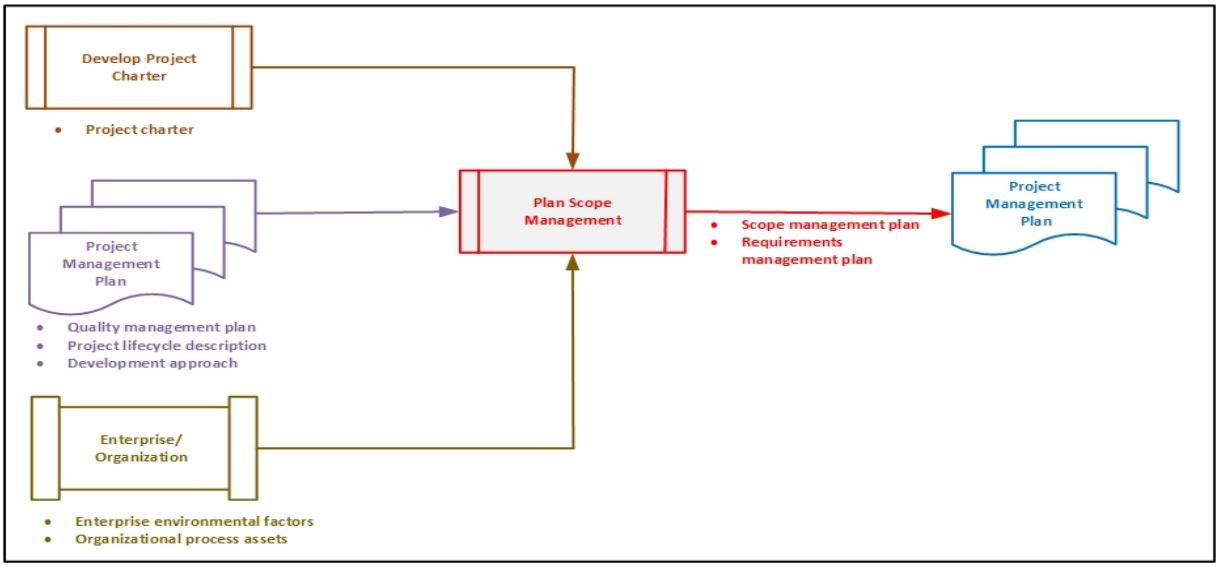

Figure 5.3. Plan Scope Management: Data Flow Diagram.

5.3. Collect Requirements

Collect Requirements is the process of determining, documenting, and managing stakeholder needs and requirements to meet objectives. The key benefit of this process is that it provides the basis for defining the product scope and project scope. This process is performed once or at predefined points in the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 5.4. Figure 5.5 depicts the data flow diagram of the process.

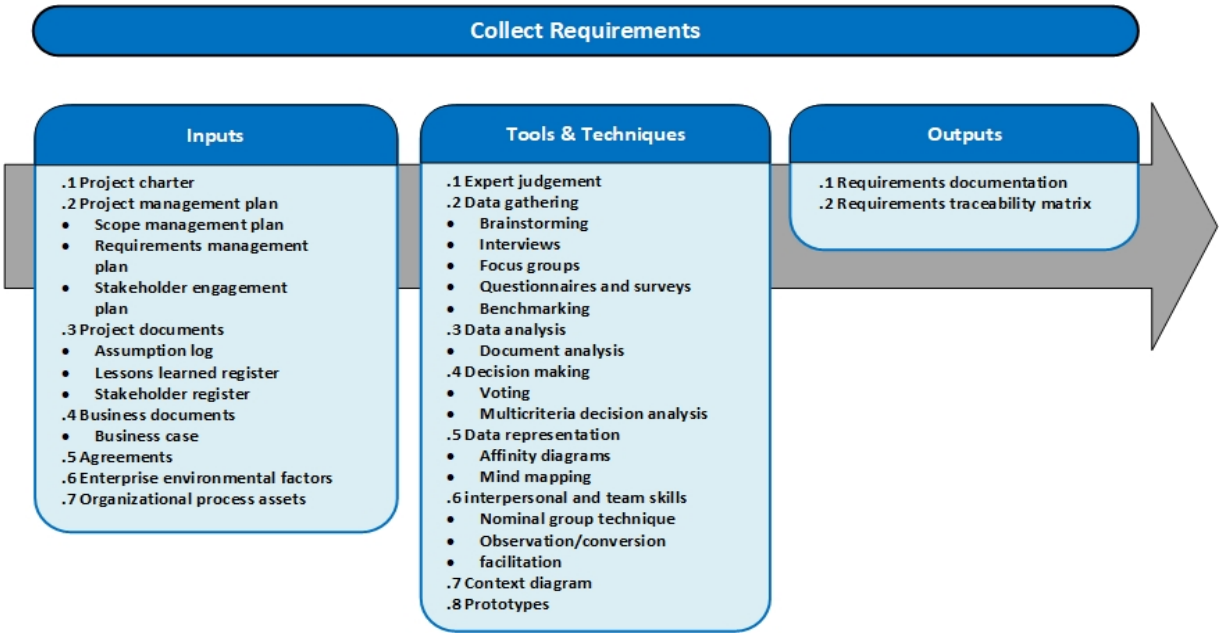

Figure 5.4. Collect Requirements: Inputs, Tools and Techniques, and Outputs.

The project's success is directly influenced by active stakeholder involvement in the discovery and decomposition of needs into project and product requirements and by the care taken in determining, documenting, and managing the requirements of the product, service, or result of the project. Requirements include conditions or capabilities that are required to be present in a product, service, or result to satisfy an agreement or other formally imposed specification. Requirements include the quantified and documented needs and expectations of the sponsor, customer, and other stakeholders. These requirements need to be elicited, analyzed, and recorded in enough detail to be included in the scope baseline and to be measured once project execution begins. Requirements become the foundation of the WBS. Cost, schedule, quality planning, and procurement are all based on these requirements.

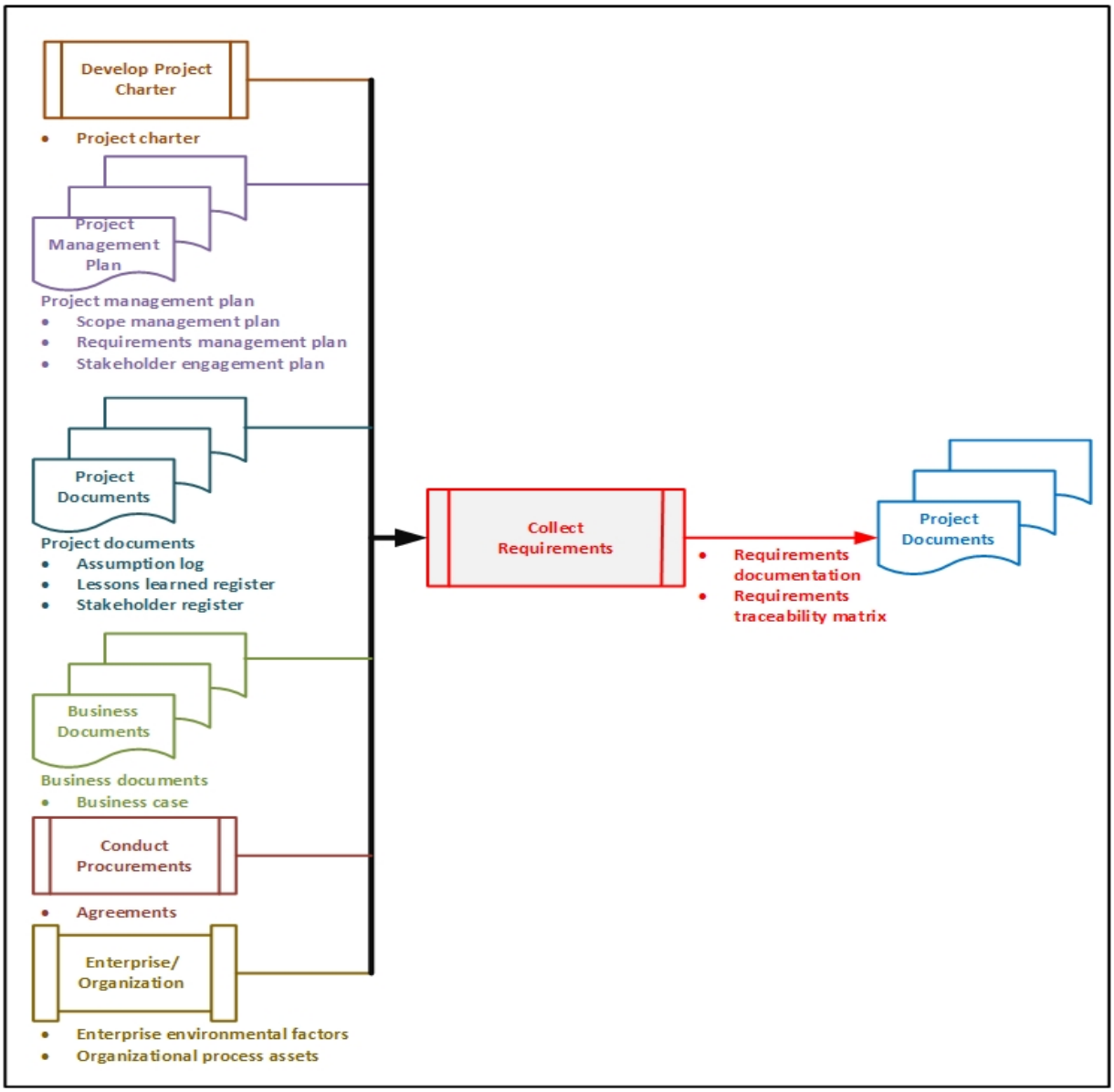

Figure 5.5. Collect Requirements: Data Flow Diagram.

5.4. Define Scope

Define Scope is the process of developing a detailed description of the project and product. The key benefit of this process is that it describes the product, service, or result boundaries and acceptance criteria. The inputs, tools and techniques, and outputs of this process are depicted in Figure 5.6. Figure 5.7 depicts the data flow diagram of the process.

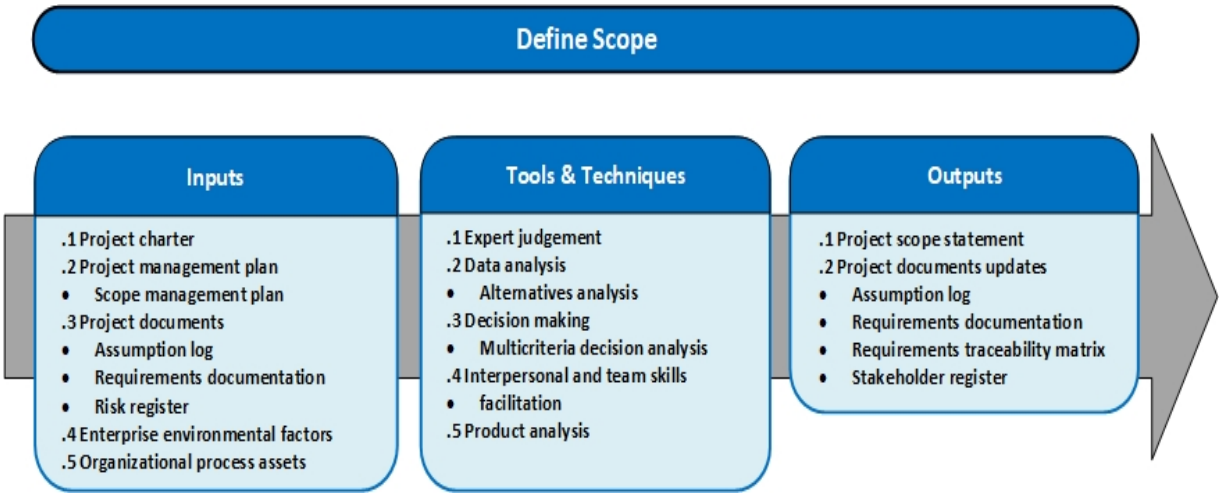

Figure 5.6. Define Scope: Inputs, Tools and Techniques, and Outputs.

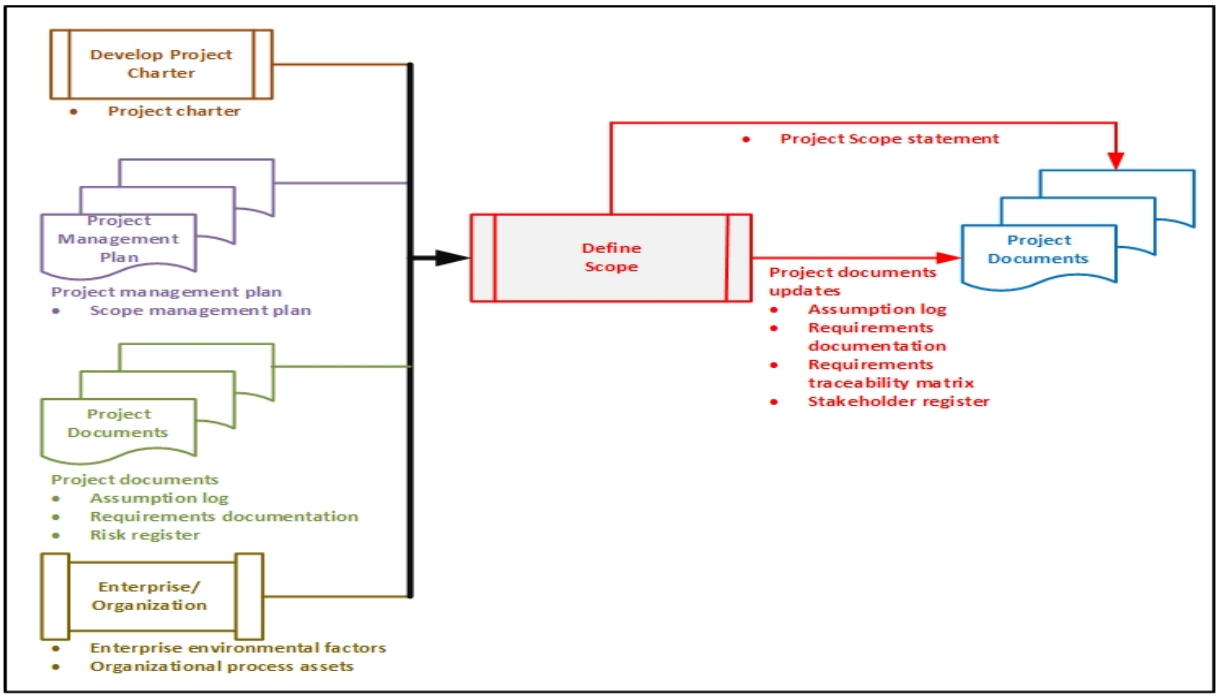

Figure 5.7. Define Scope: Data Flow Diagram.

Since all the requirements identified in Collect Requirements may not be included in the project, the Define Scope process selects the final project requirements from the requirements documentation developed during the Collect Requirements process. It then develops a detailed description of the project and product, service, or result.

5.5. Create WBS

Create WBS is the process of subdividing project deliverables and project work into smaller, more manageable components. The key benefit of this process is that it provides a framework of what has to be delivered. This process is performed once or at predefined points in the project. The

inputs, tools and techniques, and outputs of this process are depicted in Figure 5.8. Figure 5.9 depicts the data flow diagram of the process.

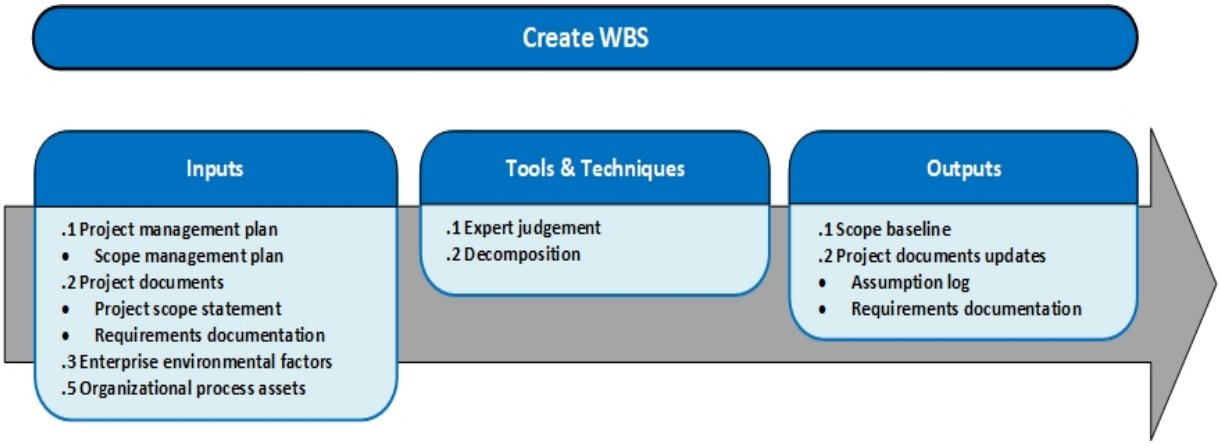

Figure 5.8. Create WBS: Inputs, Tools and Techniques, and Outputs.

The WBS is a hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables. The WBS organizes and defines the total scope of the project and represents the work specified in the current approved project scope statement. The planned work is contained within the lowest level of WBS components, which are called work packages. A work package can be used to group the activities where work is scheduled and estimated, monitored, and controlled. In the context of the WBS, work refers to work products or deliverables that are the result of activity and not to the activity itself.

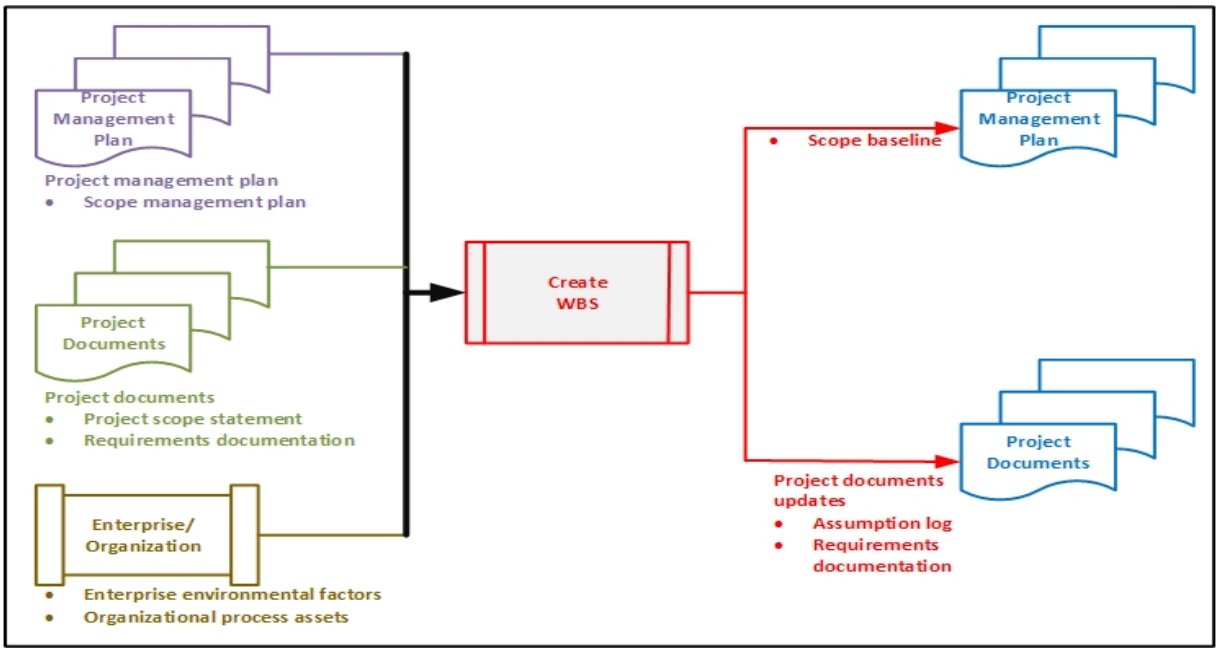

Figure 5.9. Create WBS: Data Flow Diagram.

5.6. Validate Scope

Validate Scope is the process of formalizing acceptance of the completed project deliverables. The key benefit of this process is that it brings objectivity to the acceptance process and increases the probability of final product, service, or result acceptance by validating each deliverable. The inputs, tools and techniques, and outputs of this process are depicted in Figure 5.10. Figure 5.11 depicts the data flow diagram of the process.

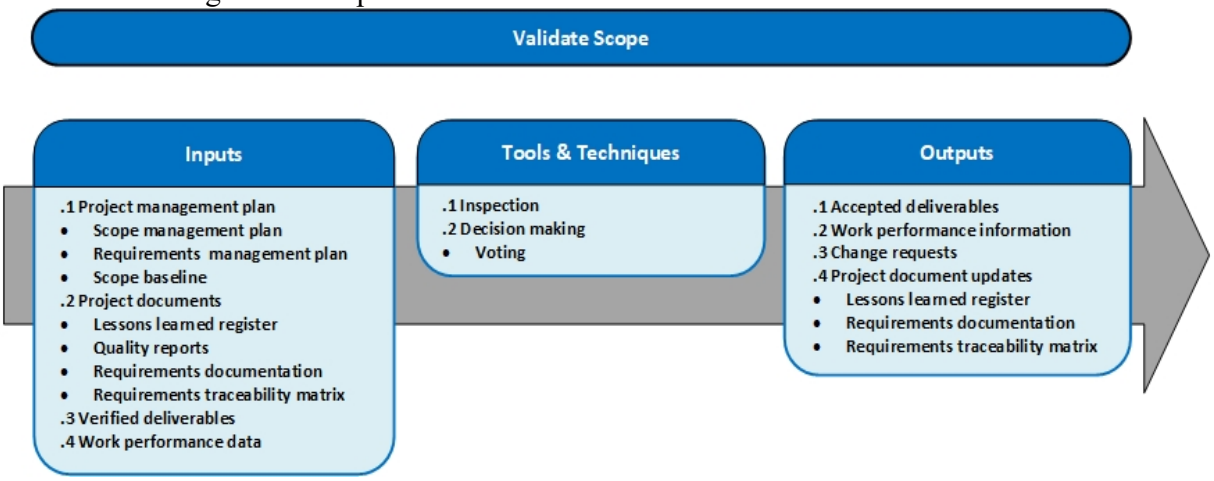

Figure 5.10. Validate Scope: Inputs, Tools and Techniques, and Outputs.

The verified deliverables obtained from the Control Quality process are reviewed with the customer or sponsor to ensure they are completed satisfactorily and have received formal acceptance of the deliverables by the customer or sponsor. In this process, the outputs obtained as a result of the Planning processes in the Project Scope Management Knowledge Area, such as the requirements documentation or the scope baseline, as well as the work performance data obtained from the Execution processes in other Knowledge Areas, are the basis for performing the validation and for final acceptance. The Validate Scope process differs from the Control Quality process in that the former is primarily concerned with acceptance of the deliverables, while the latter is primarily concerned with correctness of the deliverables and meeting the quality requirements specified for the deliverables.

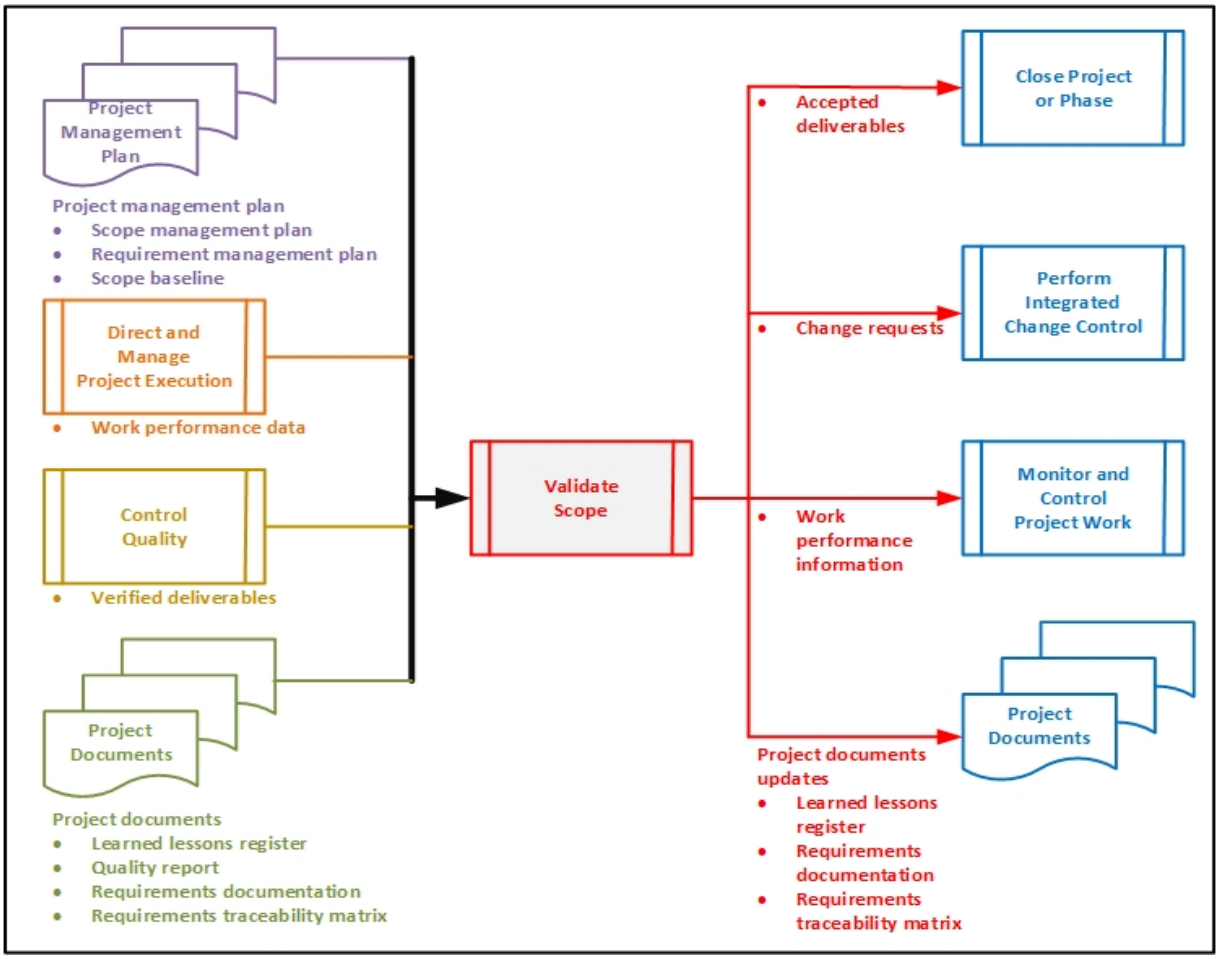

Figure 5.11. Validate Scope: Data Flow Diagram.

5.7. Control Scope

Control Scope is the process of monitoring the status of the project and product scope and managing changes to the scope baseline. The key benefit of this process is that the scope baseline is maintained throughout the project. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 5.12. Figure 5.13 depicts the data flow diagram of the process.

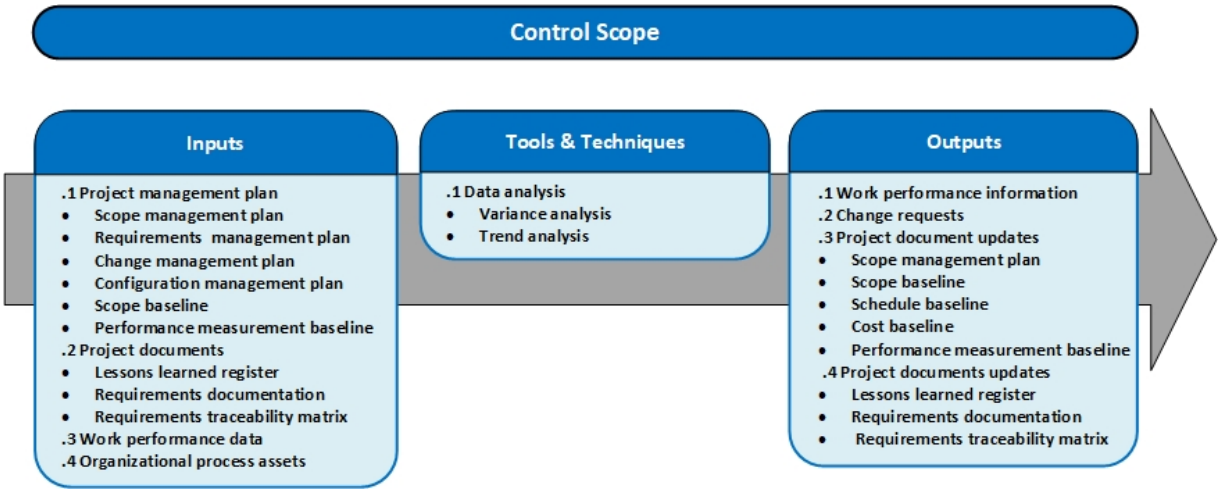

Figure 5.12. Control Scope: Inputs, Tools and Techniques, and Outputs.

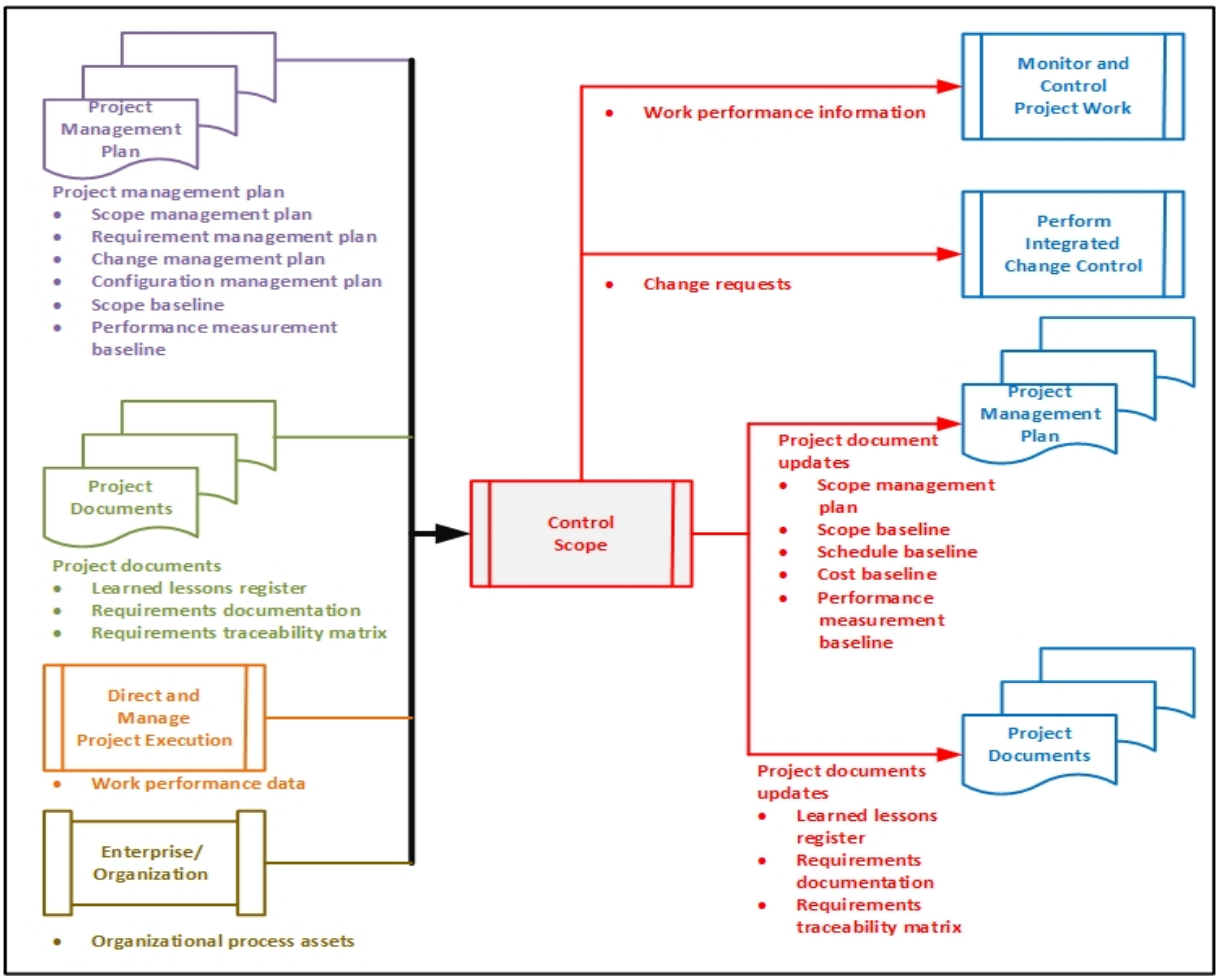

Figure 5.13. Control Scope: Data Flow Diagram.

Controlling the project scope ensures all requested changes and recommended corrective or preventive actions are processed through the Perform Integrated Change Control process. Control Scope is also used to manage the actual changes when they occur and is integrated with the other control processes. The uncontrolled expansion to product or project scope without adjustments to time, cost, and resources is referred to as scope creep. Change is inevitable; therefore, some type of change control process is mandatory for every project.

Questions

1. The following are included within the WBS dictionary except
   A. Code of accounts identifiers
   B. Cost estimates
   C. Description of the work of the component
   D. Activity list
2. Sam is currently in the planning stages of a project and is working on developing the project scope statement. As part of converting the product scope description into deliverables, he has used the product breakdown and systems analysis techniques. Which of the following tools and techniques of the Define Scope process is Sam currently using?
   A. Expert judgment
   B. Product analysis
   C. Alternatives generation
   D. Facilitated workshops
3. The scope management plan should contain the following information except:
   A. The process used to prepare the project scope statement
   B. The definition of how deliverables will be checked for accuracy and the process for accepting deliverables
   C. The list of all the requirements to be included in the scope
   D. The process used to create the WBS
4. The scope management plan is an input to all of the following processes except?
   A. Collect requirements
   B. Define scope
   C. Create WBS
   D. Develop schedule
5. The requirements management plan is an input into which of the following processes?
   A. Collect requirements
   B. Define scope
   C. Create WBS
   D. Develop schedule
6. The requirements management plan describes:
   A. Process for preparing a detailed project scope statement
   B. Process that enables the creation of the WBS
   C. Configuration management activities
   D. Marketplace conditions
7. The scope management plan describes:
   A. Requirements prioritization process
   B. Process that enables the creation of the WBS
   C. Configuration management activities
   D. Marketplace conditions

8. Completion of the project scope is measured against?
A. The scope management plan
B. The requirements management plan
C. The project management plan
D. The product requirement

9. Which of the following is TRUE about a work breakdown structure?
A. It contains work packages that are described in a linear, unstructured list.
B. Each item in the WBS represents a feature in the product scope.
C. The WBS represents all of the work that must be done on the project.
D. The WBS is created by the product sponsor and stakeholders

10. Which is NOT an output of a Scope Management process?
A. Business case
B. WBS dictionary
C. Change requests
D. Accepted deliverables

11. Which of the following is NOT TRUE about a work breakdown structure?
A. It describes procedures to define the scope, verify work, and manage scope changes. **B.** It contains a graphical, hierarchical list of all work to be performed.
C. It can be broken down by project phase or deliverable.
D. It is an important element of the baseline.

12. What is the correct order of the Scope Management processes?
A. Plan Scope Management, Define Scope, Create WBS, Collect Requirements, Validate Scope, Control Scope
B. Plan Scope Management, Collect Requirements, Control Scope, Create WBS, Validate Scope
C. Plan Scope Management, Collect Requirements, Define Scope, Create WBS, Validate Scope, Control Scope
D. Plan Scope Management, Collect Requirements, Baseline, Define Scope, Control Scope, Validate Scope

13. The goal of Validate Scope is:
A. To inspect the scope statement for defects so that it is correct
B. To gain formal acceptance of the project deliverables from the sponsor and stakeholders
C. To get everyone in the project working together toward a common goal
D. To verify that all PMBOK® Guide processes are complied with

14. Which of the following BEST describes the purpose of a requirements traceability matrix?
A. It describes how WBS dictionary entries are traced to work packages, and how work packages are decomposed from deliverables.
B. It's used to make sure that all of the subplans of the Project Management plan have been created.
C. It helps you understand the source of each requirement, and how that requirement was verified in a later deliverable.
D. It's used to trace the source of every change, so that you can keep track of them through the entire Control Scope process and verify that the change was properly implemented.

15. It's the end of execution for a large highway construction project. The work has been done, and the workers are ready to pack up their equipment. The project manager and project sponsor have come by with specialists to check that each requirement has been met, and that all of the work in the WBS has been performed. What process is being done?

A. Control Scope
B. Validate Scope
C. Scope Testing
D. Define Scope

Chapter 6

Project Schedule Management

General Objective of the Chapter:

Trainee will be able to describe the process of Project Schedule Management**.**

Detailed Objectives:

1. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Plan Schedule Management process.
2. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Define Activities process.
3. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Sequence Activities process.
4. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Estimate Activity Durations process.
5. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of Develop Schedule process.
6. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Control Schedule process.

6.1. Overview

Project Schedule Management includes the processes required to manage the timely completion of the project. The Project Schedule Management processes are:

- **Plan Schedule Management**. The process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.
- **Define Activities.** The process of identifying and documenting the specific actions to be performed to produce the project deliverables.
- **Sequence Activities.** The process of identifying and documenting relationships among the project activities.
- **Estimate Activity Durations.** The process of estimating the number of work periods needed to complete individual activities with the estimated resources.
- **Develop Schedule.** The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model for project execution and monitoring and controlling.
- **Control Schedule.** The process of monitoring the status of the project to update the project schedule and manage changes to the schedule baseline.

Figure 6.1 provides an overview of the Project Schedule Management processes.

Project scheduling provides a detailed plan that represents how and when the project will deliver the products, services, and results defined in the project scope and serves as a tool for communication, managing stakeholders' expectations, and as a basis for performance reporting.

Figure 6.2 provides a scheduling overview that shows how the scheduling method, scheduling tool, and outputs from the Project Schedule Management processes interact to create a schedule model.

Figure 6.1. Project Schedule Management overview.

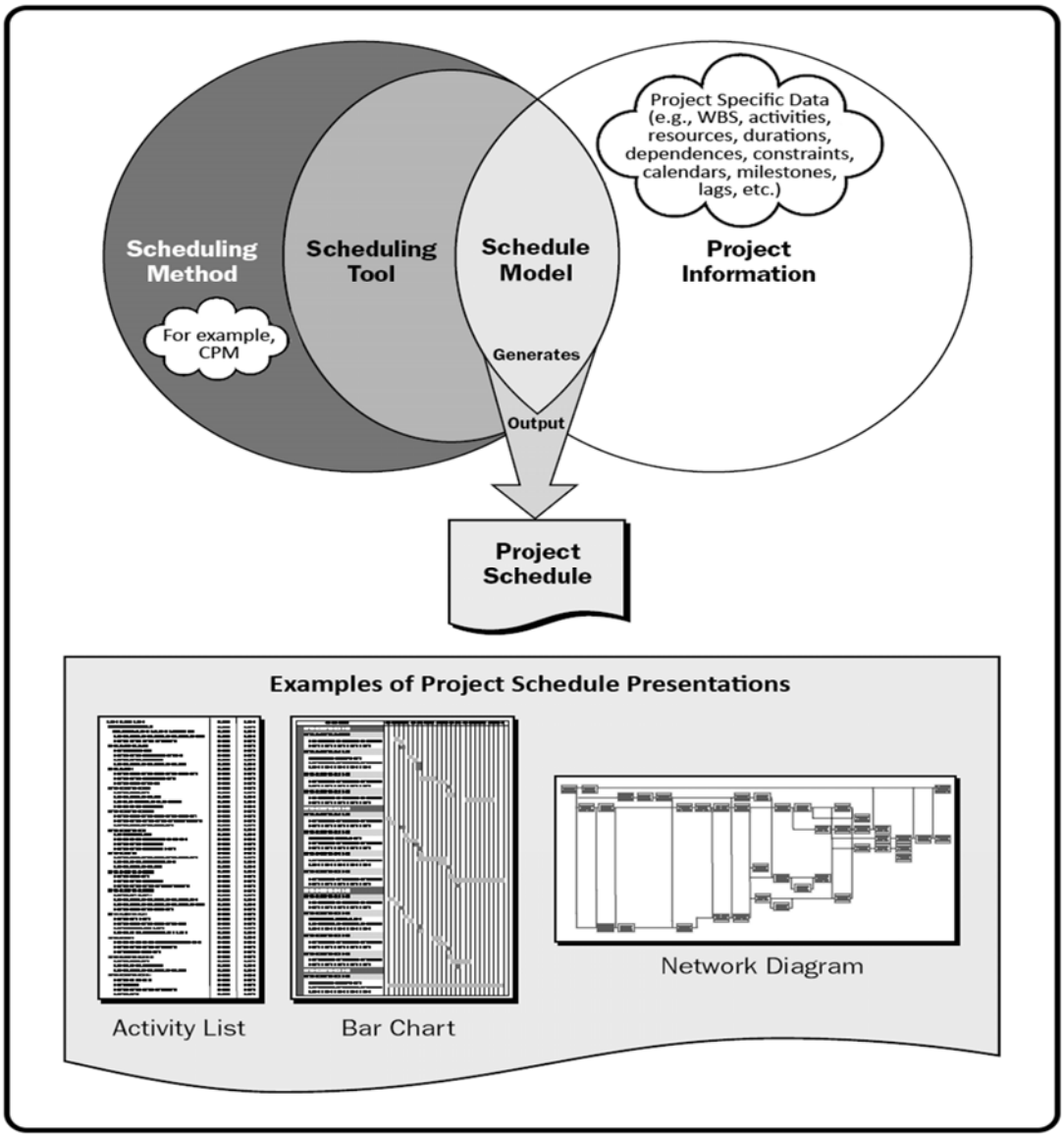

Figure 6.2. Scheduling overview.

For smaller projects, defining activities, sequencing activities, estimating activity durations, and developing the schedule model are so tightly linked that they are viewed as a single process that can be performed by a person over a relatively short period of time. These processes are presented here as distinct elements because the tools and techniques for each process are different.

6.2. Plan Schedule Management

Plan Schedule Management is the process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule. The key benefit of this process is that it provides guidance and direction on how the project schedule will be managed throughout the project. This process is performed once or at predefined points in the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 6.3. Figure 6.4 depicts the data flow diagram for the process.

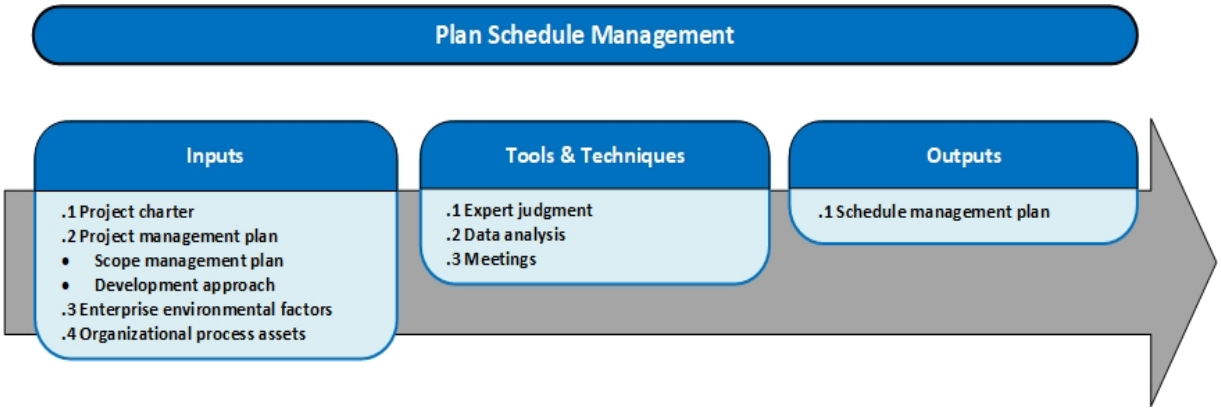

Figure 6.3. Plan Schedule Management: Inputs, Tools & Techniques, and Outputs.

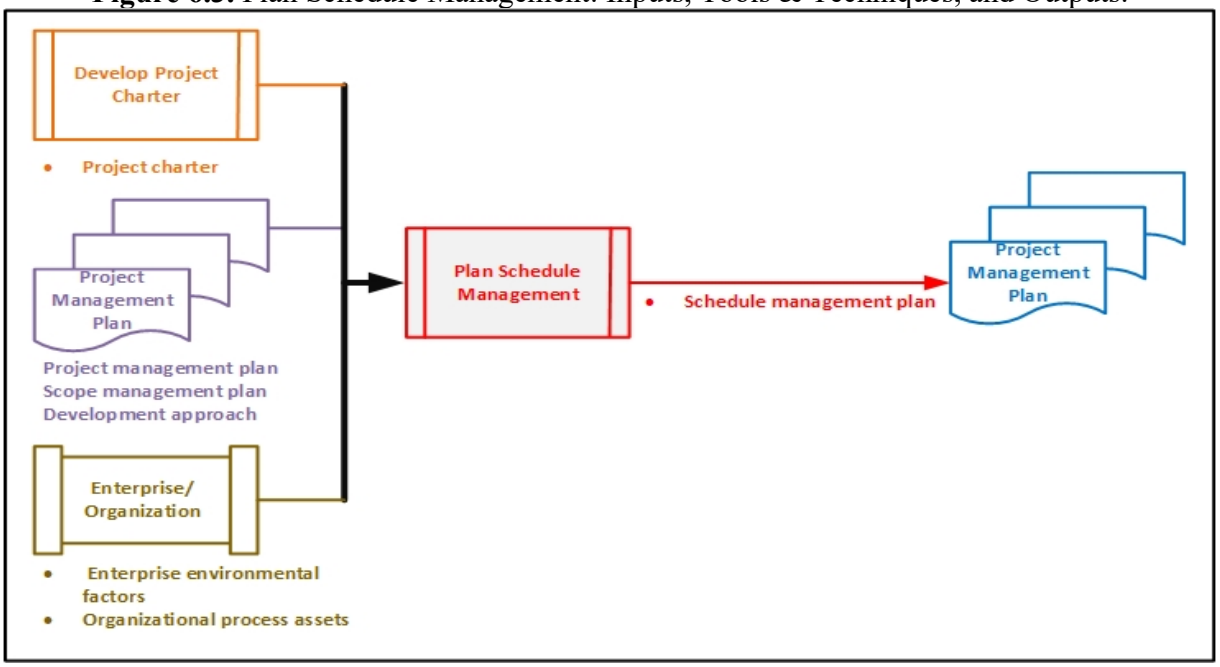

Figure 6.4. Plan Schedule Management: Data Flow Diagram.

6.2.1. Plan Schedule Management: Tools and Techniques

1) EXPERT JUDGMENT

Expertise should be considered from individuals or groups with specialized knowledge or training in previous, similar projects:

- Schedule development, management, and control;
- Scheduling methodologies (e.g., predictive or adaptive life cycle); and
- Scheduling software.

2) DATA ANALYSIS

A data analysis technique that can be used for this process includes but is not limited to alternatives analysis. Alternatives analysis can include determining which schedule methodology to use, or how to combine various methods on the project.

3) MEETINGS

Project teams may hold planning meetings to develop the schedule management plan.

6.3. Define Activities

Define Activities is the process of identifying and documenting the specific actions to be performed to produce the project deliverables. The key benefit of this process is that it decomposes work packages into schedule activities that provide a basis for estimating, scheduling, executing, monitoring, and controlling the project work. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 6.5. Figure 6.6 depicts the data flow diagram of the process.

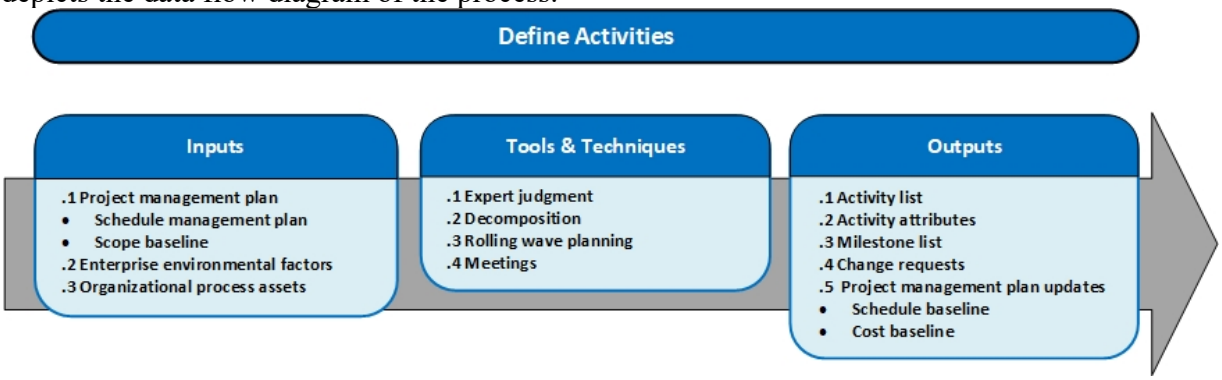

Figure 6.5. Define Activities: Inputs, Tools & Techniques, and Outputs.

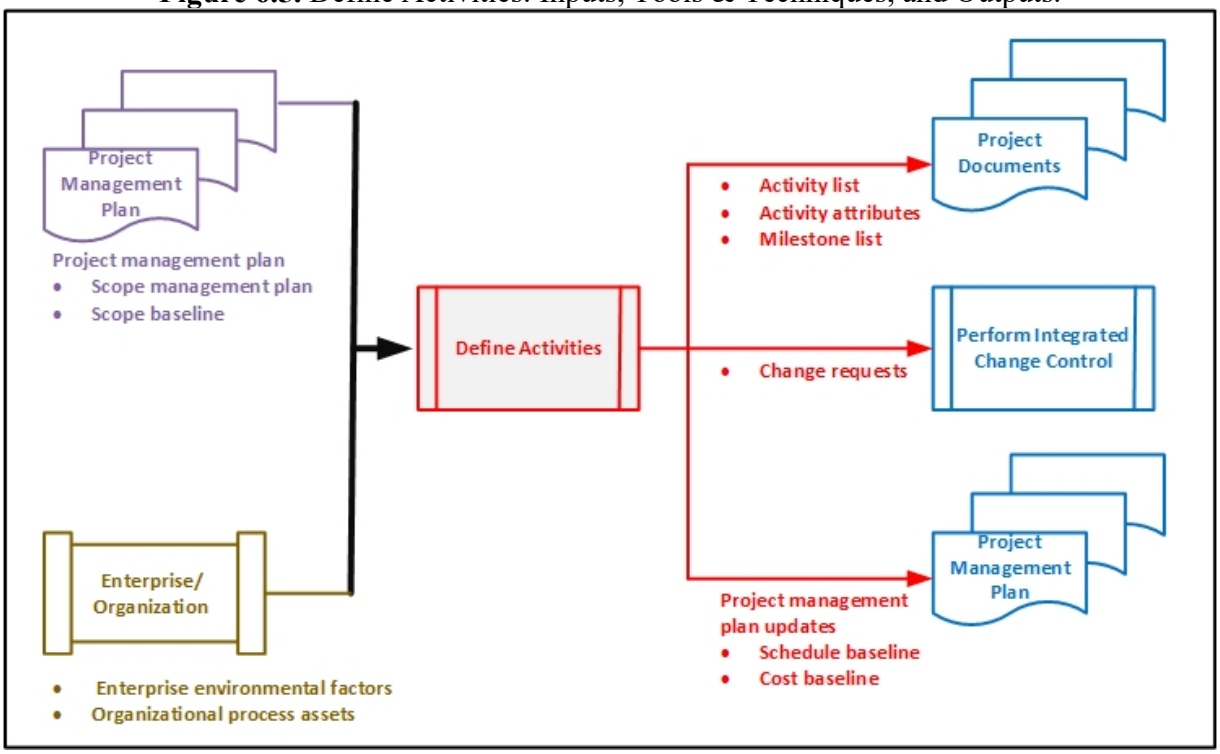

Figure 6.6. Define Activities: Data Flow Diagram.

6.3.1. Define Activities: Tools and Techniques

1) EXPERT JUDGMENT

Expertise should be considered from individuals or groups with specialized knowledge of similar past projects and the work being performed.

2) DECOMPOSITION

Decomposition is a technique used for dividing and subdividing the project scope and project deliverables into smaller, more manageable parts. Activities represent the effort needed to complete a work package.

3) ROLLING WAVE PLANNING

Rolling wave planning is an iterative planning technique in which the work to be accomplished in the near term is planned in detail, while work further in the future is planned at a higher level.

4) MEETINGS

Meetings may be face-to-face, virtual, formal, or informal.

6.4. Sequence Activities

Sequence Activities is the process of identifying and documenting relationships among the project activities. The key benefit of this process is that it defines the logical sequence of work to obtain the greatest efficiency given all project constraints. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 6.7. Figure 6.8 depicts the data flow diagram of the process.

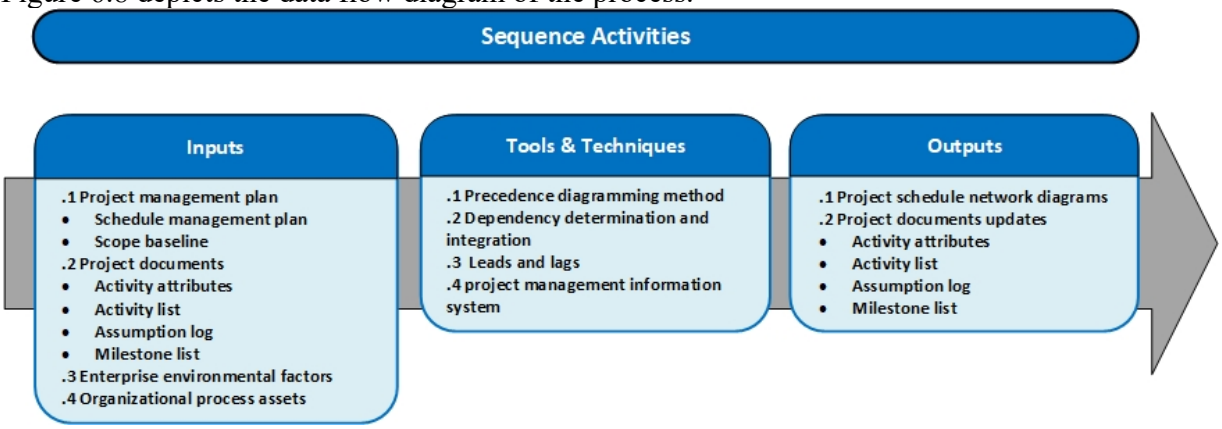

Figure 6.7. Sequence Activities: Inputs, Tools & Techniques, and Outputs.

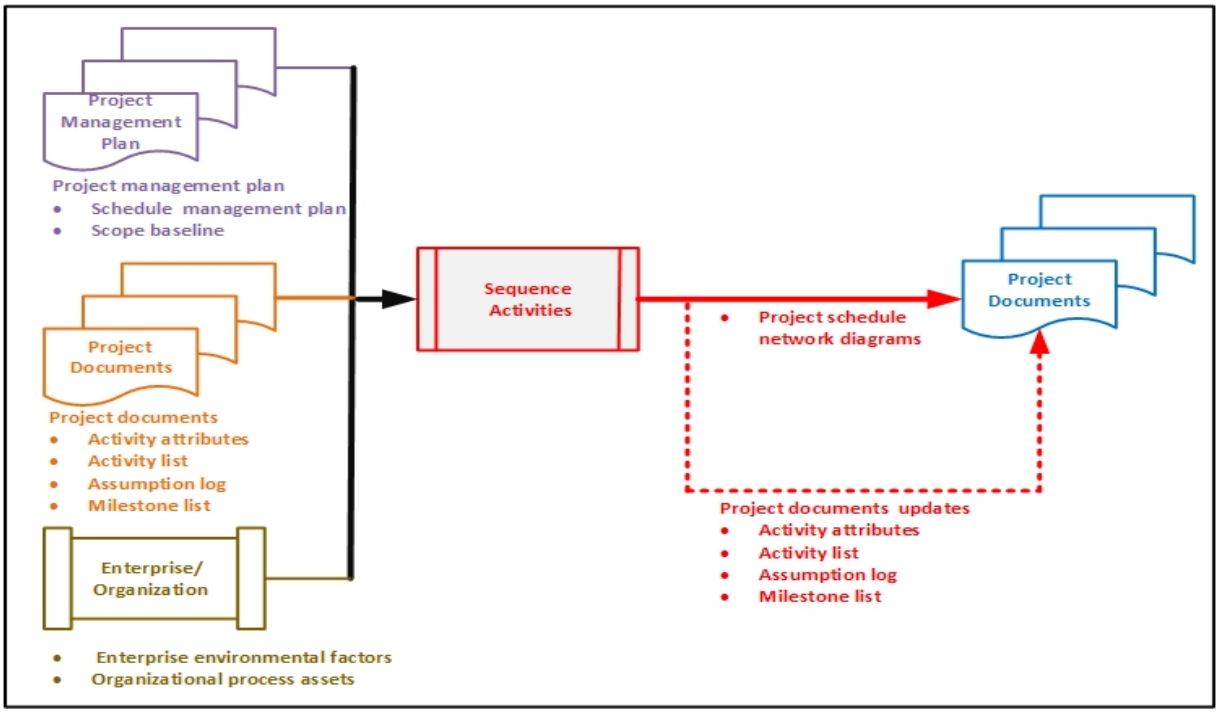

Figure 6.8. Sequence Activities: Data Flow Diagram.

Every activity except the first and last should be connected to at least one predecessor and at least one successor activity with an appropriate logical relationship. Logical relationships should be designed to create a realistic project schedule. It may be necessary to use lead or lag time between activities to support a realistic and achievable project schedule.

6.4.1. Sequence Activities: Tools and Techniques

1) PRECEDENCE DIAGRAMMING METHOD

The precedence diagramming method (PDM) is a technique used for constructing a schedule model in which activities are represented by nodes and are graphically linked by one or more logical relationships to show the sequence in which the activities are to be performed.

PDM includes four types of dependencies or logical relationships. A predecessor activity is an activity that logically comes before a dependent activity in a schedule. A successor activity is a dependent activity that logically comes after another activity in a schedule. These relationships are defined below and are illustrated in Figure 6.9:

- **Finish-to-start (FS).** A logical relationship in which a successor activity cannot start until a predecessor activity has finished.
- **Finish-to-finish (FF).** A logical relationship in which a successor activity cannot finish until a predecessor activity has finished.
- **Start-to-start (SS).** A logical relationship in which a successor activity cannot start until a predecessor activity has started.
- **Start-to-finish (SF).** A logical relationship in which a successor activity cannot finish until a predecessor activity has started.

In PDM, FS is the most commonly used type of precedence relationship. The SF relationship is very rarely used, but is included to present a complete list of the PDM relationship types.

Two activities can have two logical relationships at the same time (for example, SS and FF). Multiple relationships between the same activities are not recommended, so a decision has to be made to select the relationship with the highest impact. Closed loops are also not recommended in logical relationships.

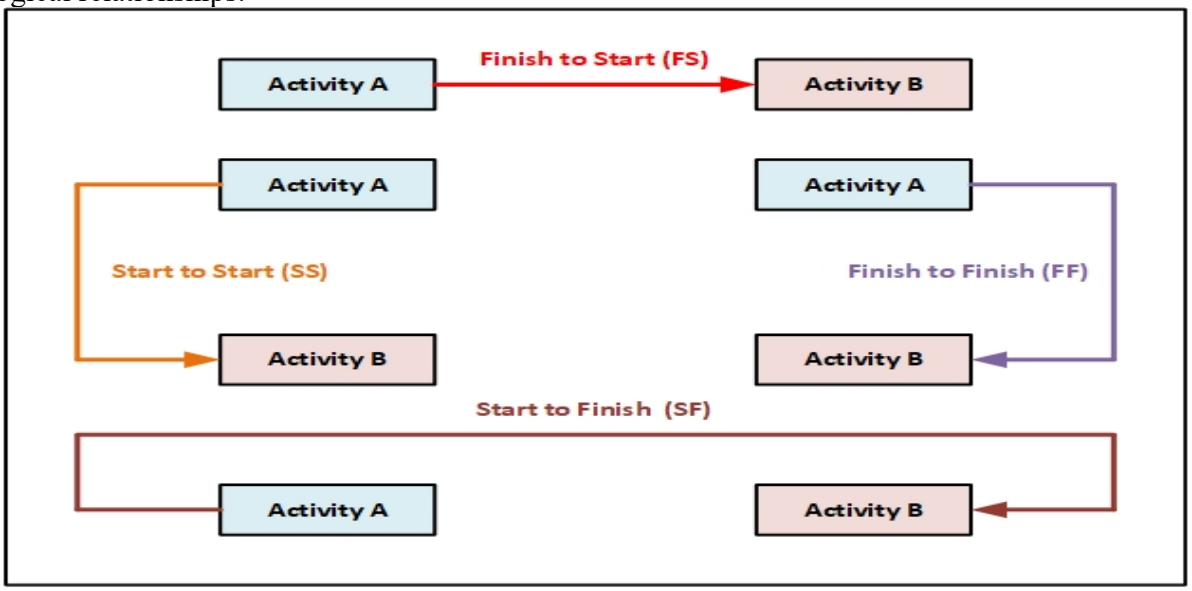

Figure 6.9. Precedence Diagramming Method (PDM) Relationship Types.

2) DEPENDENCY DETERMINATION AND INTEGRATION

Dependencies may be characterized by the following attributes: mandatory or discretionary, internal or external (as described below):

- **Mandatory dependencies.** Mandatory dependencies are those that are legally or contractually required or inherent in the nature of the work.
- **Discretionary dependencies.** Discretionary dependencies are sometimes referred to as preferred logic, preferential logic, or soft logic.
- **External dependencies.** External dependencies involve a relationship between project activities and non-project activities.
- **Internal dependencies.** Internal dependencies involve a precedence relationship between project activities and are generally inside the project team's control.

3) LEADS AND LAGS

A lead is the amount of time a successor activity can be advanced with respect to a predecessor activity. For example, on a project to construct a new office building, the landscaping could be scheduled to start 2 weeks prior to the scheduled punch list completion. This would be shown as a finish-to-start with a 2-week lead as shown in Figure 6.10. Lead is often represented as a negative value for lag in scheduling software.

A lag is the amount of time a successor activity will be delayed with respect to a predecessor activity. For example, a technical writing team may begin editing the draft of a large document 15 days after they begin writing it. This can be shown as a start-to-start relationship with a 15-day lag as shown in Figure 6.10. Lag can also be represented in project schedule network diagrams as shown in Figure 6.11 in the relationship between activities H and I (as indicated by the

nomenclature SS+10 (start-to-start plus 10 days lag) even though the offset is not shown relative to a timescale).

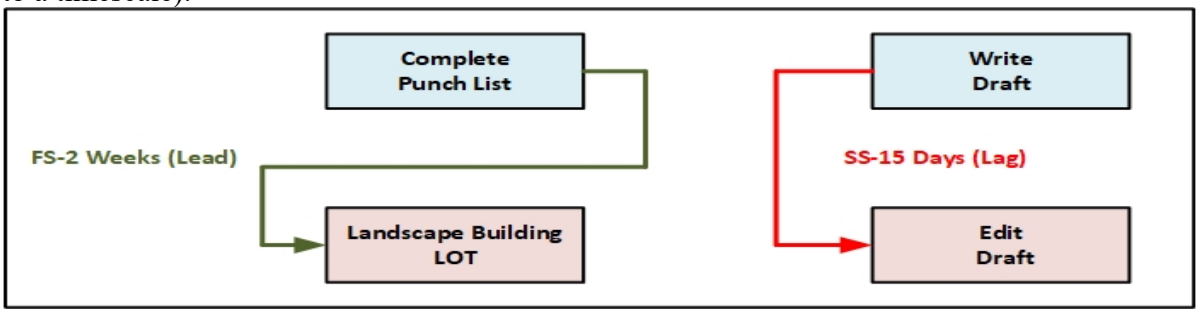

Figure 6.10. Examples of Lead and Lag.

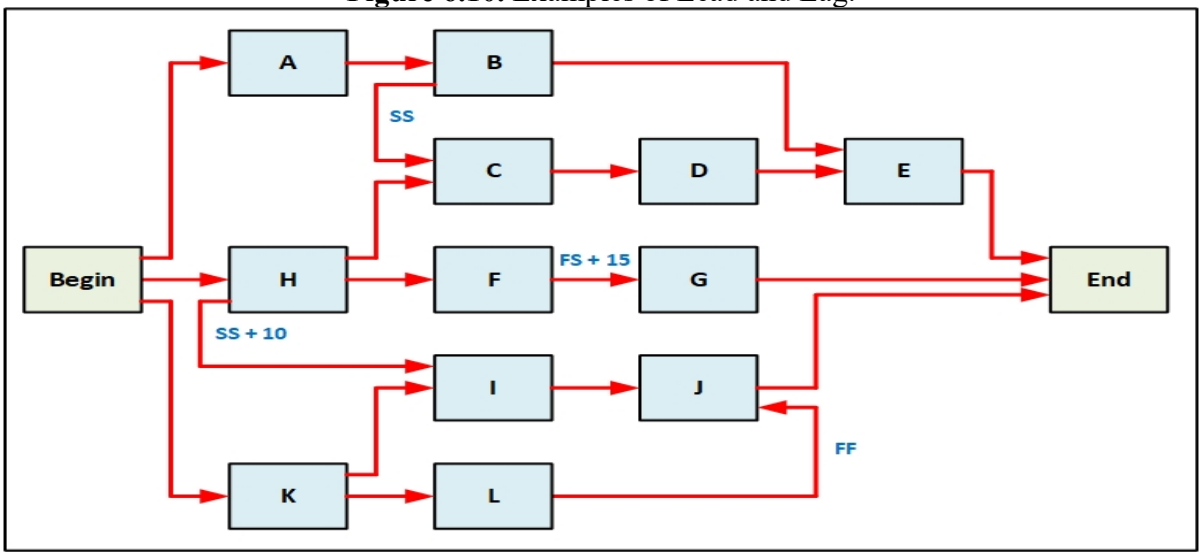

Figure 6.11. Project Schedule Network Diagram.

4) PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

Project management information systems includes scheduling software that has the capability to help plan, organize, and adjust the sequence of the activities; insert the logical relationships, lead and lag values; and differentiate the different types of dependencies.

6.5. Estimate Activity Durations

Estimate Activity Durations is the process of estimating the number of work periods needed to complete individual activities with estimated resources. The key benefit of this process is that it provides the amount of time each activity will take to complete. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 6.12. Figure 6.13 depicts the data flow diagram of the process.

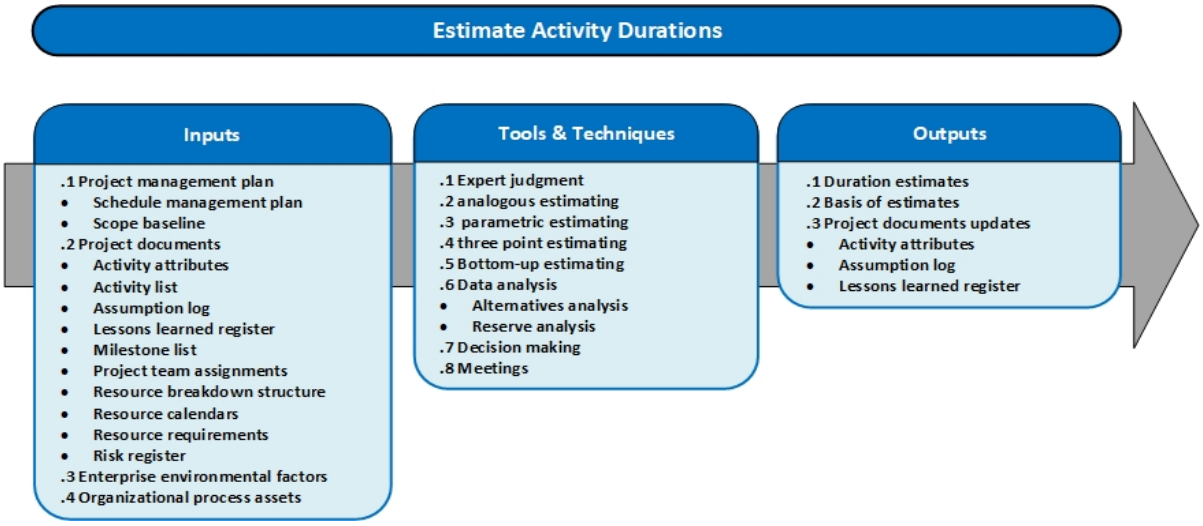

Figure 6.12. Estimate Activity Durations: Inputs, Tools & Techniques, and Outputs.

Estimating activity durations uses information from the scope of work, required resource types or skill levels, estimated resource quantities, and resource calendars. Other factors that may influence the duration estimates include constraints imposed on the duration, effort involved, or type of resources (e.g., fixed duration, fixed effort or work, fixed number of resources), as well as the schedule network analysis technique used.

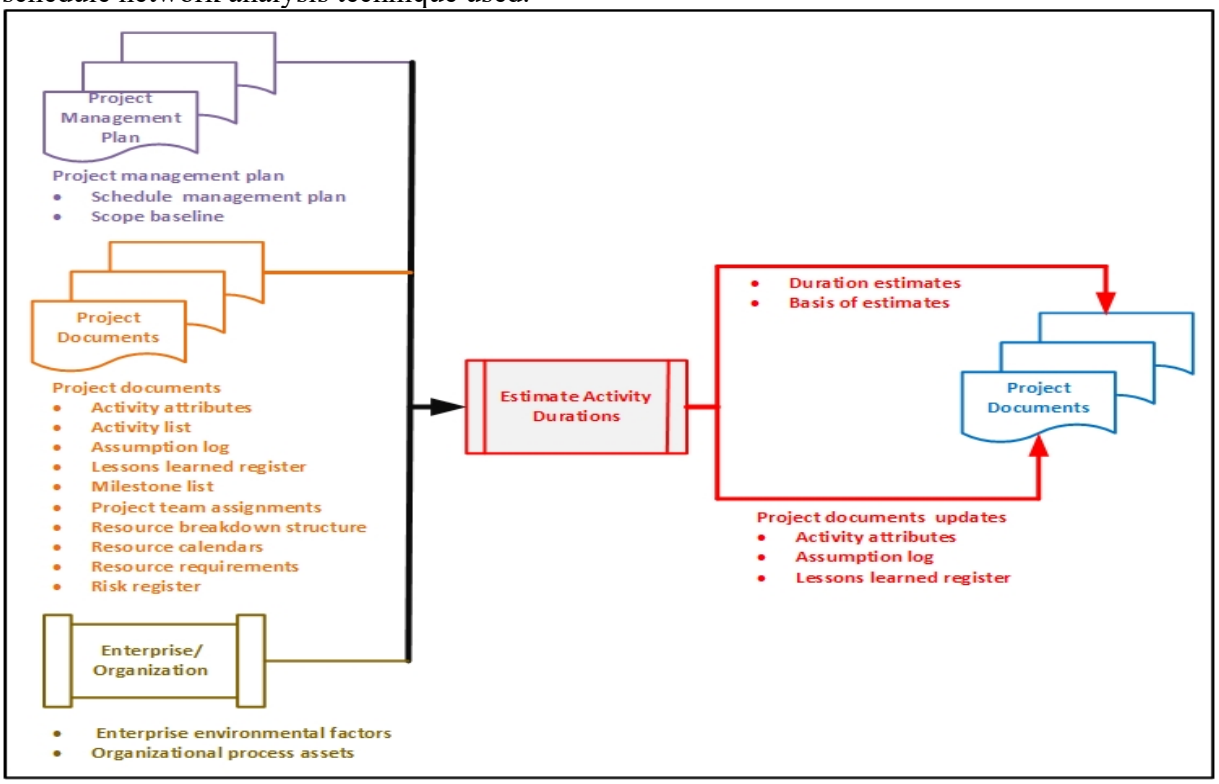

Figure 6.13. Estimate Activity Durations: Data Flow Diagram.

6.5.1. Estimate Activity Durations: Tools and Techniques

1) EXPERT JUDGMENT

Expertise should be considered from individuals or groups with specialized knowledge or training in the following topics:

- Schedule development, management, and control;
- Expertise in estimating; and
- Discipline or application knowledge.

2) ANALOGOUS ESTIMATING

Analogous estimating is a technique for estimating the duration or cost of an activity or a project using historical data from a similar activity or project. Analogous estimating uses parameters from a previous, similar project, such as duration, budget, size, as the basis for estimating the same parameter or measure for a future project.

3) PARAMETRIC ESTIMATING

Parametric estimating is an estimating technique in which an algorithm is used to calculate cost or duration based on historical data and project parameters.

4) THREE-POINT ESTIMATING

The accuracy of single-point duration estimates may be improved by considering estimation uncertainty and risk. Using three-point estimates helps define an approximate range for an activity's duration:

- **Most likely (*tM*).** This estimate is based on the duration of the activity, given the resources likely to be assigned, their productivity, realistic expectations of availability for the activity, dependencies on other participants, and interruptions.
- **Optimistic (*tO*).** The activity duration based on analysis of the best-case scenario for the activity.
- **Pessimistic (*tP*).** The duration based on analysis of the worst-case scenario for the activity.

Depending on the assumed distribution of values within the range of the three estimates, the expected duration, tE, can be calculated. One commonly used formula is triangular distribution: $\boldsymbol{tE = (tO + tM + tP) / 3}$.

Triangular distribution is used when there is insufficient historical data or when using judgmental data.

5) BOTTOM-UP ESTIMATING

Bottom-up estimating is a method of estimating project duration or cost by aggregating the estimates of the lower-level components of the WBS.

6) DATA ANALYSIS

Data analysis techniques that can be used for this process include but are not limited to:

- **Alternatives analysis.** Alternatives analysis is used to compare various levels of resource capability or skills; scheduling compression techniques; and different tools.
- **Reserve analysis.** Reserve analysis is used to determine the amount of contingency and management reserve needed for the project. Duration estimates may include contingency reserves to account for schedule uncertainty.

7) DECISION MAKING

Decision-making techniques that can be used in this process include but are not limited to voting. One variation of the voting method that is often used in agile-based projects is called the fist of five. In this technique, the project manager asks the team to show their level of support for a

decision by holding up a closed fist (indicating no support) up to five fingers (indicating full support).

8) MEETINGS

The project team may hold meetings to estimate activity durations.

6.6. Develop Schedule

Develop Schedule is the process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create a schedule model for project execution and monitoring and controlling. The key benefit of this process is that it generates a schedule model with planned dates for completing project activities. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 6.14. Figure 6.15 depicts the data flow diagram of the process.

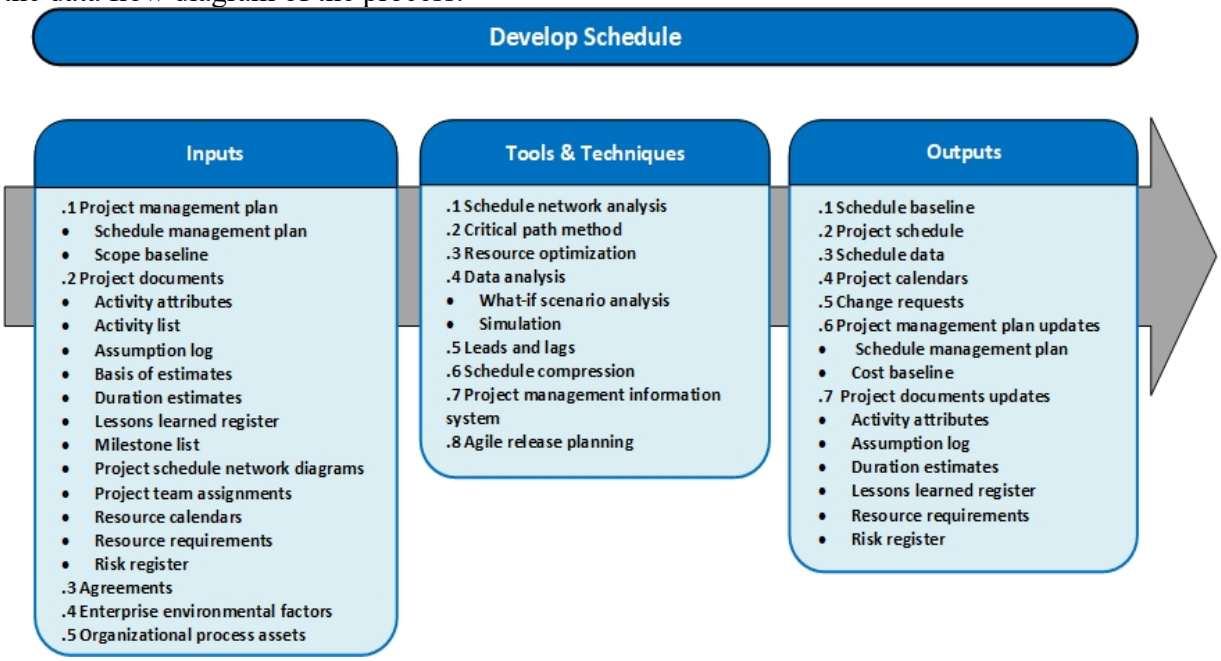

Figure 6.14. Develop Schedule: Inputs, Tools & Techniques, and Outputs.

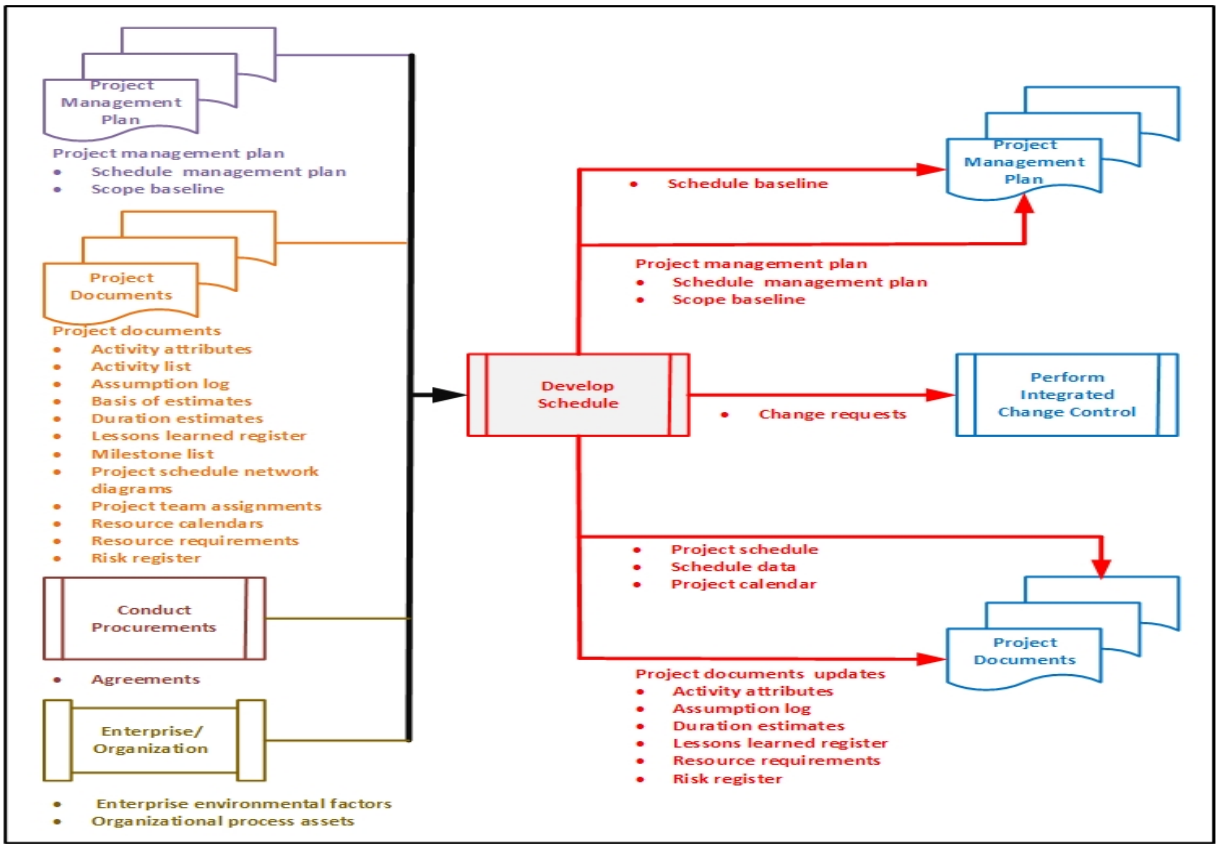

Figure 6.15. Develop Schedule: Data Flow Diagram.

Developing an acceptable project schedule is an iterative process. The schedule model is used to determine the planned start and finish dates for project activities and milestones based on the best available information.

6.6.1. Develop Schedule: Tools and Techniques

1) SCHEDULE NETWORK ANALYSIS

Schedule network analysis is the overarching technique used to generate the project schedule model. It employs several other techniques such as critical path method, resource optimization techniques, and modeling techniques.

2) CRITICAL PATH METHOD

The critical path method is used to estimate the minimum project duration and determine the amount of schedule flexibility on the logical network paths within the schedule model. This schedule network analysis technique calculates the early start, early finish, late start, and late finish dates for all activities without regard for any resource limitations by performing a forward and backward pass analysis through the schedule network, as shown in Figure 6-16. In this example, the longest path includes activities A, C, and D, and therefore the sequence of A-C-D is the critical path. The critical path is the sequence of activities that represents the longest path through a project, which determines the shortest possible project duration. The longest path has the least total float—usually zero. The resulting early and late start and finish dates are not necessarily the project schedule; rather they indicate the time periods within which the activity could be executed, using

the parameters entered in the schedule model for activity durations, logical relationships, leads, lags, and other known constraints. The critical path method is used to calculate the critical path(s) and the amount of total and free float or schedule flexibility on the logical network paths within the schedule model.

3) RESOURCE OPTIMIZATION

Resource optimization is used to adjust the start and finish dates of activities to adjust planned resource use to be equal to or less than resource availability. Examples of resource optimization techniques that can be used to adjust the schedule model due to demand and supply of resources include but are not limited to:

- **Resource leveling.** A technique in which start and finish dates are adjusted based on resource constraints with the goal of balancing the demand for resources with the available supply (Figure 6.17).
- **Resource smoothing.** A technique that adjusts the activities of a schedule model such that the requirements for resources on the project do not exceed certain predefined resource limits.

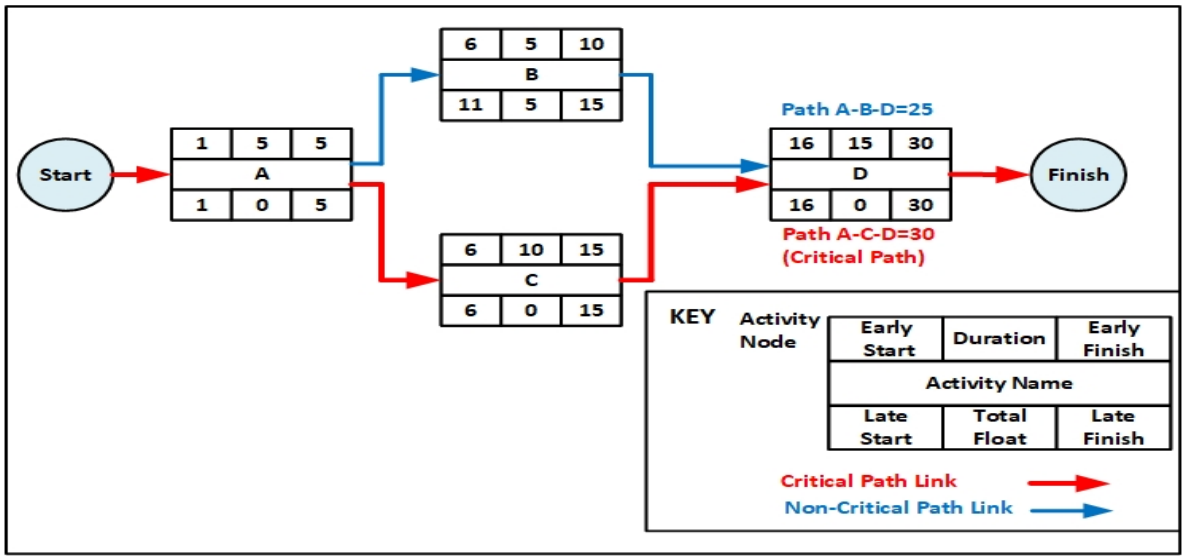

Figure 6.16. Example of Critical Path Method.

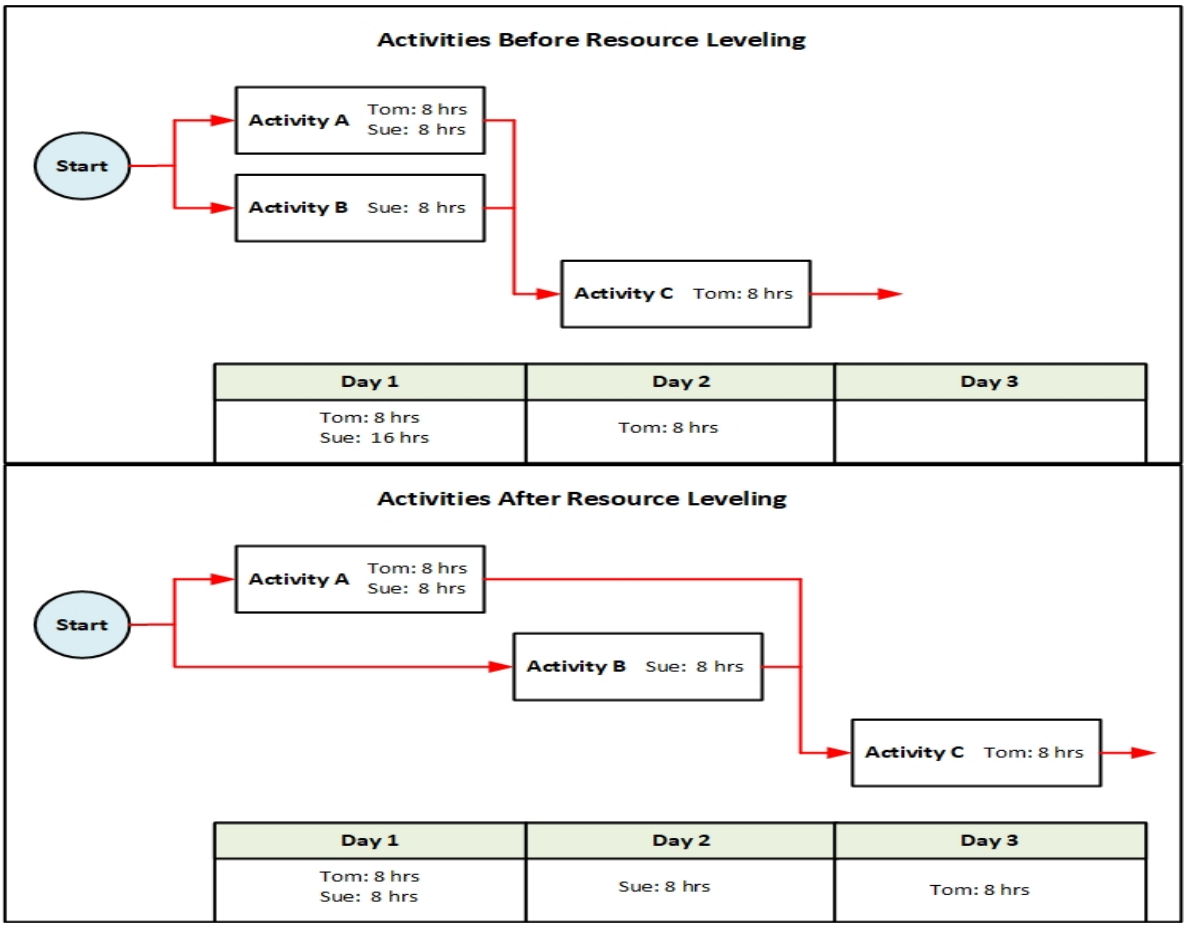

Figure 6.17. Resource Leveling.

4) DATA ANALYSIS

Data analysis techniques that can be used for this process include but are not limited to:

- **What-if scenario analysis.** What-if scenario analysis is the process of evaluating scenarios in order to predict their effect, positive or negative, on project objectives. This is an analysis of the question, "What if the situation represented by scenario X happens?".
- **Simulation.** Simulation models the combined effects of individual project risks and other sources of uncertainty to evaluate their potential impact on achieving project objectives. The most common simulation technique is Monte Carlo analysis, in which risks and other sources of uncertainty are used to calculate possible schedule outcomes for the project.

5) LEADS AND LAGS

Leads and lags are refinements applied during network analysis to develop a viable schedule by adjusting the start time of the successor activities.

6) SCHEDULE COMPRESSION

Schedule compression techniques are used to shorten or accelerate the schedule duration without reducing the project scope in order to meet schedule constraints, imposed dates, or other schedule objectives.

7) PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

Project management information systems include scheduling software that expedites the process of building a schedule model by generating start and finish dates based on the inputs of activities, network diagrams, resources, and activity durations.

8) AGILE RELEASE PLANNING

Agile release planning provides a high-level summary timeline of the release schedule (typically 3 to 6 months) based on the product roadmap and the product vision for the product's evolution.

6.7. Control Schedule

Control Schedule is the process of monitoring the status of the project to update the project schedule and managing changes to the schedule baseline. The key benefit of this process is that the schedule baseline is maintained throughout the project. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 6.18. Figure 6.19 depicts the data flow diagram of the process.

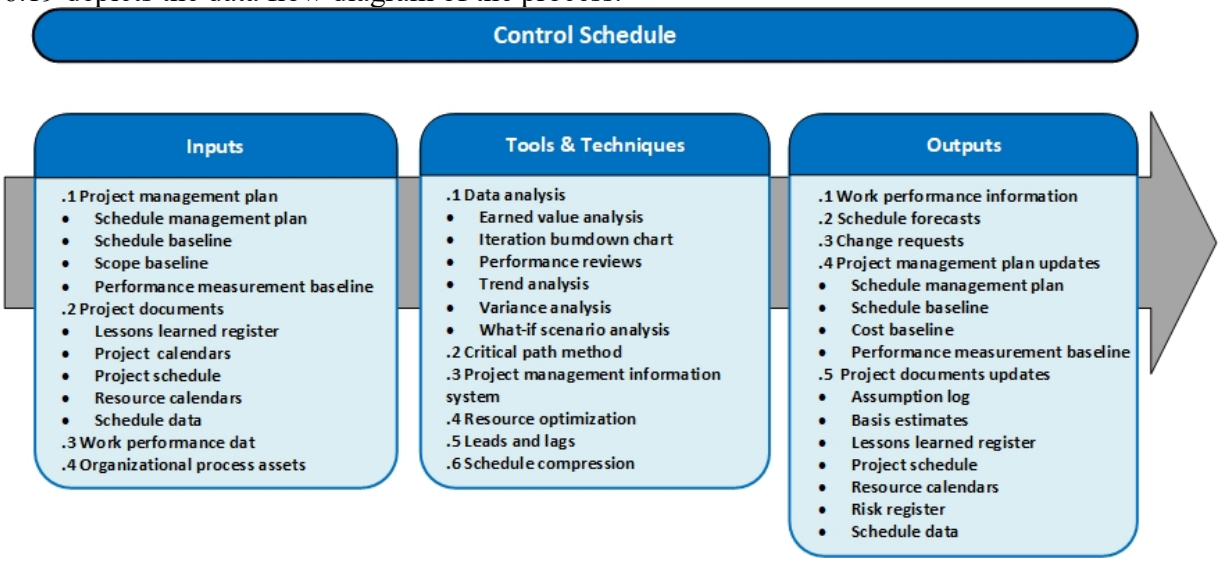

Figure 6.18. Control Schedule: Inputs, Tools & Techniques, and Outputs.

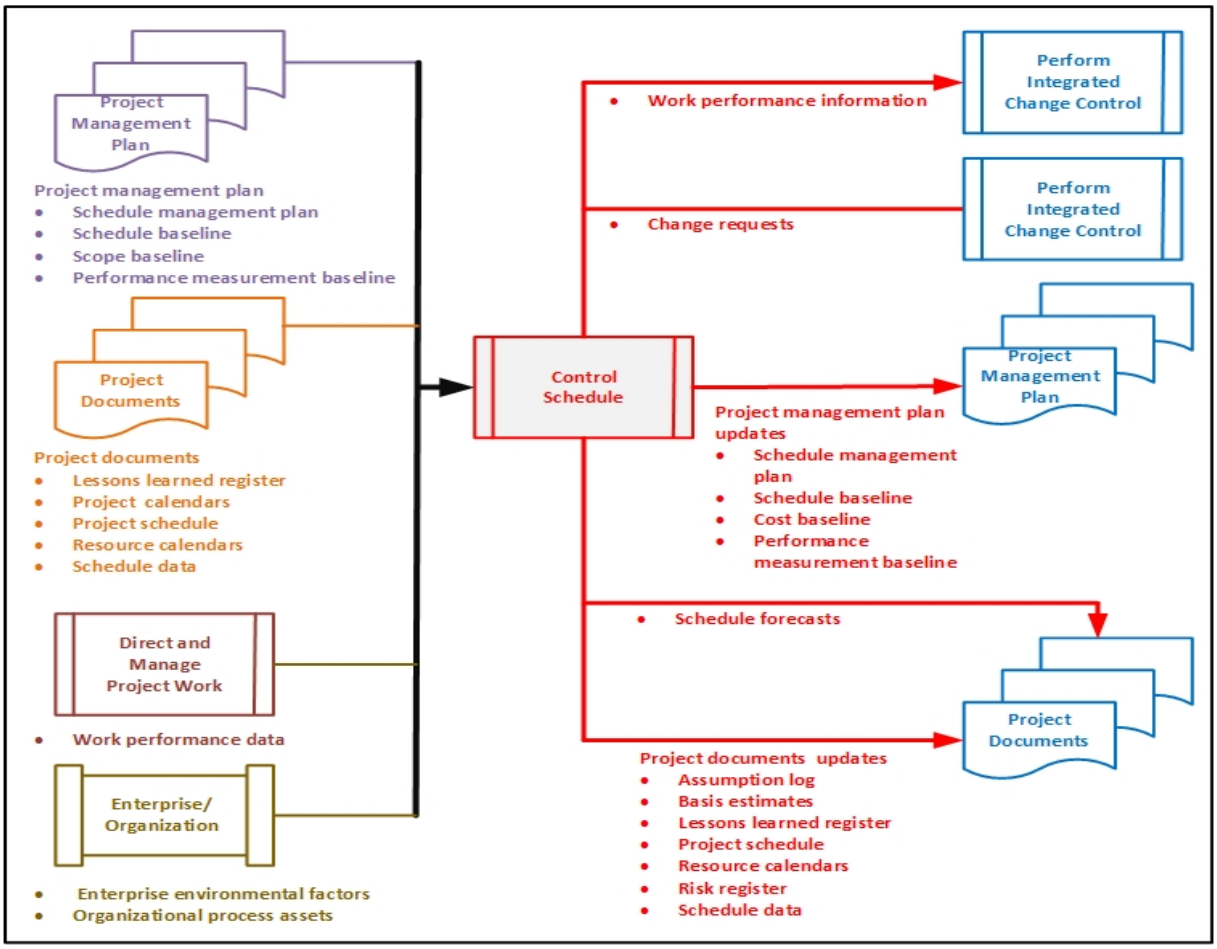

Figure 6.19. Control Schedule: Inputs, Tools & Techniques, and Outputs.

Updating the schedule model requires knowing the actual performance to date. Any change to the schedule baseline can only be approved through the Perform Integrated Change Control process. Control Schedule, as a component of the Perform Integrated Change Control process, is concerned with:

- Determining the current status of the project schedule, Influencing the factors that create schedule changes,
- Reconsidering necessary schedule reserves,
- Determining if the project schedule has changed, and
- Managing the actual changes as they occur.

When work is being contracted, regular and milestone status updates from contractors and suppliers are a means of ensuring the work is progressing as agreed upon to ensure the schedule is under control. Scheduled status reviews and walkthroughs should be done to ensure the contractor reports are accurate and complete.

Questions

1. The schedule management plan establishes:
   A. the planned start and finish dates for all activities
   B. the dependencies for project activities
   C. the units of measure (staff hours, staff days) for project activities
   D. the leads and lags for project activities
2. In the process of define activities we:
   A. Decompose the work packages into a list of activities
   B. Decompose the activities into a list of work packages
   C. Decompose the work packages into a hierarchy of activities
   D. Decompose the activities into a hierarchy of work packages
3. Milestones:
   A. Have zero duration
   B. Are always mandatory
   C. Have a planned start and finish date
   D. Are an input to define activities
4. In the precedence diagramming method, which relationship is most common:
   A. Finish to start
   B. Finish to finish
   C. Start to start
   D. Start to finish
5. Soft logic is another name for:
   A. Discretionary dependency
   B. Mandatory dependency
   C. External dependency
   D. Internal dependency
6. The schedule network diagrams are an output of sequence activities. This output becomes an input to which process?
   A. Estimate activity resources
   B. Estimate activity durations
   C. Develop schedule
   D. Plan schedule management
7. The purpose of estimating activity durations is to get an approximation on:
   A. The amount of time it will take to complete the project
   B. The number of work periods for each activity
   C. the quantity of resources needed for the project
   D. The amount of effort required for each activity
8. Your team is deciding between analogous estimating and parametric estimating to assist with estimating the activity durations. Which of the following is true of analogous estimating compared to parametric estimating?
   A. Analogous is a slower process
   B. Analogous is based on statistics

C. Analogous is generally more costly to develop
D. Analogous is based on one past project

9. All of the following are outputs of estimate activity resources except:
A. Activity resource requirements
B. Activity duration estimates
C. Resource breakdown structure
D. Project documentation updates

10. You are managing a software project. Your QA manager tells you that you need to plan to have her team start their test planning activity so that it finishes just before testing begins. But other than that, she says it can start as late in the project as necessary. What's the relationship between the test planning activity and the testing activity?
A. Start-to-Start (SS)
B. Start-to-Finish (SF)
C. Finish-to-Start (FS)
D. Finish-to-Finish (FF)

11. Which of the following is NOT an input to Develop Schedule?
A. Activity list
B. Project schedule network diagrams
C. Resource calendars
D. Schedule baseline

12. You're managing a construction project. You've decomposed work packages into activities, and your client needs a duration estimate for each activity that you come up with. Which of the following will you use for this?
A. Milestone list
B. Activity list
C. Critical path analysis
D. Project schedule network diagram

13. Which of the following is NOT a tool or technique used in Estimate Activity Durations?
A. SWAG estimation
B. Parametric estimation
C. Analogous estimation
D. Three-point estimation

14. The purpose of schedule compression is to:
A. Shorten the project schedule
B. Obtain a constant use of resources
C. Overlap the project activities
D. Add resources to the critical path

15. The most common type of simulation technique used to develop the schedule is:
A. Earned value method
B. Monte Carlo Analysis
C. Decision tree analysis
D. Expected monetary value

Chapter 7

Project Cost Management

General Objective of the Chapter:

Trainee will be able to describe and understand the process of Project Cost Management**.**

Detailed Objectives:

1. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Plan Cost Management process.
2. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Estimate Costs process.
3. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Determine Budget process.
4. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Control Costs process.

7.1. Overview

Project Cost Management includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget. The Project Cost Management processes are:

- **Plan Cost Management.** The process of defining how the project costs will be estimated, budgeted, managed, monitored, and controlled.
- **Estimate Costs.** The process of developing an approximation of the monetary resources needed to complete project work.
- **Determine Budget.** The process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.
- **Control Costs**. The process of monitoring the status of the project to update the project costs and manage changes to the cost baseline.

Figure 7.1 provides an overview of the Project Cost Management processes. The Project Cost Management processes are presented as discrete processes with defined interfaces. These processes interact with each other and with processes in other Knowledge Areas.

On some projects, especially those of smaller scope, cost estimating and cost budgeting are tightly linked and can be viewed as a single process that can be performed by a single person over a relatively short period of time. They are presented here as distinct processes because the tools and techniques for each are different. The ability to influence cost is greatest at the early stages of the project, making early scope definition critical.

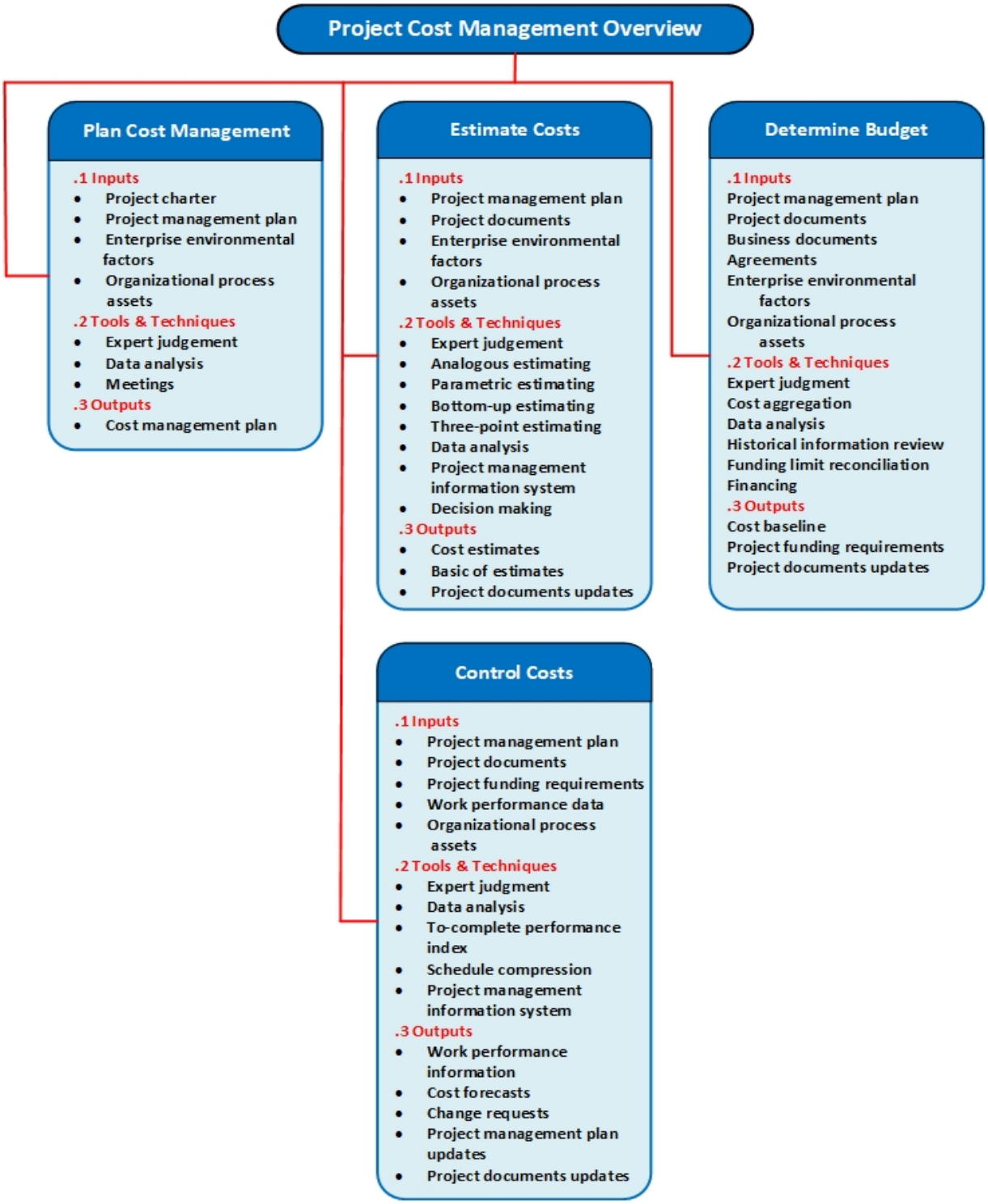

Figure 7.1. Project Cost Management overview.

Project Cost Management is primarily concerned with the cost of the resources needed to complete project activities. Project Cost Management should consider the effect of project decisions on the subsequent recurring cost of using, maintaining, and supporting the product, service, or result of the project. For example, limiting the number of design reviews can reduce the cost of the project but could increase the resulting product's operating costs.

Another aspect of cost management is recognizing that different stakeholders measure project costs in different ways and at different times. For example, the cost of an acquired item may be measured when the acquisition decision is made or committed, the order is placed, the item is delivered, or the actual cost is incurred or recorded for project accounting purposes. In many organizations, predicting and analyzing the prospective financial performance of the project's product is performed outside of the project. In others, such as a capital facilities project, Project Cost Management can include this work. When such predictions and analyses are included, Project Cost Management may address additional processes and numerous general financial management techniques such as return on investment, discounted cash flow, and investment payback analysis.

Because each project is unique, the project manager may need to tailor the way Project Cost Management processes are applied. Considerations for tailoring include but are not limited to:

- **Knowledge management.** Does the organization have a formal knowledge management and financial database repository that a project manager is required to use and that is readily accessible?
- **Estimating and budgeting.** Does the organization have existing formal or informal cost estimating and budgeting-related policies, procedures, and guidelines?
- **Earned value management.** Does the organization use earned value management in managing projects?
- **Use of agile approach.** Does the organization use agile methodologies in managing projects? How does this impact cost estimating?
- **Governance.** Does the organization have formal or informal audit and governance policies, procedures, and guidelines?

7.2. Plan Cost Management

Plan Cost Management is the process of defining how the project costs will be estimated, budgeted, managed, monitored, and controlled. The key benefit of this process is that it provides guidance and direction on how the project costs will be managed throughout the project. This process is performed once or at predefined points in the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 7.2. Figure 7.3 depicts the data flow diagram of the process.

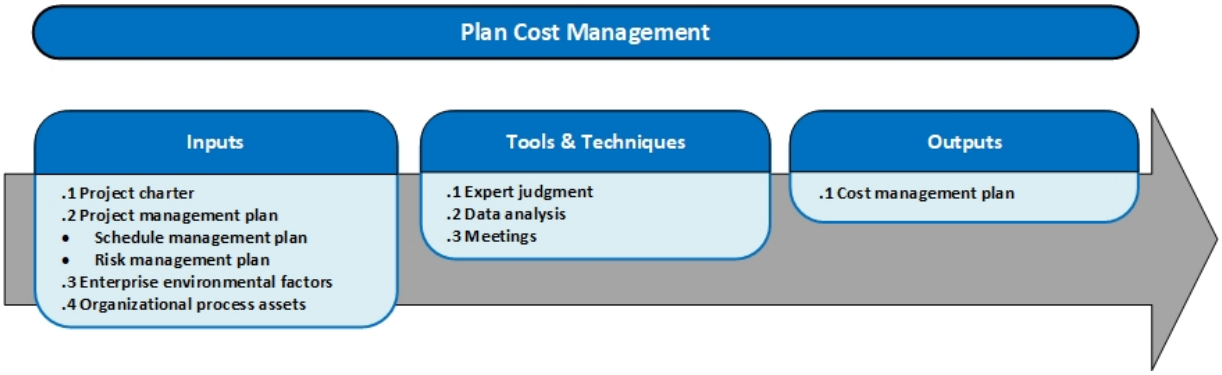

Figure 7.2. Plan Cost Management: Inputs, Tools & Techniques, and Outputs.

The cost management planning effort occurs early in project planning and sets the framework for each of the cost management processes so that performance of the processes will be efficient and coordinated. The cost management processes and their associated tools and techniques are documented in the cost management plan. The cost management plan is a component of the project management plan.

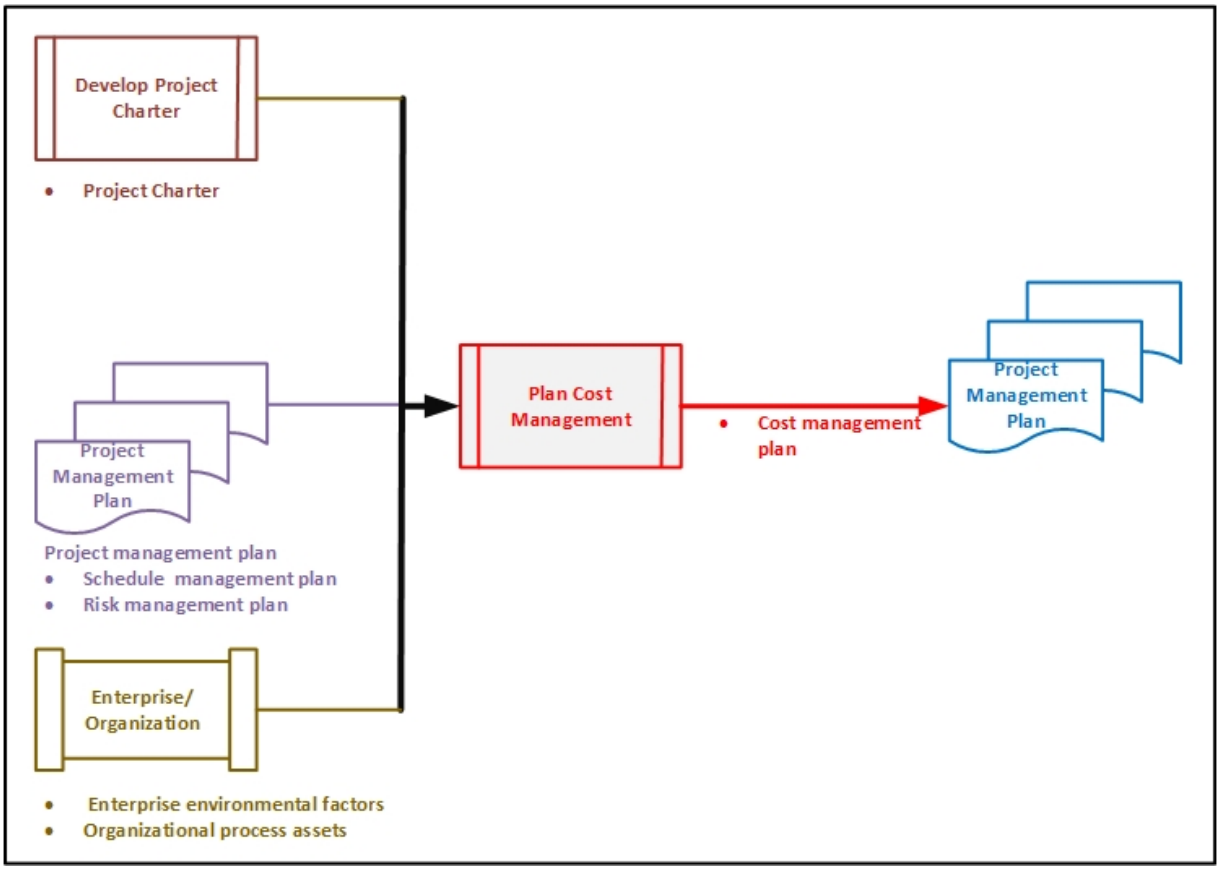

Figure 7.3. Plan Cost Management: Data Flow Diagram.

7.2.1. Plan Cost Management: Inputs

1) PROJECT CHARTER

The project charter provides the preapproved financial resources from which the detailed project costs are developed. The project charter also defines the project approval requirements that will influence the management of the project costs.

2) PROJECT MANAGEMENT PLAN

Project management plan components include but are not limited to:

- **Schedule management plan.** The schedule management plan establishes the criteria and the activities for developing, monitoring, and controlling the schedule.
- **Risk management plan.** The risk management plan provides the approach for identifying, analyzing, and monitoring risks.

3) ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Plan Cost Management process include but are not limited to:

- Organizational culture and structure can influence cost management.
- Market conditions describe what products, services, and results are available in the regional and global markets.
- Currency exchange rates for project costs are sourced from more than one country.

4) ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Plan Cost Management process include but are not limited to:

- Financial controls procedures (e.g., time reporting, required expenditure and disbursement reviews, accounting codes, and standard contract provisions); and
- Historical information and lessons learned repository; Financial databases.

7.2.2. Plan Cost Management: Tools and Techniques

1) EXPERT JUDGMENT

Expertise should be considered from individuals or groups with specialized knowledge or training in the following topics:

- Previous similar projects;
- Information in the industry, discipline, and application area;
- Cost estimating and budgeting; and
- Earned value management.

2) DATA ANALYSIS

A data analysis technique that can be used for this process includes but is not limited to alternatives analysis. Alternatives analysis can include reviewing strategic funding options such as: self-funding, funding with equity, or funding with debt.

3) MEETINGS

Project teams may hold planning meetings to develop the cost management plan.

7.2.3. Plan Cost Management: Outputs

1) COST MANAGEMENT PLAN

The cost management plan is a component of the project management plan and describes how the project costs will be planned, structured, and controlled. The cost management processes and their

associated tools and techniques are documented in the cost management plan. For example, the cost management plan can establish the following:

- **Units of measure.** Each unit used in measurements (such as staff hours, staff days, or weeks for time measures; meters, liters, tons, kilometers, or cubic yards for quantity measures; or lump sum in currency form) is defined for each of the resources.
- **Level of precision.** This is the degree to which cost estimates will be rounded up or down, based on the scope of the activities and magnitude of the project.
- **Level of accuracy.** The acceptable range (e.g., ±10%) used in determining realistic cost estimates is specified, and may include an amount for contingencies.
- **Organizational procedures links.** The work breakdown structure (WBS) provides the framework for the cost management plan, allowing for consistency with the estimates, budgets, and control of costs.
- **Control thresholds.** Variance thresholds for monitoring cost performance may be specified to indicate an agreed-upon amount of variation to be allowed before some action needs to be taken.
- **Rules of performance measurement.** Earned value management (EVM) rules of performance measurement are set. For example, the cost management plan may:
    - Define the points in the WBS at which measurement of control accounts will be performed;
    - Establish the EVM techniques (e.g., weighted milestones, fixed-formula, percent complete, etc.) to be employed; and
    - Specify tracking methodologies and the EVM computation equations for calculating projected estimate at completion (EAC) forecasts to provide a validity check on the bottom-up EAC.
- **Reporting formats.** The formats and frequency for the various cost reports are defined.
- **Additional details.** Additional details about cost management activities include but are not limited to:
    - Description of strategic funding choices,
    - Procedure to account for fluctuations in currency exchange rates, and
    - Procedure for project cost recording.

7.3. Estimate Costs

Estimate Costs is the process of developing an approximation of the cost of resources needed to complete project work. The key benefit of this process is that it determines the monetary resources required for the project. This process is performed periodically throughout the project as needed. The inputs, tools and techniques, and outputs of this process are depicted in Figure 7.4. Figure 7.5 depicts the data flow diagram of the process.

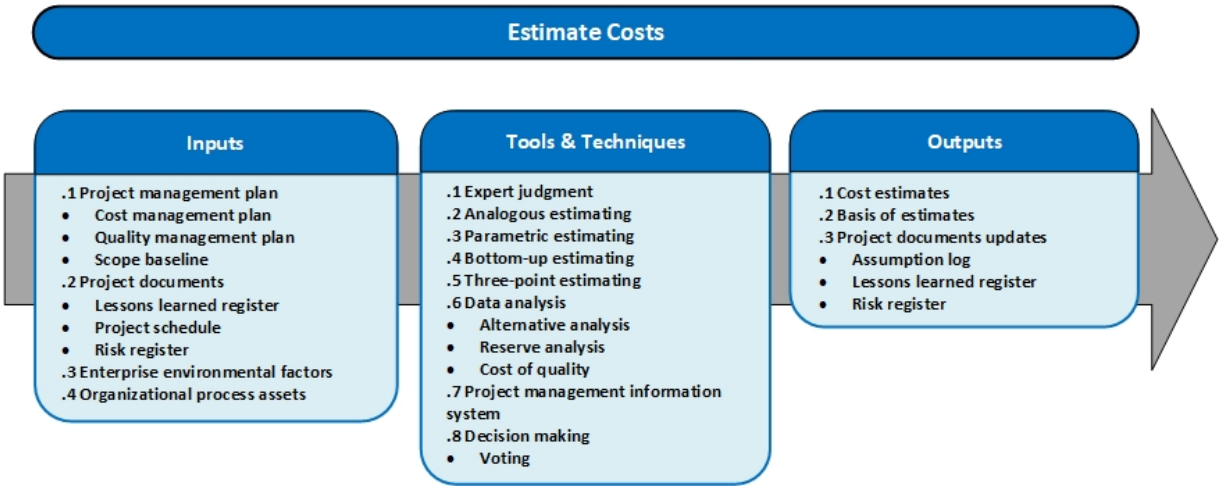

Figure 7.4. Estimate Costs: Inputs, Tools & Techniques, and Outputs.

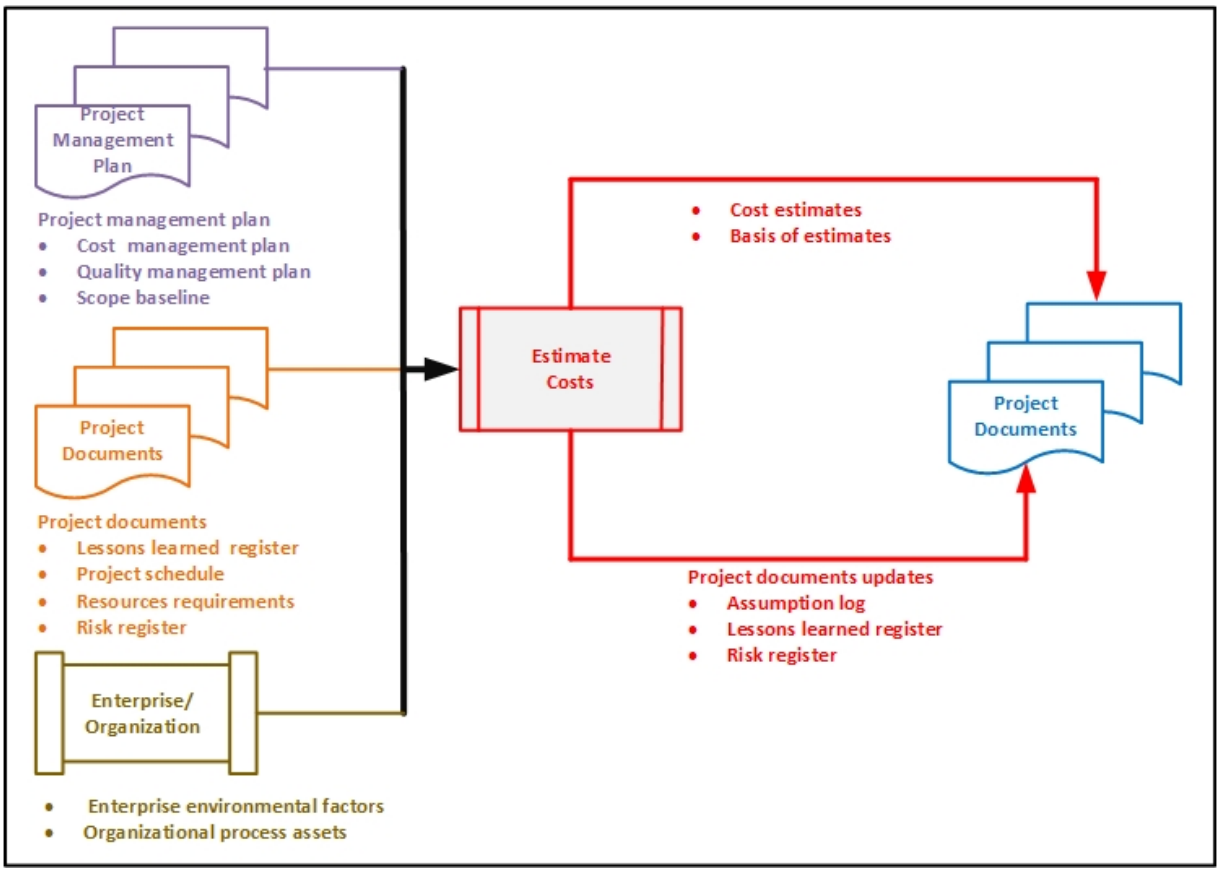

Figure 7.5. Estimate Costs: Data Flow Diagram.

7.3.1. Estimate Costs: Inputs

1) PROJECT MANAGEMENT PLAN

Project management plan components include but are not limited to:

- **Cost management plan.** The cost management plan describes estimating methods that can be used and the level of precision and accuracy required for the cost estimate.
- **Quality management plan.** The quality management plan describes the activities and resources necessary for the project management team to achieve the quality objectives set for the project.
- **Scope baseline.** The scope baseline includes the project scope statement, WBS, and WBS dictionary.

2) PROJECT DOCUMENTS

Project documents that can be considered as inputs for this process include but are not limited to:

- **Lessons learned register.** Lessons learned earlier in the project with regard to developing cost estimates can be applied to later phases in the project to improve the accuracy and precision of the cost estimates.
- **Project schedule.** The schedule includes the type, quantity, and amount of time that team and physical resources will be active on the project. The duration estimates will affect cost estimates when resources are charged per unit of time and when there are seasonal fluctuations in costs.
- **Resource requirements.** Resource requirements identify the types and quantities of resources required for each work package or activity.
- **Risk register.** The risk register contains details of individual project risks that have been identified and prioritized, and for which risk responses are required.

3) ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Estimate Costs process include but are not limited to:

- **Market conditions.** These conditions describe what products, services, and results are available in the market, from whom, and under what terms and conditions.
- **Published commercial information.** Resource cost rate information is often available from commercial databases that track skills and human resource costs, and provide standard costs for material and equipment.
- **Exchange rates and inflation.** For large-scale projects that extend multiple years with multiple currencies, the fluctuations of currencies and inflation need to be understood and built into the Estimate Cost process.

4) ORGANIZATIONALPROCESS ASSETS

The organizational process assets that can influence the Estimate Costs process include but are not limited to:

- Cost estimating policies,
- Cost estimating templates,
- Historical information and lessons learned repository.

7.3.2. Estimate Costs: Tools and Techniques

1) EXPERT JUDGMENT

Expertise should be considered from individuals or groups with specialized knowledge or training in the following topics:

- Previous similar projects;
- Information in the industry, discipline, and application area; and
- Cost estimating methods.

2) ANALOGOUS ESTIMATING

Analogous cost estimating uses values, or attributes, of a previous project that are similar to the current project. Values and attributes of the projects may include but are not limited to: scope, cost, budget, duration, and measures of scale (e.g., size, weight).

3) PARAMETRIC ESTIMATING

Parametric estimating uses a statistical relationship between relevant historical data and other variables (e.g., square footage in construction) to calculate a cost estimate for project work.

4) BOTTOM-UP ESTIMATING

Bottom-up estimating is a method of estimating a component of work. The cost of individual work packages or activities is estimated to the greatest level of specified detail.

5) THREE-POINT ESTIMATING

The accuracy of single-point cost estimates may be improved by considering estimation uncertainty and risk and using three estimates to define an approximate range for an activity's cost:

- **Most likely (cM).** The cost of the activity, based on realistic effort assessment for the required work and any predicted expenses.
- **Optimistic (cO).** The cost based on analysis of the best-case scenario for the activity.
- **Pessimistic (cP).** The cost based on analysis of the worst-case scenario for the activity.

Depending on the assumed distribution of values within the range of the three estimates, the expected cost, cE, can be calculated using a formula. Two commonly used formulas are triangular and beta distributions. The formulas are:

- **Triangular distribution.** $cE = (cO + cM + cP) / 3$
- **Beta distribution.** $cE = (cO + 4cM + cP) / 6$

Cost estimates based on three points with an assumed distribution provide an expected cost and clarify the range of uncertainty around the expected cost.

6) DATA ANALYSIS

Data analysis techniques that can be used in the Estimate Costs process include but are not limited to:

- **Alternatives analysis.** Alternatives analysis is a technique used to evaluate identified options in order to select which options or approaches to use to execute and perform the work of the project.
- **Reserve analysis.** Cost estimates may include contingency reserves (sometimes called contingency allowances) to account for cost uncertainty. Contingency reserves are the budget within the cost baseline that is allocated for identified risks.
- **Cost of quality.** Assumptions about costs of quality may be used to prepare the estimates. This includes evaluating the cost impact of additional investment in conformance versus the cost of nonconformance.

7) PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

The project management information system can include spreadsheets, simulation software, and statistical analysis tools to assist with cost estimating.

8) DECISION MAKING

The decision-making techniques that can be used in the Estimate Costs process include but are not limited to voting.

7.3.3. Estimate Costs: Outputs

1) COST ESTIMATES

Cost estimates include quantitative assessments of the probable costs required to complete project work, as well as contingency amounts to account for identified risks, and management reserve to cover unplanned work.

2) BASIS OF ESTIMATES

The amount and type of additional details supporting the cost estimate vary by application area. Regardless of the level of detail, the supporting documentation should provide a clear and complete understanding of how the cost estimate was derived. Supporting detail for cost estimates may include:

- Documentation of the basis of the estimate (i.e., how it was developed),
- Documentation of all assumptions made,
- Documentation of any known constraints, Documentation of identified risks included when estimating costs,
- Indication of the range of possible estimates (e.g., US$10,000 (±10%) to indicate that the item is expected to cost between a range of values), and
- Indication of the confidence level of the final estimate.

3) PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- **Assumption log.** During the Cost Estimates process, new assumptions may be made, new constraints may be identified, and existing assumptions or constraints may be revisited and changed.
- **Lessons learned register.** The lessons learned register can be updated with techniques that were efficient and effective in developing cost estimates.
- **Risk register.** The risk register may be updated when appropriate risk responses are chosen and agreed upon during the Estimate Cost process.

7.4. Determine Budget

Determine Budget is the process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline. The key benefit of this process is that it determines the cost baseline against which project performance can be monitored and controlled. This process is performed once or at predefined points in the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 7.6. Figure 7.7 depicts the data flow diagram of the process.

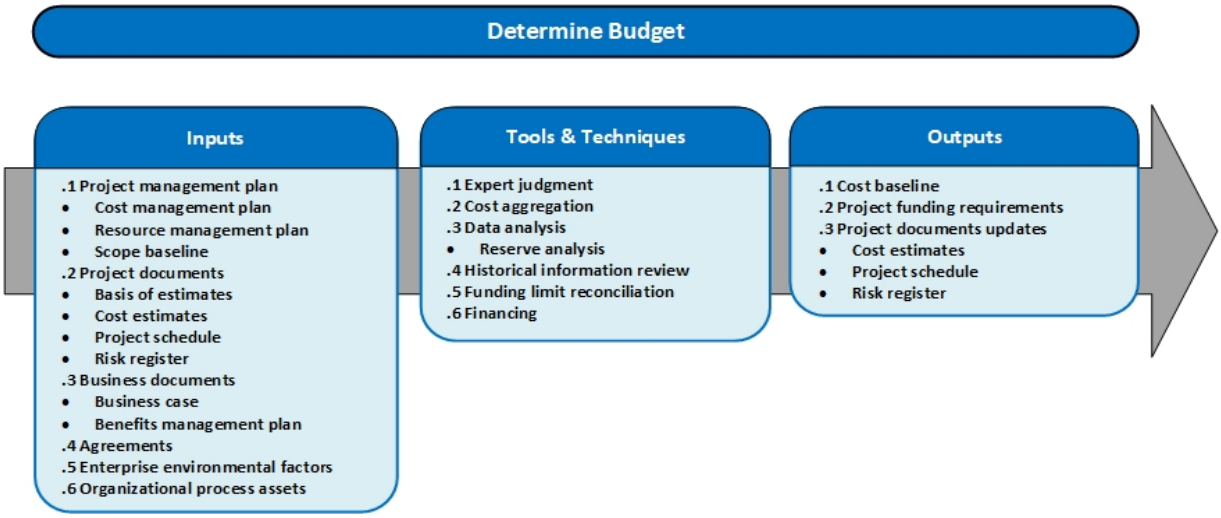

Figure 7.6. Determine Budget: Inputs, Tools & Techniques, and Outputs.

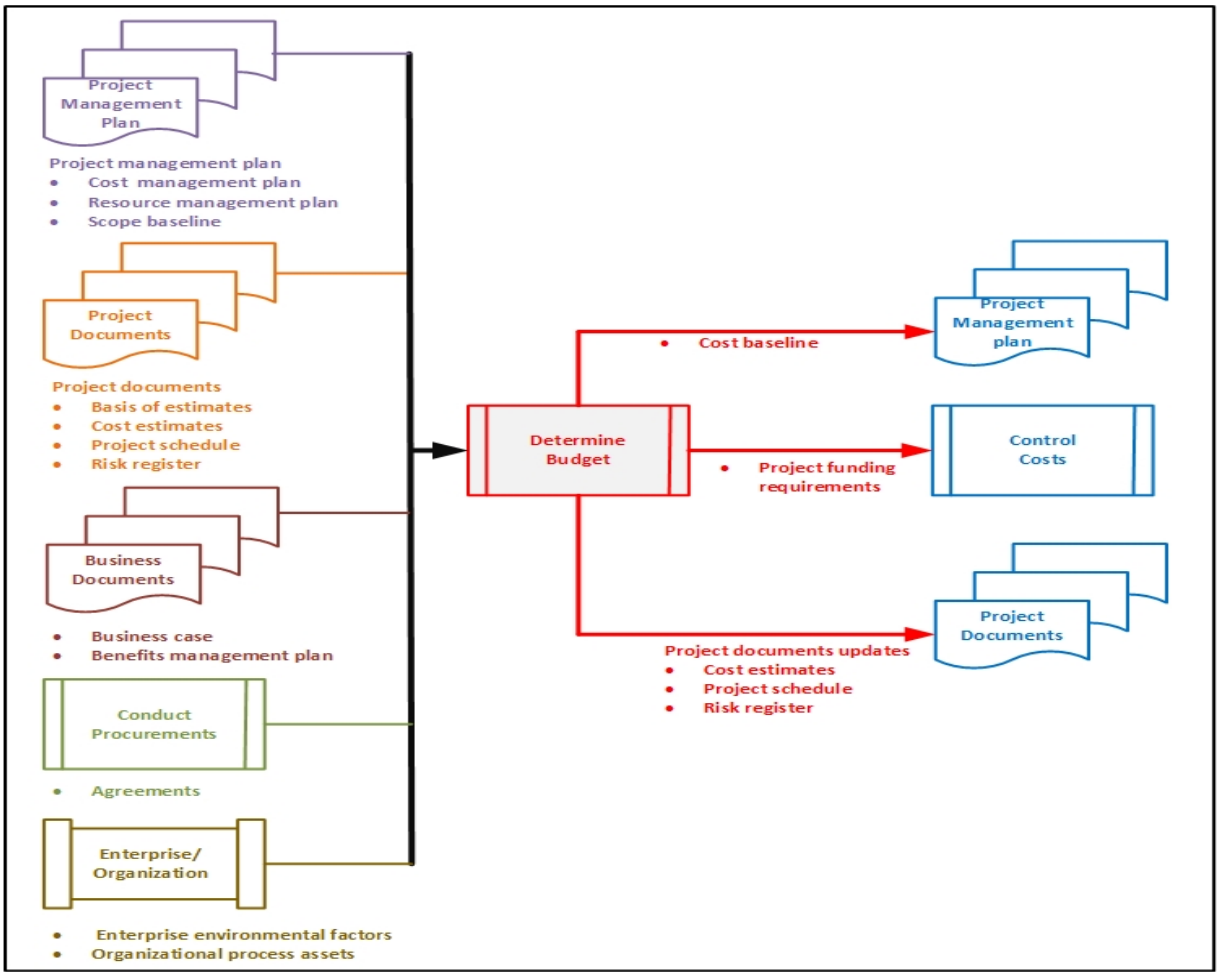

Figure 7.7. Determine Budget: Data Flow Diagram.

7.4.1. Determine Budget: Inputs

1) PROJECT MANAGEMENT PLAN

Project management plan components include but are not limited to:

- **Cost management plan.** The cost management plan describes how the project costs will be structured into the project budget.
- **Resource management plan.** The resource management plan provides information on rates (personnel and other resources), estimation of travel costs, and other foreseen costs that are necessary to estimate the overall project budget.
- **Scope baseline.** The scope baseline includes the project scope statement, WBS, and WBS dictionary details for cost estimation and management.

2) PROJECT DOCUMENTS

Examples of project documents that can be considered as inputs for this process include but are not limited to:

- **Basis of estimates.** Supporting detail for cost estimates contained in the basis for estimates should specify any basic assumptions dealing with the inclusion or exclusion of indirect or other costs in the project budget.
- **Cost estimates.** Cost estimates for each activity within a work package are aggregated to obtain a cost estimate for each work package.
- **Project schedule.** The project schedule includes planned start and finish dates for the project's activities, milestones, work packages, and control accounts.
- **Risk register.** The risk register should be reviewed to consider how to aggregate the risk response costs. Updates to the risk register are included with project documents updates.

3) BUSINESS DOCUMENTS

The business documents that can be considered as inputs for this process include but are not limited to:

- **Business case.** The business case identifies the critical success factors for the project, including financial success factors.
- **Benefits management plan.** The benefits management plan includes the target benefits, such as net present value calculations, timeframe for realizing benefits, and the metrics associated with the benefits.

4) AGREEMENTS

Applicable agreement information and costs relating to products, services, or results that have been or will be purchased are included when determining the budget.

5) ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Estimate Costs process include but are not limited to exchange rates.

6) ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Determine Budget process include but are not limited to:

- Existing formal and informal cost budgeting-related policies, procedures, and guidelines;
- Historical information and lessons learned repository.
- Cost budgeting tools; and
- Reporting methods.

7.4.2. Determine Budget: Tools and Techniques

1) EXPERT JUDGMENT

Expertise should be considered from individuals or groups with specialized knowledge or training in the following topics:

- Previous similar projects;
- Information in the industry, discipline, and application area;
- Financial principles; and
- Funding requirement and sources.

2) COST AGGREGATION

Cost estimates are aggregated by work packages in accordance with the WBS. The work package cost estimates are then aggregated for the higher component levels of the WBS.

3) DATA ANALYSIS

A data analysis technique that can be used in the Determine Budget process includes but is not limited to reserve analysis, which can establish the management reserves for the project. Management reserves are an amount of the project budget withheld for management control purposes and are reserved for unforeseen work that is within scope of the project

4) HISTORICAL INFORMATION REVIEW

Reviewing historical information can assist in developing parametric estimates or analogous estimates. Historical information may include project characteristics (parameters) to develop mathematical models to predict total project costs.

5) FUNDING LIMIT RECONCILIATION

The expenditure of funds should be reconciled with any funding limits on the commitment of funds for the project. A variance between the funding limits and the planned expenditures will sometimes necessitate the rescheduling of work to level out the rate of expenditures

6) FINANCING

Financing entails acquiring funding for projects. It is common for long-term infrastructure, industrial, and public services projects to seek external sources of funds.

7.4.3. Determine Budget: Outputs

1) COST BASELINE

The cost baseline is the approved version of the time-phased project budget, excluding any management reserves, which can only be changed through formal change control procedures.

2) PROJECT FUNDING REQUIREMENTS

Total funding requirements and periodic funding requirements (e.g., quarterly, annually) are derived from the cost baseline.

3) PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- **Cost estimates.** Cost estimates are updated to record any additional information.
- **Project schedule.** Estimated costs for each activity may be recorded as part of the project schedule.
- **Risk register.** New risks identified during this process are recorded in the risk register and managed using the risk management processes.

7.5. Control Costs

Control Costs is the process of monitoring the status of the project to update the project costs and managing changes to the cost baseline. The key benefit of this process is that the cost baseline is maintained throughout the project. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in Figure 7.8. Figure 7.9 depicts the data flow diagram of the process.

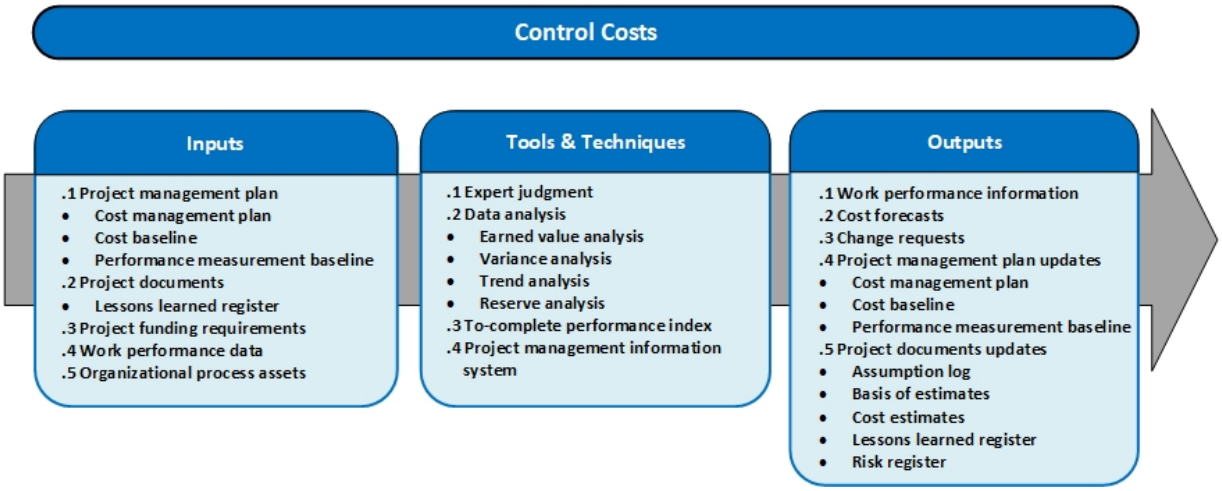

Figure 7.8. Control Costs: Inputs, Tools & Techniques, and Outputs.

Updating the budget requires knowledge of the actual costs spent to date. Any increase to the authorized budget can only be approved through the Perform Integrated Change Control process. Monitoring the expenditure of funds without regard to the value of work being accomplished for such expenditures has little value to the project, other than to track the outflow of funds. Much of the effort of cost control involves analyzing the relationship between the consumption of project funds and the work being accomplished for such expenditures.

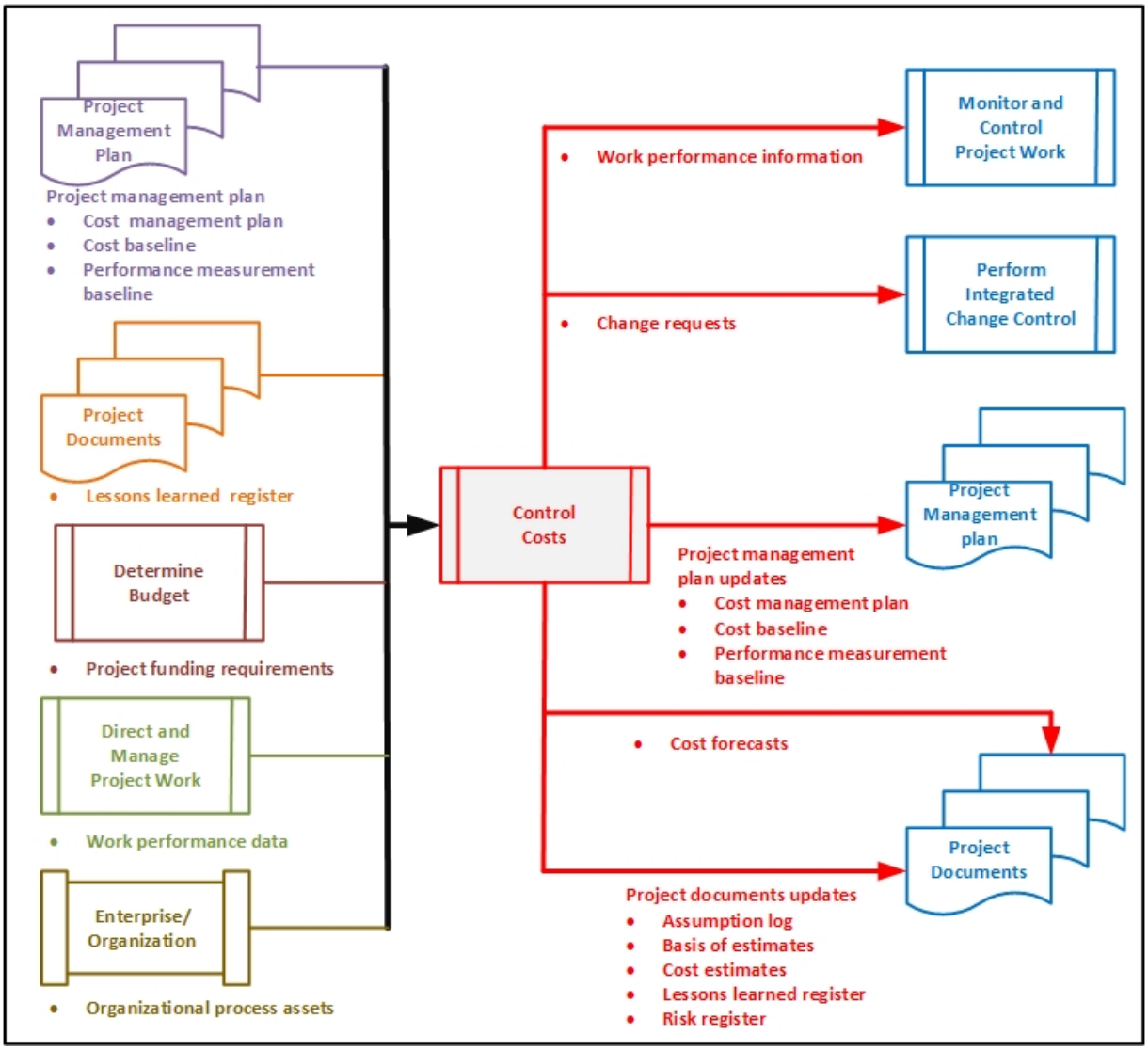

Figure 7.9. Control Costs: Data Flow Diagram.

7.5.1. Control Costs: Inputs

1) PROJECT MANAGEMENT PLAN

Project management plan components include but are not limited to:

- **Cost management plan.** The cost management plan describes how the project costs will be managed and controlled.
- **Cost baseline.** The cost baseline is compared with actual results to determine if a change, corrective action, or preventive action is necessary.
- **Performance measurement baseline.** When using earned value analysis, the performance measurement baseline is compared to actual results to determine if a change, corrective action, or preventive action is necessary.

2) PROJECT DOCUMENTS

Examples of project documents that can be considered as inputs for this process include but are not limited to the lessons learned register. Lessons learned earlier in the project can be applied to later phases in the project to improve cost control.

3) PROJECT FUNDING REQUIREMENTS

The project funding requirements include projected expenditures plus anticipated liabilities.

4) WORK PERFORMANCE DATA

Work performance data contains data on project status such as which costs have been authorized, incurred, invoiced, and paid.

5) ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Control Costs process include but are not limited to:

- Existing formal and informal cost control-related policies, procedures, and guidelines;
- Cost control tools; and
- Monitoring and reporting methods to be used.

7.5.2. Control Costs: Tools and Techniques

1) EXPERT JUDGMENT

Examples of expert judgment during the Control Costs process include but are not limited to:

- Variance analysis,
- Earned value analysis,
- Forecasting, and
- Financial analysis

2) DATA ANALYSIS

Data analysis techniques that can be used to control costs include but are not limited to:

- **Earned value analysis (EVA).** Earned value analysis compares the performance measurement baseline to the actual schedule and cost performance. EVM develops and monitors three key dimensions for each work package and control account:
  - *Planned value*. Planned value (PV) is the authorized budget assigned to scheduled work. It is the authorized budget planned for the work to be accomplished for an activity or work breakdown structure (WBS) component, not including management reserve. The total of the PV is sometimes referred to as the performance measurement baseline (PMB). The total planned value for the project is also known as budget at completion (BAC).
  - *Earned value*. Earned value (EV) is a measure of work performed expressed in terms of the budget authorized for that work. It is the budget associated with the authorized work that has been completed. The EV being measured needs to be related to the PMB, and the EV measured cannot be greater than the authorized PV budget for a component.
  - *Actual cost*. Actual cost (AC) is the realized cost incurred for the work performed on an activity during a specific time period. It is the total cost incurred in accomplishing the work that the EV measured. The AC needs to correspond in definition to what was budgeted in the PV and measured in the EV.

- **Variance analysis.** Variance analysis, as used in EVM, is the explanation (cause, impact, and corrective actions) for cost (CV = EV – AC), schedule (SV = EV – PV), and variance at completion (VAC = BAC – EAC) variances. Cost and schedule variances are the most frequently analyzed measurements. The percentage range of acceptable variances will tend to decrease as more work is accomplished. Examples of variance analysis include but are not limited to:
  - *Schedule variance*. Schedule variance (SV) is a measure of schedule performance expressed as the difference between the earned value and the planned value. It is the amount by which the project is ahead or behind the planned delivery date, at a given point in time. It is a measure of schedule performance on a project. The EVA schedule variance is a useful metric in that it can indicate when a project is falling behind or is ahead of its baseline schedule. The EVA schedule variance will ultimately equal zero when the project is completed because all of the planned values will have been earned. Schedule variance is best used in conjunction with critical path method (CPM) scheduling and risk management.
    Equation: $\mathrm{SV} = \mathrm{EV} - \mathrm{PV}$.
  - *Cost variance*. Cost variance (CV) is the amount of budget deficit or surplus at a given point in time, expressed as the difference between earned value and the actual cost. It is a measure of cost performance on a project. The cost variance at the end of the project will be the difference between the budget at completion (BAC) and the actual amount spent. The CV is particularly critical because it indicates the relationship of physical performance to the costs spent. Negative CV is often difficult for the project to recover.
    Equation: $CV = EV - AC$.
  - *Schedule performance index*. The schedule performance index (SPI) is a measure of schedule efficiency expressed as the ratio of earned value to planned value. It measures how efficiently the project team is accomplishing the work. It is sometimes used in conjunction with the cost performance index (CPI) to forecast the final project completion estimates. An SPI value less than 1.0 indicates less work was completed than was planned. An SPI greater than 1.0 indicates that more work was completed than was planned.
    Equation: $SPI = EV/PV$.
  - *Cost performance index*. The cost performance index (CPI) is a measure of the cost efficiency of budgeted resources, expressed as a ratio of earned value to actual cost. It is considered the most critical EVA metric and measures the cost efficiency for the work completed. A CPI value of less than 1.0 indicates a cost overrun for work completed. A CPI value greater than 1.0 indicates a cost underrun of performance to date.
    Equation: $CPI = EV/AC$.
- **Trend analysis.** Trend analysis examines project performance over time to determine if performance is improving or deteriorating. Graphical analysis techniques are valuable for understanding performance to date and for comparison to future performance goals in the form of BAC versus estimate at completion (EAC) and completion dates. Examples of the trend analysis techniques include but are not limited to:

- *Charts*. In earned value analysis, three parameters of planned value, earned value, and actual cost can be monitored and reported on both a period-by-period basis (typically weekly or monthly) and on a cumulative basis.
- *Forecasting*. As the project progresses, the project team may develop a forecast for the estimate at completion (EAC) that may differ from the budget at completion (BAC) based on the project performance. If it becomes obvious that the BAC is no longer viable, the project manager should consider the forecasted EAC.

EACs are typically based on the actual costs incurred for work completed, plus an estimate to complete (ETC) the remaining work. The most common EAC forecasting approach is a manual, bottom-up summation by the project manager and project team.
Equation: $EAC = AC + Bottom-up\ ETC$.

- **Reserve analysis.** During cost control, reserve analysis is used to monitor the status of contingency and management reserves for the project to determine if these reserves are still needed or if additional reserves need to be requested.

3) TO-COMPLETE PERFORMANCE INDEX

The to-complete performance index (TCPI) is a measure of the cost performance that is required to be achieved with the remaining resources in order to meet a specified management goal, expressed as the ratio of the cost to finish the outstanding work to the remaining budget. TCPI is the calculated cost performance index that is achieved on the remaining work to meet a specified management goal, such as the BAC or the EAC.
The equation for the TCPI based on the BAC: (BAC – EV) / (BAC – AC).
The equation for the TCPI is based on the EAC: (BAC – EV) / (EAC – AC).

4) PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

Project management information systems are often used to monitor the three EVM dimensions (PV, EV, and AC), to display graphical trends, and to forecast a range of possible final project results.

7.5.3. Control Costs: Outputs

1) WORK PERFORMANCE INFORMATION

Work performance information includes information on how the project work is performing compared to the cost baseline. Variances in the work performed and the cost of the work are evaluated at the work package level and control account level. For projects using earned value analysis, CV, CPI, EAC, VAC, and TCPI are documented for inclusion in work performance reports.

2) COST FORECASTS

Either a calculated EAC value or a bottom-up EAC value is documented and communicated to stakeholders.

3) CHANGE REQUESTS

Analysis of project performance may result in a change request to the cost and schedule baselines or other components of the project management plan. Change requests are processed for review and disposition through the Perform Integrated Change Control process.

4) PROJECT MANAGEMENT PLAN UPDATES

Any change to the project management plan goes through the organization's change control process via a change request. Components that may require a change request for the project management plan include but are not limited to:

- **Cost management plan.** Changes to the cost management plan, such as changes to control thresholds or specified levels of accuracy required in managing the project's cost, are incorporated in response to feedback from relevant stakeholders.
- **Cost baseline.** Changes to the cost baseline are incorporated in response to approved changes in scope, resources, or cost estimates
- **Performance measurement baseline.** Changes to the performance measurement baseline are incorporated in response to approved changes in scope, schedule performance, or cost estimates.

5) PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- **Assumption log.** Cost performance may indicate the need to revise assumptions on resource productivity and other factors influencing cost performance.
- **Basis of estimates.** Cost performance may indicate the need to revisit the original basis of estimates.
- **Cost estimates.** Cost estimates may need to be updated to reflect the actual cost efficiency for the project.
- **Lessons learned register.** The lessons learned register can be updated with techniques that were effective in maintaining the budget, variance analysis, earned value analysis, forecasting, and corrective actions that were used to respond to cost variances.
- **Risk register.** The risk register may be updated if the cost variances have crossed, or are likely to cross, the cost threshold.

Questions

1. You are managing a project for a company that has previously done three projects that were similar to it. You consult with the cost baselines, lessons learned, and project managers from those projects, and use that information to come up with your cost estimate. What technique are you using?
   A. Parametric estimating
   B. Net present value
   C. Rough order of magnitude estimation
   D. Analogous estimating
2. Weighted milestones, percent complete, etc., are techniques used in:
   A. units of measure
   B. levels of precision
   C. levels of accuracy
   D. earned value measurement
3. All estimates must be within +/- 20 %is an example of:
   A. control thresholds
   B. levels of precision
   C. levels of accuracy
   D. earned value measurement
4. Currency exchange rates are an example of:
   A. units of measure
   B. enterprise environmental factors
   C. levels of accuracy
   D. organizational process assets
5. You are managing a software project when one of your stakeholders needs to make a change that will affect the budget. You follow the procedures to implement the change. Which of the following must get updated to reflect the change?
   A. Project Management plan
   B. Project cost baseline
   C. Cost change control system
   D. Project performance reviews
6. All of the following are tools and techniques of estimate costs except:
   A. cost of quality
   B. project management software
   C. vendor bid analysis
   D. benefit cost analysis
7. The total value of the control accounts is equal to:
   A. value of work package cost estimates plus value of contingency reserve
   B. value of the cost baseline plus the value of the management reserve
   C. value of the activity cost estimates plus the value of the activity contingency reserve
   D. value of the work package cost estimates plus value of the activity contingency reserve
8. Cost aggregation results in:

A. cost estimates allocated to each activity
B. cost estimates allocated to each work package
C. cost estimates added together to create an estimate for the entire project
D. cost estimates added together to create an estimate for the product life cycle

9. The project budget is equal to:
A. value of work package cost estimates plus value of contingency reserve
B. value of the cost baseline plus the value of the management reserve
C. value of the activity cost estimates plus the value of the activity contingency reserve
D. value of the work package cost estimates plus value of the activity contingency reserve

10. The project funding requirements should equal:
A. the cost baseline
B. value of work package cost estimates plus value of contingency reserve
C. the cost baseline plus the management reserve
D. the cost baseline plus the contingency reserve

11. Your management has approved a contingency reserve for the project. There seems to be some confusion between contingency reserve and management reserve. You explain that management reserve is:
A. the difference between the maximum funding and the top end of the cost baseline
B. the same as contingency reserve
C. part of the cost baseline
D. under the discretion of the project manager

12. You're working on a project that has an EV of $7,362 and a PV (BCWS) of $8,232. What's your SV?
A. –$870
B. $870
C. 0.89
D. Not enough information to tell

13. You are working on a project with a PV of $56,733 and an SPI of 1.2. What's the earned value of your project?
A. $68,079.60
B. $47,277.50
C. $68,733
D. .72

14. You are working on a project with an SPI of .72 and a CPI of 1.1. Which of the following BEST describes your project?
A. Your project is ahead of schedule and under budget.
B. Your project is behind schedule and over budget.
C. Your project is behind schedule and under budget.
D. Your project is ahead of schedule and over budget.

15. Your project has a BAC of $4,522 and is 13% complete. What is the earned value (EV)?
A. $3,934.14
B. There is not enough information to answer.
C. $587.86
D. $4,522

Chapter 8

Project Quality Management

General Objective of the Chapter:

Trainee will be able to describe and understand the process of Project Quality Management**.**

Detailed Objectives:

1. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Plan Quality Management process.
2. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Manage Quality process.
3. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Control Quality process.

8.1. Overview

Project Quality Management includes the processes for incorporating the organization's quality policy regarding planning, managing, and controlling project and product quality requirements in order to meet stakeholders' objectives. Project Quality Management also supports continuous process improvement activities as undertaken on behalf of the performing organization. The Project Quality Management processes are:

- **Plan Quality Management.** 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.
- **Manage Quality.** The process of translating the quality management plan into executable quality activities that incorporate the organization's quality policies into the project.
- **Control Quality.** The process of monitoring and recording the results of executing the quality management activities to assess performance and ensure the project outputs are complete, correct, and meet customer expectations.

Figure 8.1 provides an overview of the Project Quality Management processes.

The Plan Quality Management process is concerned with the quality that the work needs to have. Manage Quality is concerned with managing the quality processes throughout the project. During the Manage Quality process, quality requirements identified during the Plan Quality Management process are turned into test and evaluation instruments, which are then applied during the Control Quality process to verify these quality requirements are met by the project. Control Quality is concerned with comparing the work results with the quality requirements to ensure the result is acceptable. There are two outputs specific to the Project Quality Management Knowledge Area that are used by other Knowledge Areas: verified deliverables and quality reports.

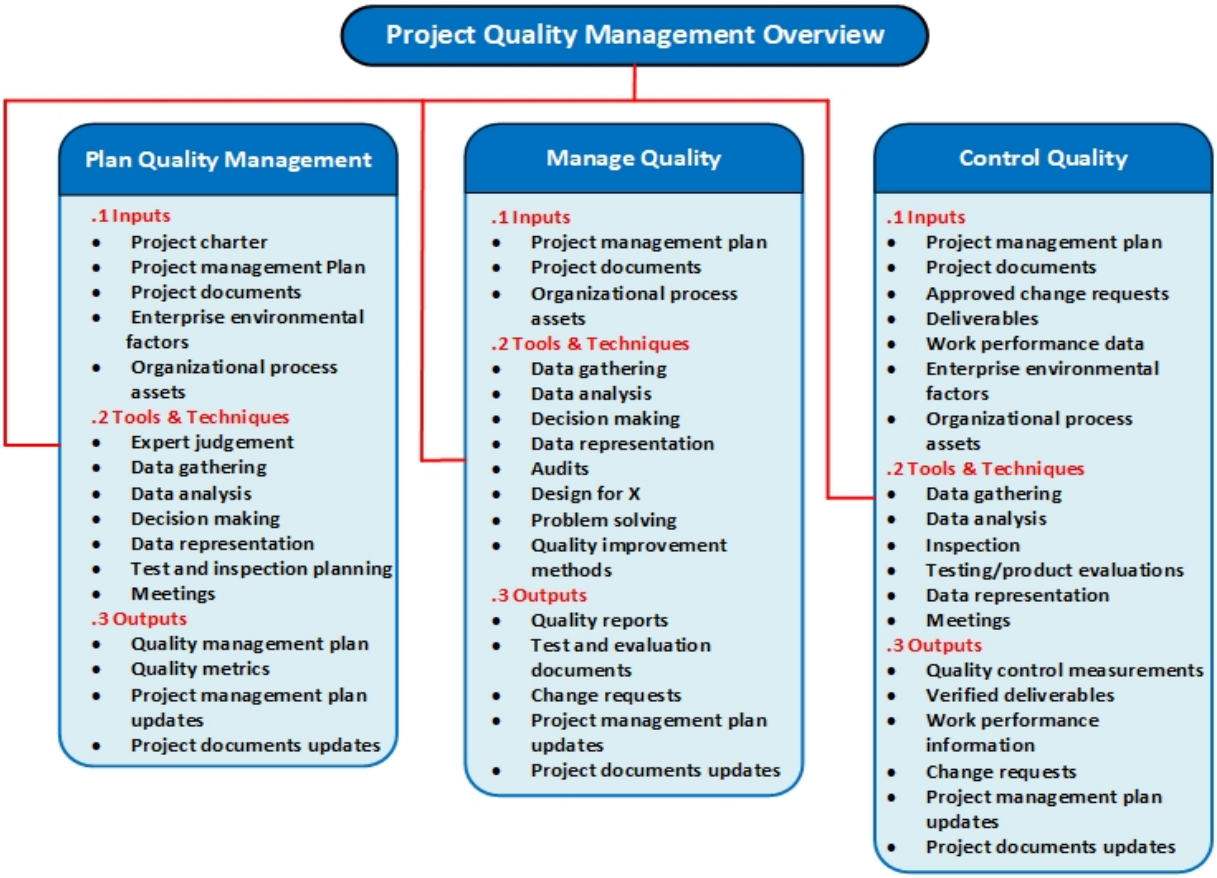

Figure 8.1. Project Quality Management Overview.

8.2. Plan Quality Management

Plan Quality Management is 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. The key benefit of this process is that it provides guidance and direction on how quality will be managed and verified throughout the project. This process is performed once or at predefined points in the project.

The inputs and outputs of this process are depicted in Figure 8.2. Figure 8.3 depicts the data flow diagram for the process.

Quality planning should be performed in parallel with the other planning processes. For example, changes proposed in the deliverables in order to meet identified quality standards may require cost or schedule adjustments and a detailed risk analysis of the impact to plans.

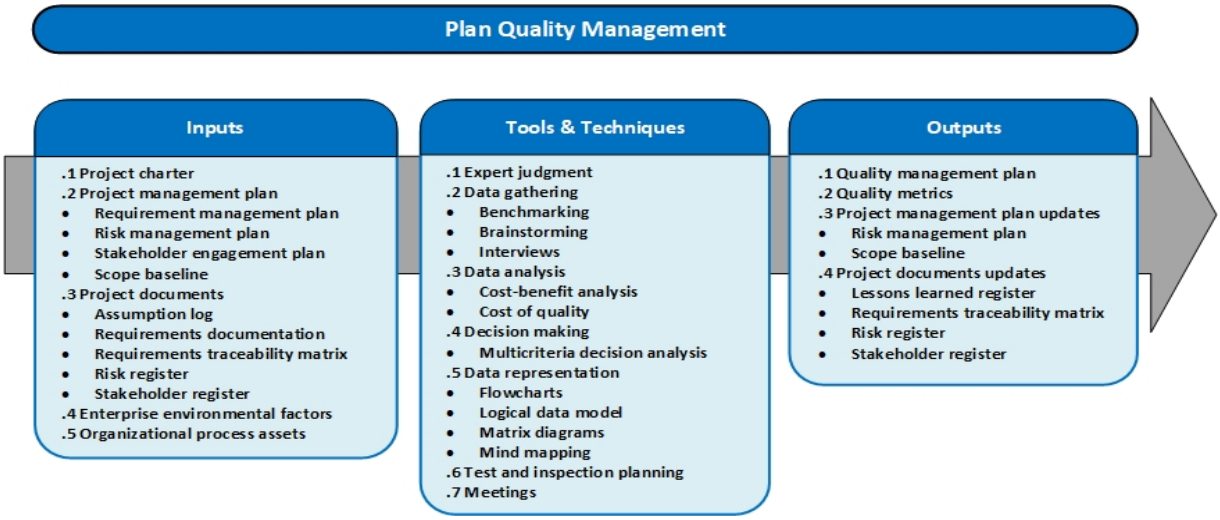

Figure 8.2. Plan Quality Management: Inputs, Tools & Techniques, and Outputs.

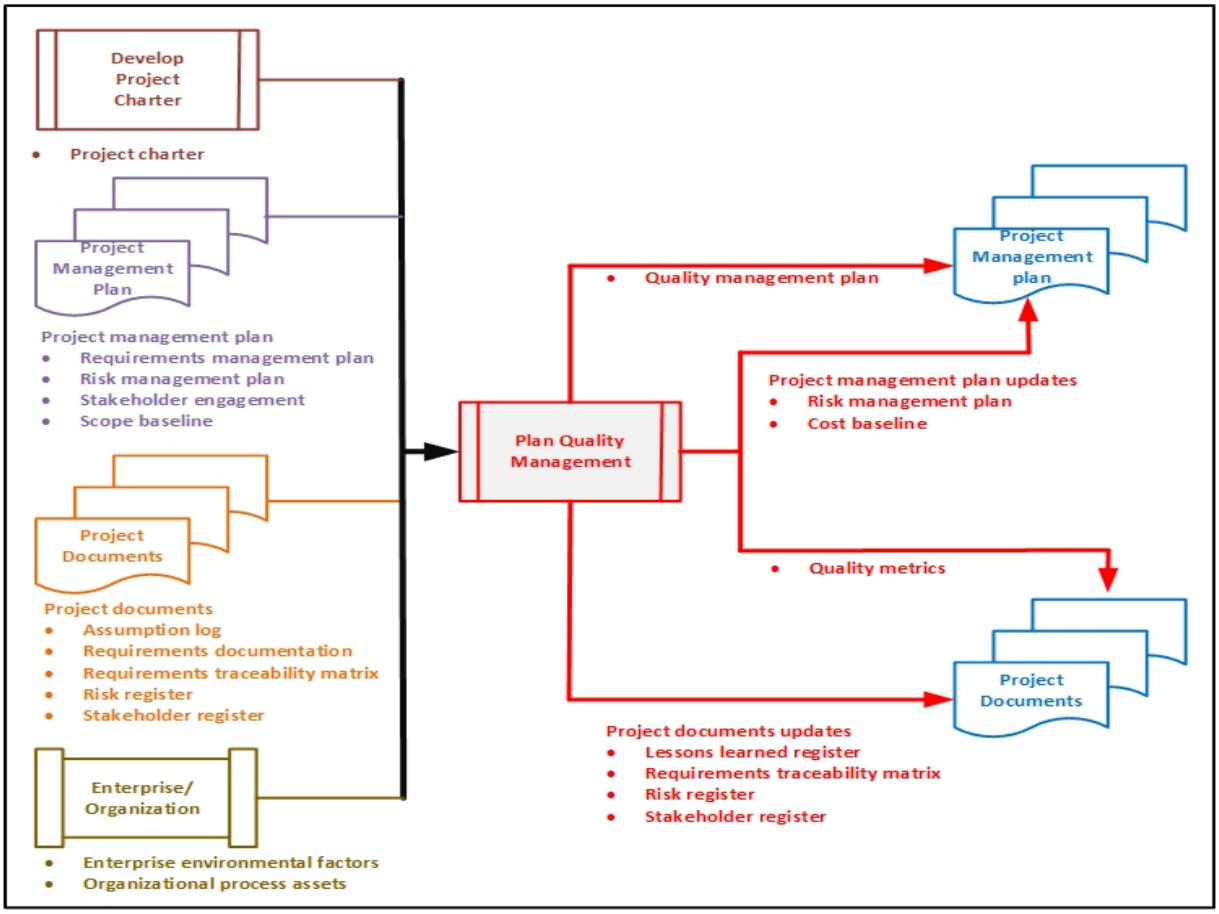

Figure 8.3. Plan Quality Management: Data Flow Diagram.

8.2.1. Plan Quality Management: Inputs

5) PROJECT CHARTER

The project charter provides the high-level project description and product characteristics. It also contains the project approval requirements, measurable project objectives, and related success criteria that will influence the quality management of the project.

6) PROJECT MANAGEMENT PLAN

Project management plan components include but are not limited to:

- **Requirements management plan.** The requirements management plan provides the approach for identifying, analyzing, and managing the requirements that the quality management plan and quality metrics will reference.
- **Risk management plan.** The risk management plan provides the approach for identifying, analyzing, and monitoring risks.
- **Stakeholder engagement plan.** The stakeholder engagement plan provides the method for documenting the stakeholders' needs and expectations that provide the foundation for quality management.
- **Scope baseline.** The WBS along with the deliverables documented in the project scope statement are considered while determining which quality standards and objectives are suitable for the project, and which project deliverables and processes will be subjected to quality review.

7) PROJECT DOCUMENTS

Project documents that can be considered as inputs for this process include but are not limited to:

- **Assumption log.** The assumption log has all the assumptions and constraints regarding quality requirements and standard compliance.
- **Requirements documentation.** Requirements documentation captures the requirements that the project and product should attain to meet stakeholder expectations. The components of the requirements documentation include but are not limited to project and product quality requirements.
- **Requirements traceability matrix.** The requirements traceability matrix links product requirements to deliverables and helps to ensure each requirement in the requirements documentation is tested.
- **Risk register.** The risk register contains information on threats and opportunities that may impact quality requirements.
- **Stakeholder register.** The stakeholder register helps to identify stakeholders who have a particular interest in or impact on quality, with the emphasis on the customer and project sponsor needs and expectations.

8) ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Plan Quality Management process include but are not limited to:

- Governmental agency regulations;
- Rules, standards, and guidelines specific to the application area;
- Geographic distribution;
- Organizational structure; and
- Marketplace conditions.

9) ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Plan Quality Management process include but are not limited to:

- Organizational quality management system including policies, procedures, and guidelines;
- Quality templates such as check sheets, traceability matrix, and others; and
- Historical databases and lessons learned repository.

8.2.2. Plan Quality Management: Tools and Techniques

4) EXPERT JUDGMENT

Expertise should be considered from individuals or groups with specialized knowledge or training in the following topics:

- Quality assurance,
- Quality control,
- Quality measurements,
- Quality improvements, and
- Quality systems.

5) DATA GATHERING

Data-gathering techniques that can be used for this process include but are not limited to:

- **Benchmarking.** Benchmarking involves comparing actual or planned project practices or the project's quality standards to those of comparable projects to identify best practices, generate ideas for improvement, and provide a basis for measuring performance.
- **Brainstorming.** Brainstorming can be used to gather data creatively from a group of team members or subject matter experts to develop the quality management plan that best fits the upcoming project.
- **Interviews.** Project and product quality needs and expectations, implicit and explicit, formal and informal, can be identified by interviewing experienced project participants, stakeholders, and subject matter experts.

6) DATA ANALYSIS

Data analysis techniques that can be used for this process include but are not limited to:

- **Cost-benefit analysis.** A cost-benefit analysis is a financial analysis tool used to estimate the strengths and weaknesses of alternatives in order to determine the best alternative in terms of benefits provided. A cost-benefit analysis will help the project manager determine if the planned quality activities are cost effective.
- **Cost of quality.** The cost of quality (COQ) associated with a project consists of one or more of the following costs:
    - *Prevention costs*. Costs related to the prevention of poor quality in the products, deliverables, or services of the specific project.
    - *Appraisal costs*. Costs related to evaluating, measuring, auditing, and testing the products, deliverables, or services of the specific project.
    - *Failure costs (internal/external)*. Costs related to nonconformance of the products, deliverables, or services to the needs or expectations of the stakeholders.

7) DECISION MAKING

A decision-making technique that can be used for this process includes but is not limited to multicriteria decision analysis.

8) DATA REPRESENTATION

Data representation techniques that can be used for this process include but are not limited to:

- **Flowcharts.** Flowcharts are also referred to as process maps because they display the sequence of steps and the branching possibilities that exist for a process that transforms one or more inputs into one or more outputs. Flowcharts show the activities, decision points, branching loops, parallel paths, and the overall order of processing by mapping the operational details of procedures that exist within a horizontal value chain. One version of a value chain, known as a SIPOC (suppliers, inputs, process, outputs, and customers) model, is shown in Figure 8.4.
- **Logical data model.** Logical data models are a visual representation of an organization's data, described in business language and independent of any specific technology. The logical data model can be used to identify where data integrity or other quality issues can arise.
- **Matrix diagrams.** Matrix diagrams help find the strength of relationships among different factors, causes, and objectives that exist between the rows and columns that form the matrix. In this process they facilitate identifying the key quality metrics that are important for the success of the project.
- **Mind mapping.** Mind mapping is a diagrammatic method used to visually organizing information. A mind map in quality is often created around a single quality concept, drawn as an image in the center of a blank landscape page, to which associated representations of ideas such as images, words, and parts of words are added.

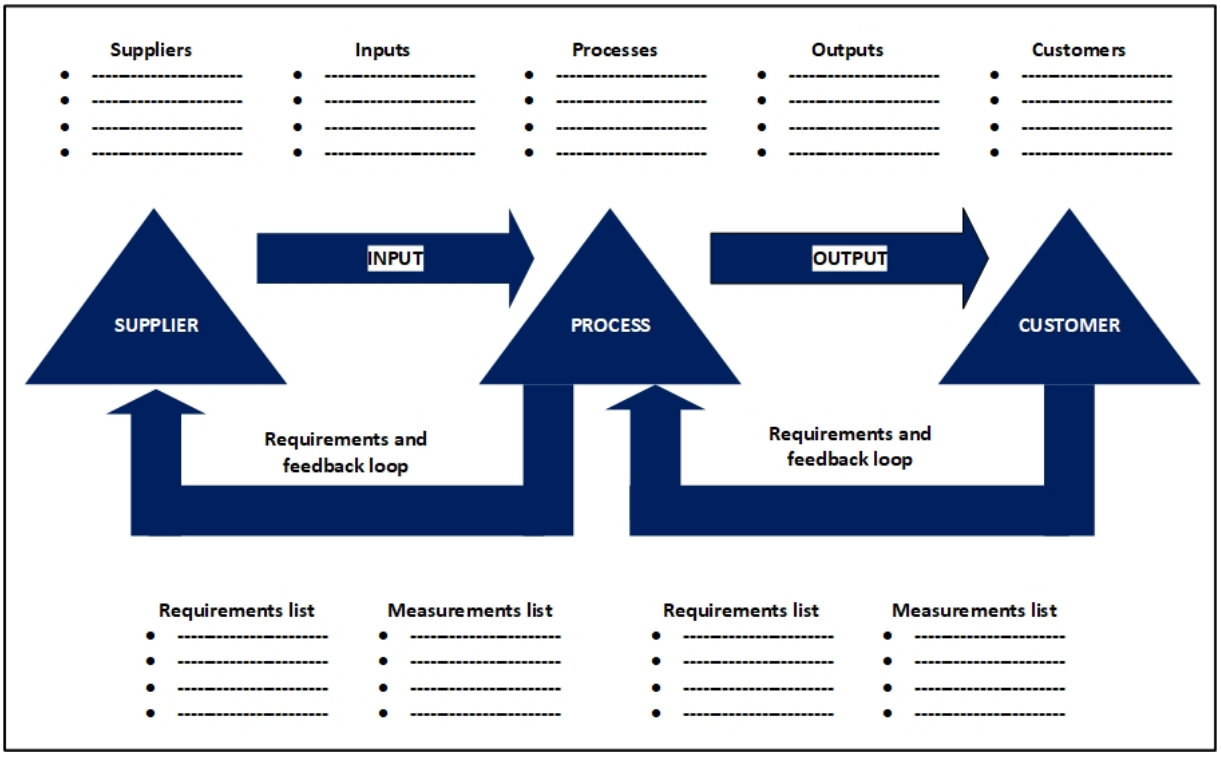

Figure 8.4. The SICOP Model.

9) TEST AND INSPECTION PLANNING

During the planning phase, the project manager and the project team determine how to test or inspect the product, deliverable, or service to meet the stakeholders' needs and expectations, as well as how to meet the goal for the product's performance and reliability.

10) MEETINGS

Project teams may hold planning meetings to develop the quality management plan.

8.2.3. Plan Quality Management: Outputs

2) QUALITY MANAGEMENT PLAN

The quality management plan is a component of the project management plan that describes how applicable policies, procedures, and guidelines will be implemented to achieve the quality objectives.

3) QUALITY METRICS

A quality metric specifically describes a project or product attribute and how the Control Quality process will verify compliance to it. Some examples of quality metrics include percentage of tasks completed on time, cost performance measured by CPI, failure rate, number of defects identified per day, and total downtime per month.

4) PROJECT MANAGEMENT PLAN UPDATES

Any change to the project management plan goes through the organization's change control process via a change request. Components that may require a change request for the project management plan include but are not limited to:

- **Risk management plan.** Decisions on the quality management approach may require changes to the agreed-upon approach to managing risk on the project, and these will be recorded in the risk management plan.
- **Scope baseline.** The scope baseline may change as a result of this process if specific quality management activities need to be added.

5) PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- **Lessons learned register.** The lessons learned register is updated with information on challenges encountered in the quality planning process.
- **Requirements traceability matrix.** Where quality requirements are specified by this process, they are recorded in the requirements traceability matrix.
- **Risk register.** New risks identified during this process are recorded in the risk register and managed using the risk management processes.
- **Stakeholder register.** Where additional information on existing or new stakeholders is gathered as a result of this process, it is recorded in the stakeholder register.

8.3. Manage Quality

Manage Quality is the process of translating the quality management plan into executable quality activities that incorporate the organization's quality policies into the project. The key benefits of this process are that it increases the probability of meeting the quality objectives as well as identifying ineffective processes and causes of poor quality. Manage Quality uses the data and results from the control quality process to reflect the overall quality status of the project to the stakeholders. This process is performed throughout the project.

The inputs, tools and techniques, and outputs of this process are depicted in Figure 8.5. Figure 8.6 depicts the data flow diagram of the process.

Manage Quality is sometimes called quality assurance, although Manage Quality has a broader definition than quality assurance as it is used in non-project work. Quality assurance is about using project processes effectively. It involves following and meeting standards to assure stakeholders that the final product will meet their needs, expectations, and requirements.

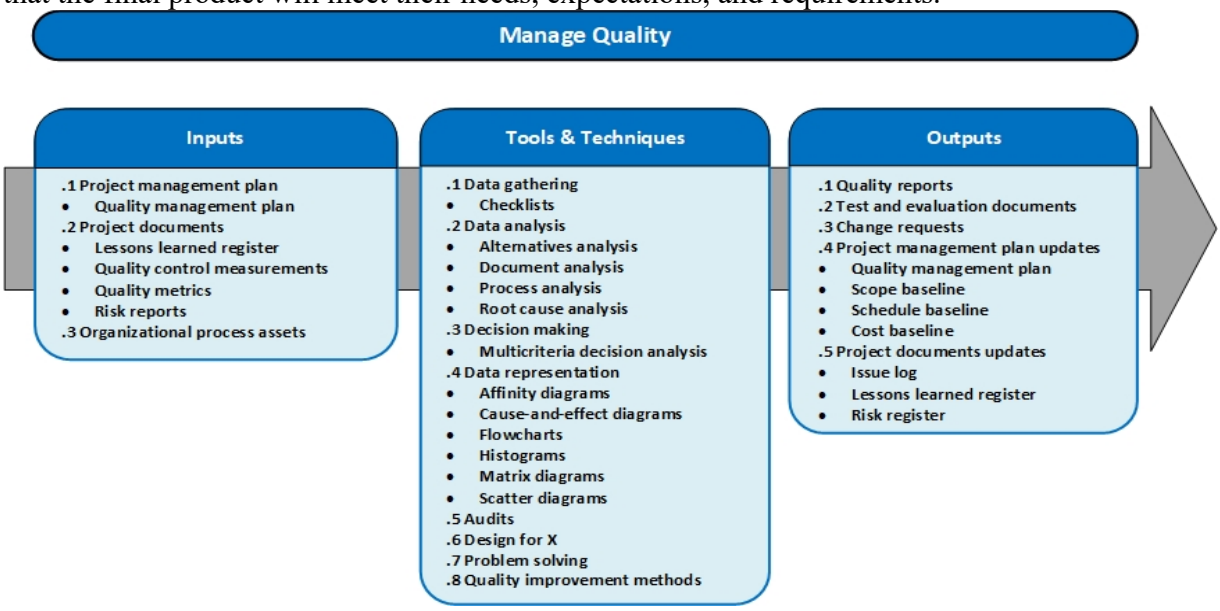

Figure 8.5. Manage Quality: Inputs, Tools & Techniques, and Outputs.

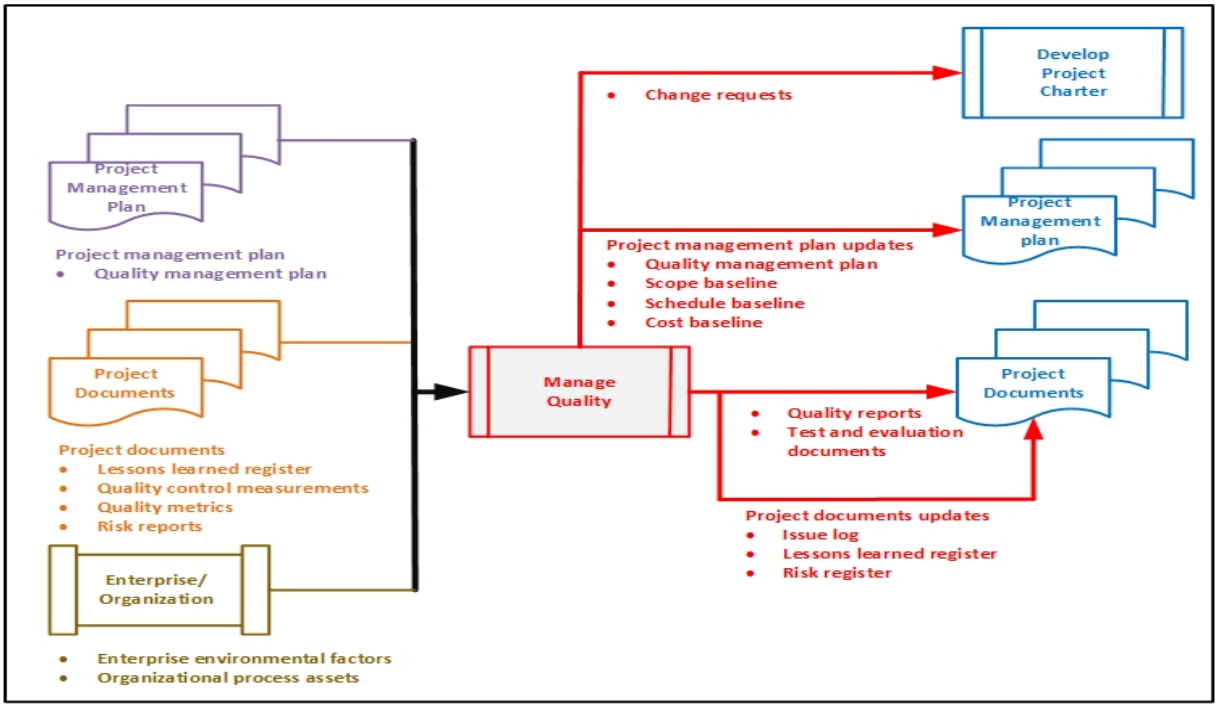

Figure 8.6. Manage Quality: Data Flow Diagram.

8.3.1. Manage Quality: Inputs

1) PROJECT MANAGEMENT PLAN

Project management plan components include but are not limited to the quality management plan. The quality management plan defines the acceptable level of project and product quality and describes how to ensure this level of quality in its deliverables and processes.

2) PROJECT DOCUMENTS

Project documents that can be considered as inputs for this process include but are not limited to:

- **Lessons learned register.** Lessons learned earlier in the project with regard to managing quality can be applied to later phases in the project to improve the efficiency and effectiveness of managing quality.
- **Quality control measurements.** Quality control measurements are used to analyze and evaluate the quality of the processes and deliverables of the project against the standards of the performing organization or the requirements specified.
- **Quality metrics.** Quality metrics are verified as part of the Control Quality process.
- **Risk report.** Risk report is used in the Manage Quality process to identify sources of overall project risk.

3) ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Manage Quality process include but are not limited to:

- Organizational quality management system that includes policies, procedures, and guidelines;
- Quality templates such as check sheets, traceability matrix, test plans, test documents, and others;
- Results from previous audits; and
- Lessons learned repository with information from similar projects.

8.3.2. Manage Quality: Tools and Techniques

1) DATA GATHERING

A data-gathering technique that can be used for this process includes but is not limited to checklists. A checklist is a structured tool, usually component-specific, used to verify that a set of required steps has been performed or to check if a list of requirements has been satisfied.

2) DATA ANALYSIS

Data analysis techniques that can be used for this process include but are not limited to:

- **Alternatives analysis.** This technique is used to evaluate identified options in order to select which different quality options or approaches are most appropriate to use.
- **Document analysis.** The analysis of different documents produced as part of the output of project control processes, such as quality reports, test reports, performance reports, and variance analysis, can point to and focus on processes that may be out of control and may expose meeting the specified requirements or stakeholders' expectations.
- **Process analysis.** Process analysis identifies opportunities for process improvements. This analysis also examines problems, constraints, and non-value-added activities that occur during a process.
- **Root cause analysis (RCA).** Root cause analysis is an analytical technique used to determine the basic underlying reason that causes a variance, defect, or risk. A root cause may underlie more than one variance, defect, or risk.

3) DECISION MAKING

A decision-making technique that can be used for this process includes but is not limited to multicriteria decision analysis. Multicriteria decision making is used to evaluate several criteria when discussing alternatives that impact project or product quality.

4) DATA REPRESENTATION

Data representation techniques that can be used for this process include but are not limited to:

- **Affinity diagrams.** Affinity diagrams can organize potential causes of defects into groups showing areas that should be focused on the most.
- **Cause-and-effect diagrams.** Cause-and-effect diagrams are also known as fishbone diagrams, why-why diagrams, or Ishikawa diagrams. This type of diagram breaks down the causes of the problem statement identified into discrete branches, helping to identify the main or root cause of the problem.
- **Flowcharts.** Flowcharts show a series of steps that lead to a defect.
- **Histograms.** Histograms show a graphical representation of numerical data. Histograms can show the number of defects per deliverable, a ranking of the cause of defects, the number of times each process is noncompliant, or other representations of project or product defects.
- **Matrix diagrams.** The matrix diagram seeks to show the strength of relationships among factors, causes, and objectives that exist between the rows and columns that form the matrix. Scatter diagrams.

5) AUDITS

An audit is a structured, independent process used to determine if project activities comply with organizational and project policies, processes, and procedures. A quality audit is usually conducted by a team external to the project, such as the organization's internal audit department, PMO, or by an auditor external to the organization.

6) DESIGN FOR X

Design for X (DfX) is a set of technical guidelines that may be applied during the design of a product for the optimization of a specific aspect of the design. DfX can control or even improve the product's final characteristics.

7) PROBLEM SOLVING

Problem solving entails finding solutions for issues or challenges. It can include gathering additional information, critical thinking, creative, quantitative and/or logical approaches.

8) QUALITY IMPROVEMENT METHODS

Quality improvements can occur based on findings and recommendations from quality control processes, the findings of the quality audits, or problem solving in the Manage Quality process.

8.3.3. Manage Quality: Outputs

1) QUALITY REPORTS

The quality reports can be graphical, numerical, or qualitative.

2) TEST AND EVALUATION DOCUMENTS

Test and evaluation documents can be created based on industry needs and the organization's templates.

3) CHANGE REQUESTS

If changes occur during the Manage Quality process that impact any of the components of the project management plan, project documents, or project or product management processes, the

project manager should submit a change request and follow the Perform Integrated Change Control process.

4) PROJECT MANAGEMENT PLAN UPDATES

Any change to the project management plan goes through the organization's change control process via a change request. Components that may require a change request for the project management plan include but are not limited to:

- **Quality management plan.** The agreed-upon approach to managing quality may need to be modified due to the actual results.
- **Scope baseline.** The scope baseline may change as a result of specific quality management activities.
- **Schedule baseline.** The schedule baseline may change as a result of specific quality management activities.
- **Cost baseline.** The cost baseline may change as a result of specific quality management activities.

5) PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- **Issue log.** New issues raised as a result of this process are recorded in the issue log.
- **Lessons learned register.** The lessons learned register is updated with information on challenges encountered and how they could have been avoided as well as approaches that worked well for the managing quality.
- **Risk register.** New risks identified during this process are recorded in the risk register and managed using the risk management processes.

8.4. Control Quality

Control Quality is the process of monitoring and recording results of executing the quality management activities in order to assess performance and ensure the project outputs are complete, correct, and meet customer expectations. The key benefit of this process is verifying that project deliverables and work meet the requirements specified by key stakeholders for final acceptance. The Control Quality process determines if the project outputs do what they were intended to do.

The inputs, tools and techniques, and outputs of this process are depicted in Figure 8.7. Figure 8.8 depicts the data flow diagram of the process.

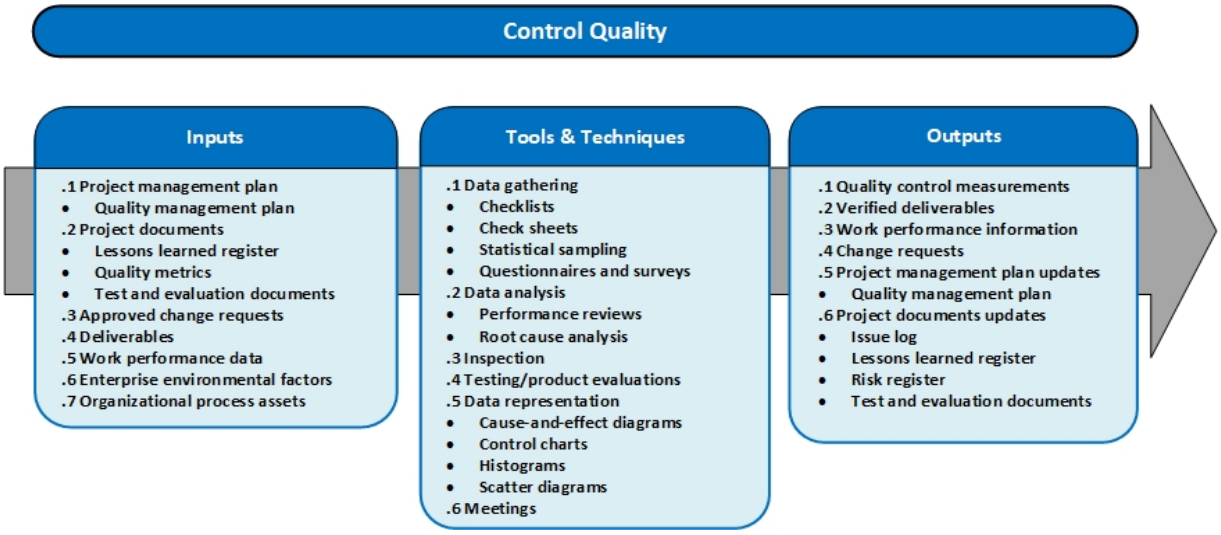

Figure 8.7. Control Quality: Inputs, Tools & Techniques, and Outputs.

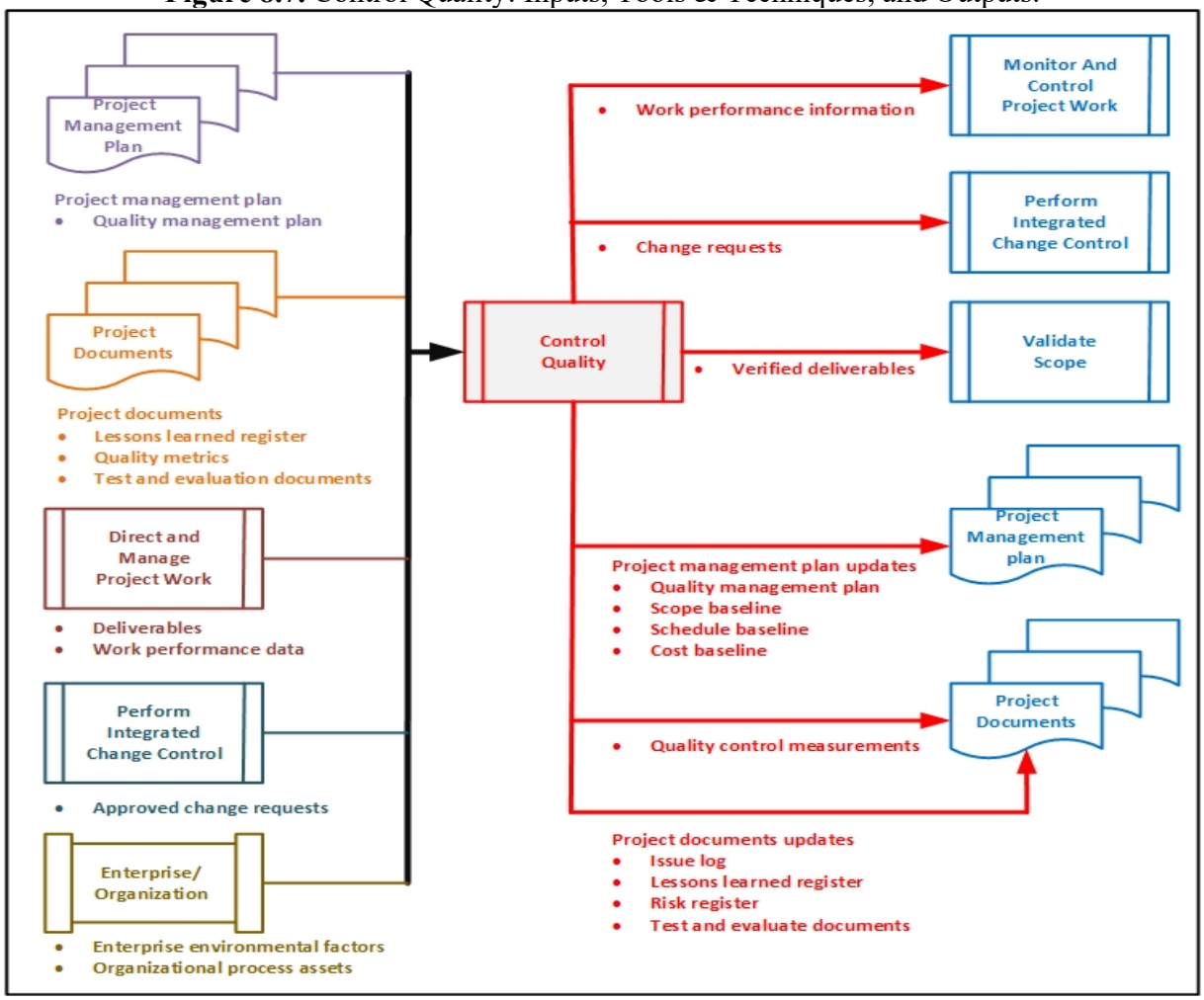

Figure 8.8. Control Quality: Data Flow Diagram.

The Control Quality process is performed to measure the completeness, compliance, and fitness for use of a product or service prior to user acceptance and final delivery. This is done by measuring all steps, attributes, and variables used to verify conformance or compliance to the specifications stated during the planning stage.

8.4.1. Control Quality: Inputs

1) PROJECT MANAGEMENT PLAN

Project management plan components include but are not limited to the quality management plan. The quality management plan defines how quality control will be performed within the project.

2) PROJECT DOCUMENTS

Project documents that can be considered as inputs for this process include but are not limited to:

- **Lessons learned register.** Lessons learned earlier in the project can be applied to later phases in the project to improve quality control.
- **Quality metrics.** A quality metric specifically describes a project or product attribute and how the Control Quality process will verify compliance to it.
- **Test and evaluation documents.** Test and evaluation documents are used to evaluate achievement of the quality objectives.

3) APPROVED CHANGE REQUESTS

As part of the Perform Integrated Change Control process, a change log update indicates that some changes are approved and some are not.

4) DELIVERABLES

A deliverable is any unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project.

5) WORK PERFORMANCE DATA

Work performance data contains data on product status such as observations, quality metrics, and measurements for technical performance, as well as project quality information on schedule performance and cost performance.

6) ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Control Quality process include but are not limited to:

- Project management information system;
- quality management software can be used to track errors and variations in processes;
- Governmental agency regulations; and
- Rules, standards, and guidelines specific to the application area.

7) ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Control Quality process include but are not limited to:

- Quality standards and policies;
- Quality templates, for example, check sheets, checklists, etc. and;
- Issue and defect reporting procedures and communication policies.

8.4.2 Control Quality: Tools and Techniques

1) DATA GATHERING

Data-gathering techniques that can be used for this process include but are not limited to:

- **Checklists.** Checklists help in managing the control quality activities in a structured manner.

- **Check sheets.** Check sheets are also known as tally sheets and are used to organize facts in a manner that will facilitate the effective collection of useful data about a potential quality problem.
- **Statistical sampling.** Statistical sampling involves choosing part of a population of interest for inspection. Sample frequency and sizes should be determined during the Plan Quality Management process.
- **Questionnaires and Surveys.** Surveys may be used to gather data about customer satisfaction after the deployment of the product or service.

2) DATA ANALYSIS

Data analysis techniques that can be used for this process include but are not limited to:

- **Performance reviews.** Performance reviews measure, compare, and analyze the quality metrics defined by the Plan Quality Management process against the actual results.
- **Root cause analysis (RCA).** Root cause analysis is used to identify the source of defects.

3) INSPECTION

An inspection is the examination of a work product to determine if it conforms to documented standards.

4) TESTING/PRODUCT EVALUATIONS

Testing is an organized and constructed investigation conducted to provide objective information about the quality of the product or service under test in accordance with the project requirements.

5) DATA REPRESENTATION

Data representation techniques that can be used for this process include but are not limited to:

- **Cause-and-effect diagrams.** Cause-and-effect diagrams are used to identify the possible effects of quality defects and errors.
- **Control charts.** Control charts are used to determine whether or not a process is stable or has predictable performance.
- **Histograms.** Histograms can demonstrate the number of defects by source or by component.
- **Scatter diagrams.** Scatter diagrams can show the planned performance on one axis and the actual performance on the second axis.

6) MEETINGS

The following meetings may be used as part of the Control Quality process:

- **Approved change requests review.** All approved change requests should be reviewed to verify that they were implemented as approved.
- **Retrospectives/lesson learned.** A meeting held by a project team to discuss:
  - Successful elements in the project/phase,
  - What could be improved,
  - What to incorporate in the ongoing project and what in future projects, and
  - What to add to the organization process assets.

8.4.3 Control Quality: Outputs

1) QUALITY CONTROL MEASUREMENTS

Quality control measurements are the documented results of Control Quality activities. They should be captured in the format that was specified in the quality management plan.

2) VERIFIED DELIVERABLES

A goal of the Control Quality process is to determine the correctness of deliverables. The results of performing the Control Quality process are verified deliverables that become an input to the Validate Scope process for formalized acceptance.

3) WORK PERFORMANCE INFORMATION

Work performance information includes information on project requirements fulfillment, causes for rejections, rework required, recommendations for corrective actions, lists of verified deliverables, status of the quality metrics, and the need for process adjustments.

4) CHANGE REQUESTS

If changes occur during the Control Quality process that may impact any of the components of the project management plan or project documents, the project manager should submit a change request. Change requests are processed for review and disposition through the Perform Integrated Change Control process.

5) PROJECT MANAGEMENT PLAN UPDATES

Any change to the project management plan goes through the organization's change control process via a change request. Components that may require a change request for the project management plan include but are not limited to the quality management plan.

6) PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- **Issue log.** Many times, a deliverable that does not meet the quality requirements is documented as an issue.
- **Lessons learned register.** The lessons learned register is updated with information on the source of quality defects and how they could have been avoided as well as approaches that worked well.
- **Risk register.** New risks identified during this process are recorded in the risk register and managed using the risk management processes.
- **Test and evaluation documents.** Test and evaluation documents may be modified as a result of this process in order to make future tests more effective.

Questions

1. Comparing project practices to those of other organizations to identify best practices is known as:
   A. the cost of quality
   B. cost–benefit analysis
   C. benchmarking
   D. design of experiments
2. A statistical method used to determine optimal conditions for producing the product is called:
   A. the cost of quality
   B. cost-benefit analysis
   C. benchmarking
   D. design of experiments
3. Ensuring that each quality activity is worth the cost is confirmed through:
   A. the cost of quality
   B. cost-benefit analysis
   C. benchmarking
   D. design of experiments
4. Testing only part of a population that is representative of the whole is known as:
   A. statistical sampling
   B. benchmarking
   C. design of experiments
   D. the cost of quality
5. A SIPOC (supplier, inputs, process, outputs, customers) model is an example of:
   A. cause-and-effect diagram
   B. check sheets
   C. Pareto diagram
   D. flowchart
6. A cause-and-effect diagram is also known as:
   A. Ishikawa diagram
   B. scatter diagram
   C. Pareto diagram
   D. flowchart
7. A project manager is using a histogram to analyze defects found by the team during inspection activities. What process is being performed?
   A. Plan Quality Management
   B. Control Quality
   C. Manage Quality
   D. Verify Scope
8. Which of the following is NOT an example of cost of quality?
   A. Having team members spend extra time reviewing requirements with the stakeholders
   B. Paying extra programmers to help meet a deadline

C. Hiring extra inspectors to look for defects
D. Sending a crew to repair a defective product that was delivered to the client

9. You're working with an audit team to check that your company's projects all meet the same quality standards. What process is being performed?
A. Plan Quality Management
B. Control Quality
C. Manage Quality
D. Perform Quality Management

10. Which of the following is NOT part of the Quality Management plan?
A. Strategies for handling defects and other quality problems
B. Guidance on how the project team will implement the company's quality policy
C. Metrics for measuring your project's quality
D. A description of which deliverables don't have to be inspected

11. You're managing a highway construction project. The foreman of your building team alerts you to a problem that the inspection team found with one of the pylons, so you use an Ishikawa diagram to try to figure out the root cause of the defect. What process is being performed?
A. Quality Management
B. Plan Quality Management
C. Control Quality
D. Manage Quality

12. Which tool or technique is used to break data into categories for analysis?
A. Scatter chart
B. Histogram
C. Checklist
D. Flowchart

13. When is inspection performed?
A. At the beginning of the project
B. Any time a project deliverable is produced
C. Just before the final product is delivered
D. At the end of the project

14. What's the difference between Control Quality and Manage Quality?
A. Control Quality involves charts like histograms and control charts, while Manage Quality doesn't use those charts.
B. Control Quality and Manage Quality mean the same thing.
C. Control Quality means inspecting for defects in deliverables, while Manage Quality means auditing a project to check the overall process.
D. Manage Quality means looking for defects in deliverables, while Control Quality means auditing a project to check the overall process.

15. Validated defect repair is an output of which process?
A. Integrated change control
B. Plan Quality Management
C. Control Quality
D. Manage Quality

Chapter 9

Project Resource Management

General Objective of the Chapter:

Trainee will be able to describe and understand the process of Project Resource Management**.**

Detailed Objectives:

1. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Plan Resource Management process.
2. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Estimate Activity Resources process.
3. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Acquire Resources process.
4. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Develop Team process.
5. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Manage Team process.
6. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Control Resources process.

9.1. Overview

Project Resource Management includes the processes to identify, acquire, and manage the resources needed for the successful completion of the project. These processes help ensure that the right resources will be available to the project manager and project team at the right time and place. The Project Resource Management processes are:

- **Plan Resource Management.** The process of defining how to estimate, acquire, manage, and utilize physical and team resources.
- **Estimate Activity Resources.** The process of estimating team resources and the type and quantities of material, equipment, and supplies necessary to perform project work.
- **Acquire Resources.** The process of obtaining team members, facilities, equipment, materials, supplies, and other resources necessary to complete project work.
- **Develop Team.** The process of improving competencies, team member interaction, and the overall team environment to enhance project performance.
- **Manage Team.** The process of tracking team member performance, providing feedback, resolving issues, and managing team changes to optimize project performance.
- **Control Resources.** The process of ensuring that the physical resources assigned and allocated to the project are available as planned, as well as monitoring the planned versus actual use of resources, and performing corrective action as necessary.

Figure 9.1 provides an overview of the Project Resource Management processes.

There is a distinction between the skills and competencies needed for the project manager to manage team resources versus physical resources. Physical resources include equipment, materials, facilities, and infrastructure. Team resources or personnel refer to the human resources. Personnel may have varied skill sets, may be assigned full- or part-time, and may be added or removed from the project team as the project progresses.

The project team consists of individuals with assigned roles and responsibilities who work collectively to achieve a shared project goal.

Figure 9.1. Project Quality Management Overview.

9.2. Plan Resource Management

Plan Resource Management is the process of defining how to estimate, acquire, manage, and use team and physical resources. The key benefit of this process is that it establishes the approach and level of management effort needed for managing project resources based on the type and complexity of the project. This process is performed once or at predefined points in the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 9.2. Figure 9.3 depicts the data flow diagram for the process.

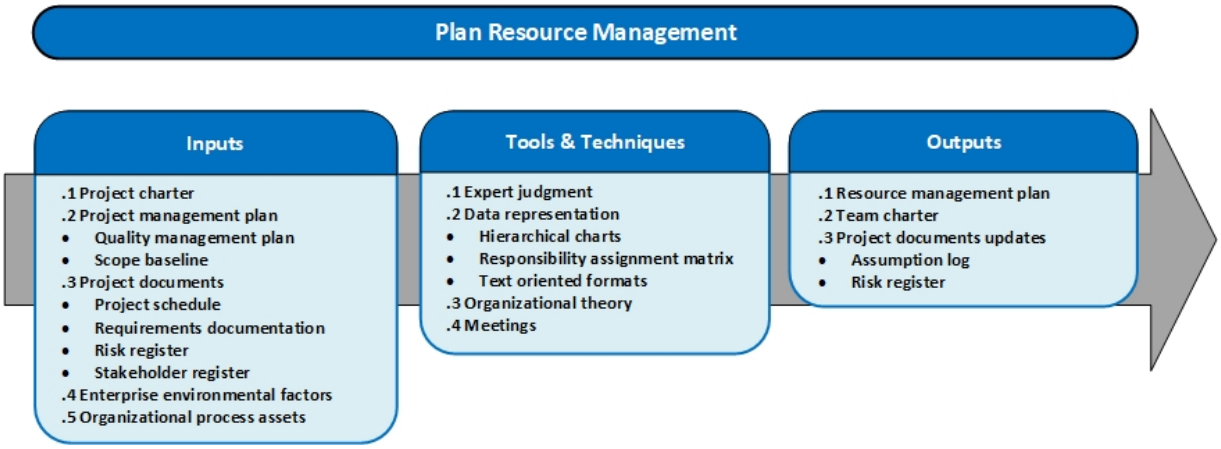

Figure 9.2. Plan Resource Management: Inputs, Tools & Techniques, and Outputs.

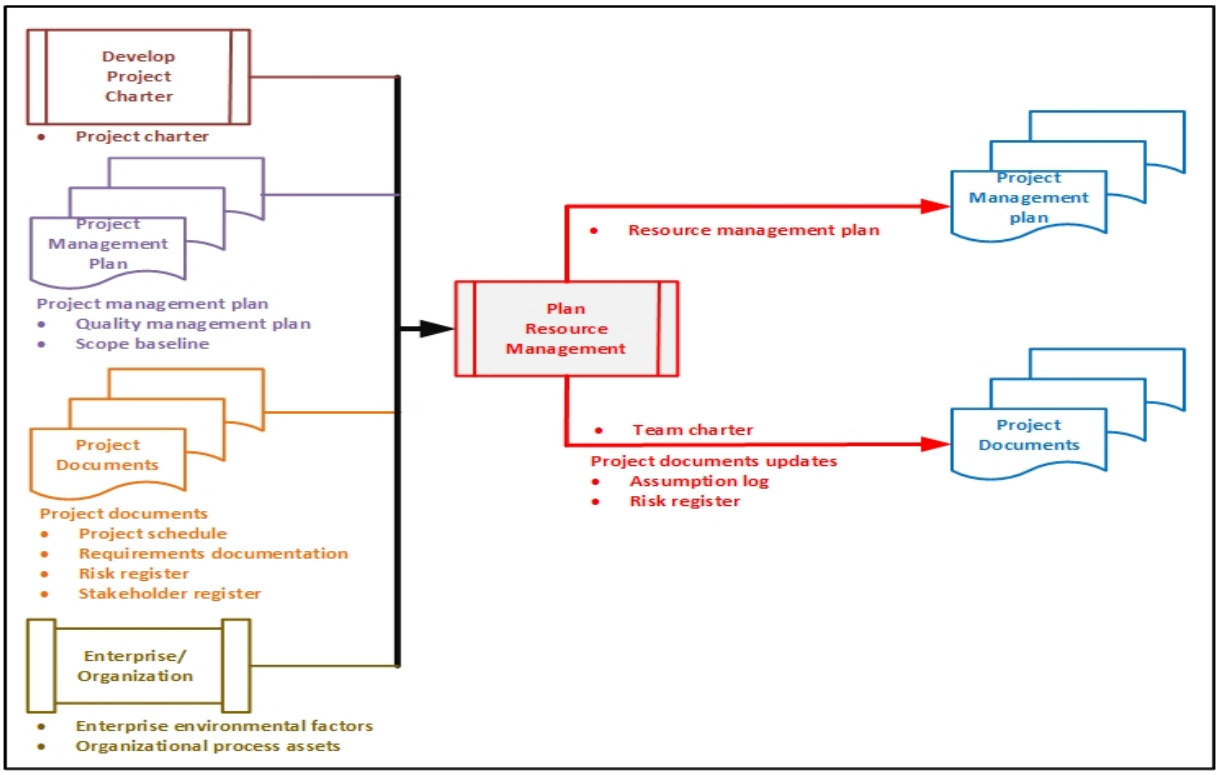

Figure 9.3. Plan Resource Management: Data Flow Diagram.

Resource planning is used to determine and identify an approach to ensure that sufficient resources are available for the successful completion of the project. Project resources may include team members, supplies, materials, equipment, services and facilities. Effective resource planning should consider and plan for the availability of, or competition for, scarce resources.

Those resources can be obtained from the organization's internal assets or from outside the organization through a procurement process. Other projects may be competing for the same resources required for the project at the same time and location. This may significantly impact project costs, schedules, risks, quality, and other project areas.

9.3. Estimate Activity Resources

Estimate Activity Resources is the process of estimating team resources and the type and quantities of materials, equipment, and supplies necessary to perform project work. The key benefit of this process is that it identifies the type, quantity, and characteristics of resources required to complete the project. This process is performed periodically throughout the project as needed.
The inputs, tools and techniques, and outputs of this process are depicted in Figure 9.4. Figure 9.5 depicts the data flow diagram of the process.

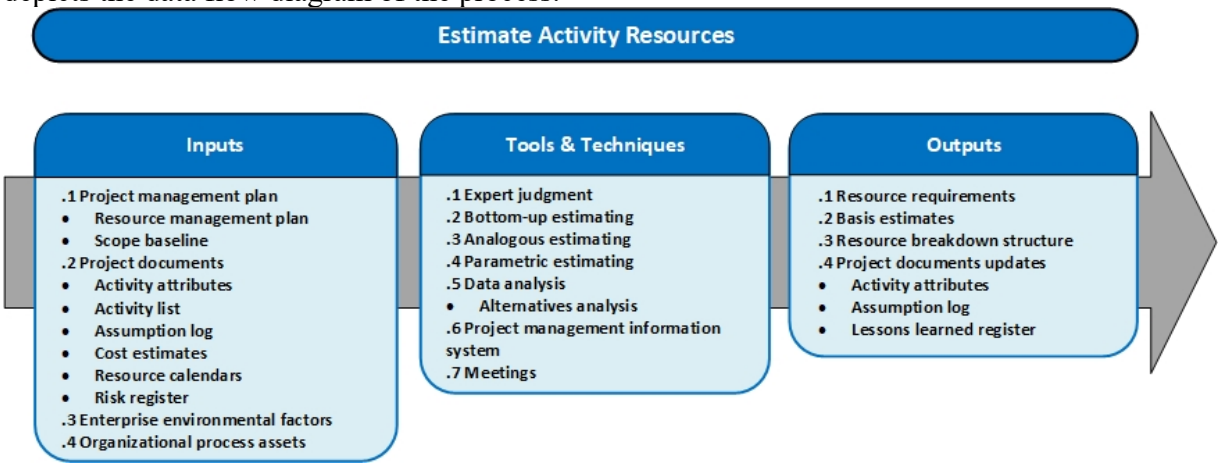

Figure 9.4. Estimate Activity Resources: Inputs, Tools & Techniques, and Outputs.

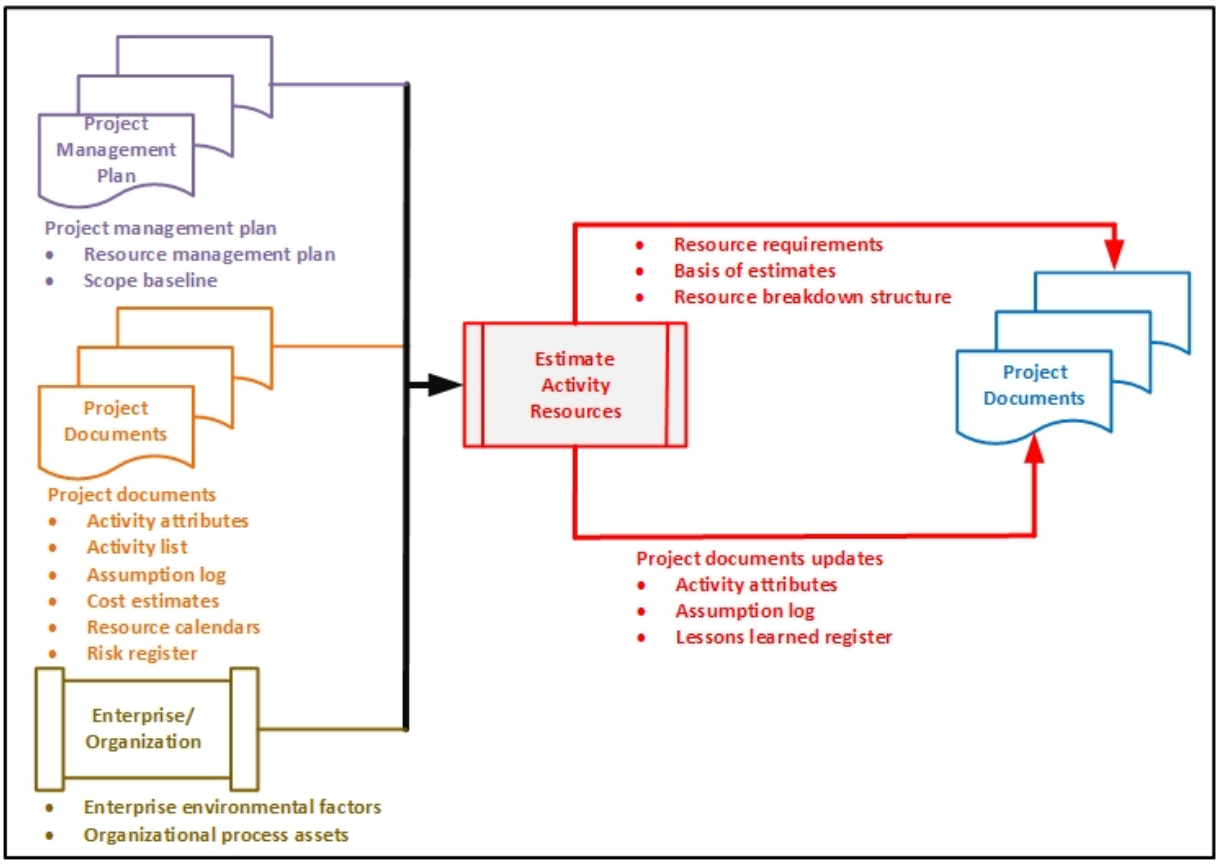

Figure 9.5. Estimate Activity Resources: Data Flow Diagram.

9.4. Acquire Resources

Acquire Resources is the process of obtaining team members, facilities, equipment, materials, supplies, and other resources necessary to complete project work. The key benefit of this process is that it outlines and guides the selection of resources and assigns them to their respective activities. This process is performed periodically throughout the project as needed.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 9.6. Figure 9.7 depicts the data flow diagram for the process.

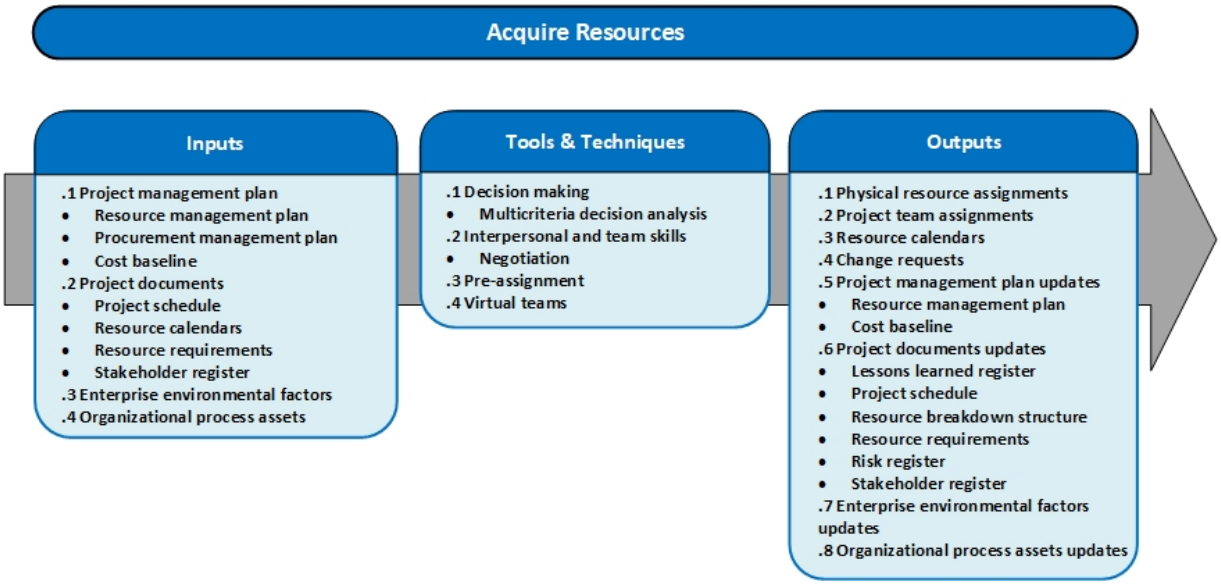

Figure 9.6. Acquire Resources: Inputs, Tools & Techniques, and Outputs.

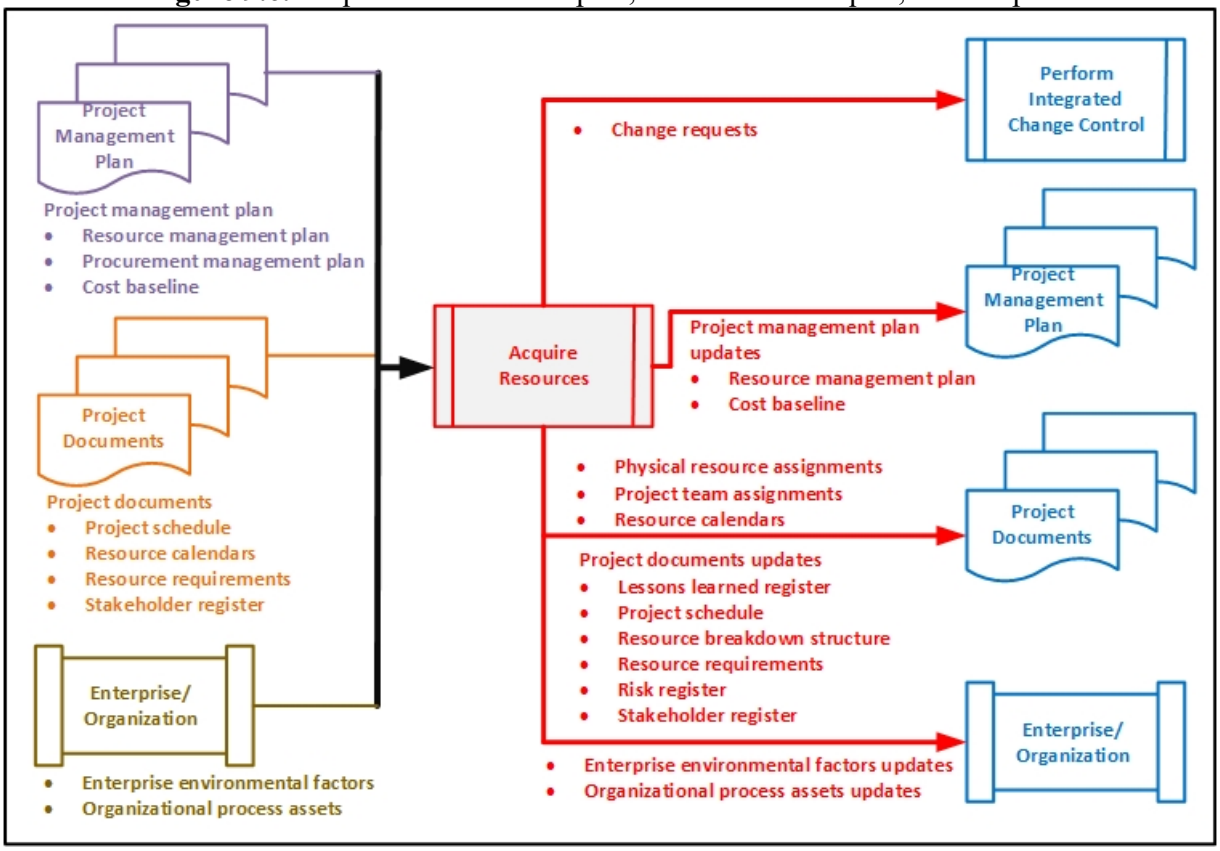

Figure 9.7. Acquire Resources: Data Flow Diagram.

The resources needed for the project can be internal or external to the project-performing organization. Internal resources are acquired (assigned) from functional or resource managers. External resources are acquired through the procurement processes.

The project management team may or may not have direct control over resource selection because of collective bargaining agreements, use of subcontractor personnel, a matrix project environment, internal or external reporting relationships, or other reasons. It is important that the following factors are considered during the process of acquiring the project resources:

- The project manager or project team should effectively negotiate and influence others who are in a position to provide the required team and physical resources for the project.
- Failure to acquire the necessary resources for the project may affect project schedules, budgets, customer satisfaction, quality, and risks. Insufficient resources or capabilities decrease the probability of success and, in a worst-case scenario, could result in project cancellation.
- If the team resources are not available due to constraints such as economic factors or assignment to other projects, the project manager or project team may be required to assign alternative resources, perhaps with different competencies or costs. Alternative resources are allowed provided there is no violation of legal, regulatory, mandatory, or other specific criteria.

These factors should be considered and accounted for in the planning stages of the project. The project manager or project management team will be required to document the impact of the unavailability of required resources in the project schedule, project budget, project risks, project quality, training plans, and other project management plans.

9.5. Develop Team

Develop Team is the process of improving competencies, team member interaction, and the overall team environment to enhance project performance. The key benefit of this process is that it results in improved teamwork, enhanced interpersonal skills and competencies, motivated employees, reduced attrition, and improved overall project performance. This process is performed throughout the project.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 9.8. Figure 9.9 depicts the data flow diagram for the process.

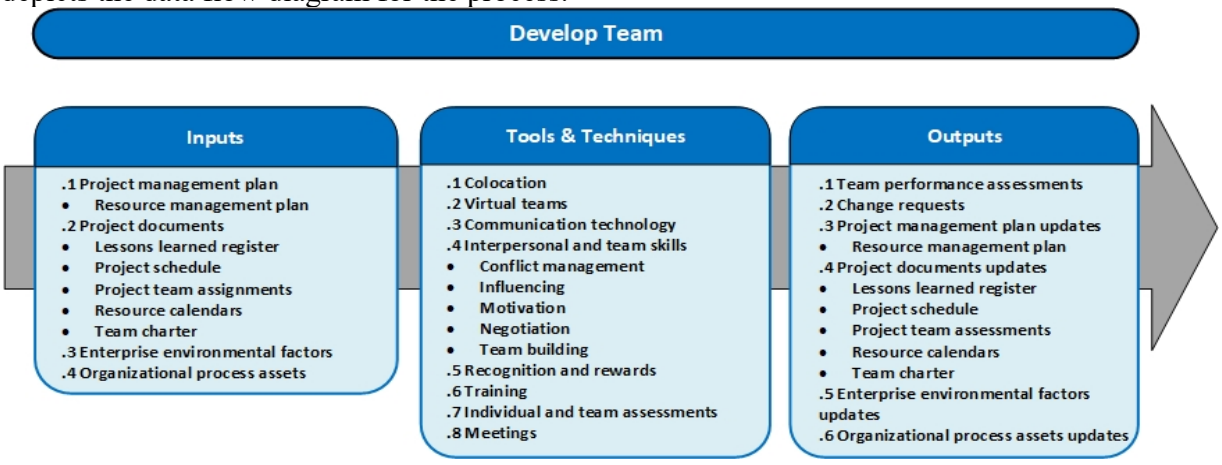

Figure 9.8. Develop Team: Inputs, Tools & Techniques, and Outputs.

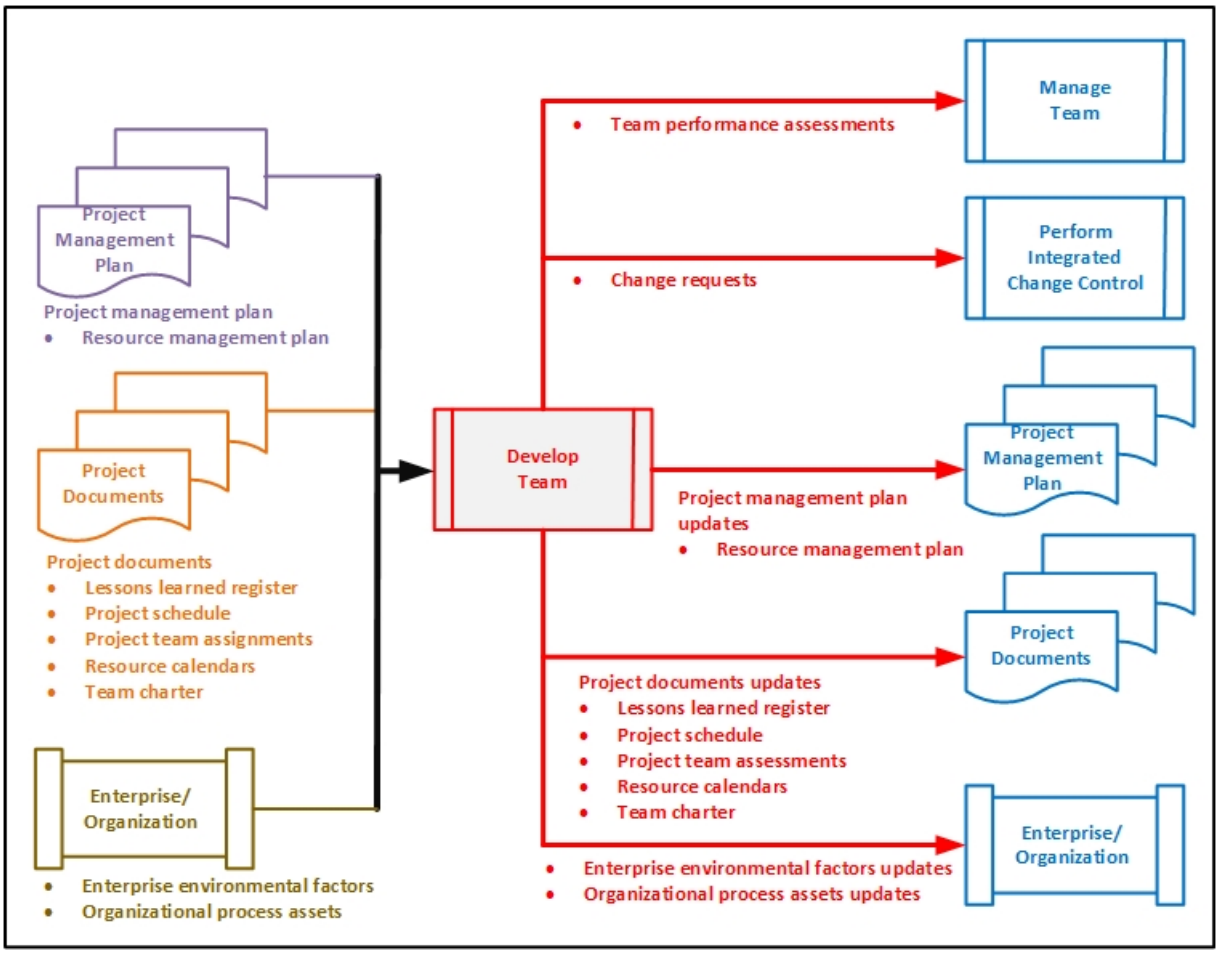

Figure 9.9. Develop Team: Data Flow Diagram.

Project managers require the skills to identify, build, maintain, motivate, lead, and inspire project teams to achieve high team performance and to meet the project's objectives. Teamwork is a critical factor for project success, and developing effective project teams is one of the primary responsibilities of the project manager. Project managers should create an environment that facilitates teamwork and continually motivates the team by providing challenges and opportunities, providing timely feedback and support as needed, and recognizing and rewarding good performance. High team performance can be achieved by employing these behaviors:

- Using open and effective communication,
- Creating team-building opportunities,
- Developing trust among team members,
- Managing conflicts in a constructive manner,
- Encouraging collaborative problem solving, and
- Encouraging collaborative decision making.

Project managers operate in a global environment and work on projects characterized by cultural diversity. Team members often have diverse industry experience, communicate in multiple languages, and sometimes work with a “team language” or cultural norm that may be different

from their native one. The project management team should capitalize on cultural differences, focus on developing and sustaining the project team throughout the project life cycle, and promote working together interdependently in a climate of mutual trust. Developing the project team improves the people skills, technical competencies, and overall team environment and project performance. It requires clear, timely, effective, and efficient communication between team members throughout the life of the project. Objectives of developing a project team include but are not limited to:

- Improving the knowledge and skills of team members to increase their ability to complete project deliverables, while lowering costs, reducing schedules, and improving quality;
- Improving feelings of trust and agreement among team members to raise morale, lower conflict, and increase teamwork;
- Creating a dynamic, cohesive, and collaborative team culture to: (1) improve individual and team productivity, team spirit, and cooperation; and (2) allow cross-training and mentoring between team members to share knowledge and expertise; and
- Empowering the team to participate in decision making and take ownership of the provided solutions to improve team productivity for more effective and efficient results.

9.6. Manage Team

Manage Team is the process of tracking team member performance, providing feedback, resolving issues, and managing team changes to optimize project performance. The key benefit of this process is that it influences team behavior, manages conflict, and resolves issues. This process is performed throughout the project.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 9.10. Figure 9.11 depicts the data flow diagram for the process.

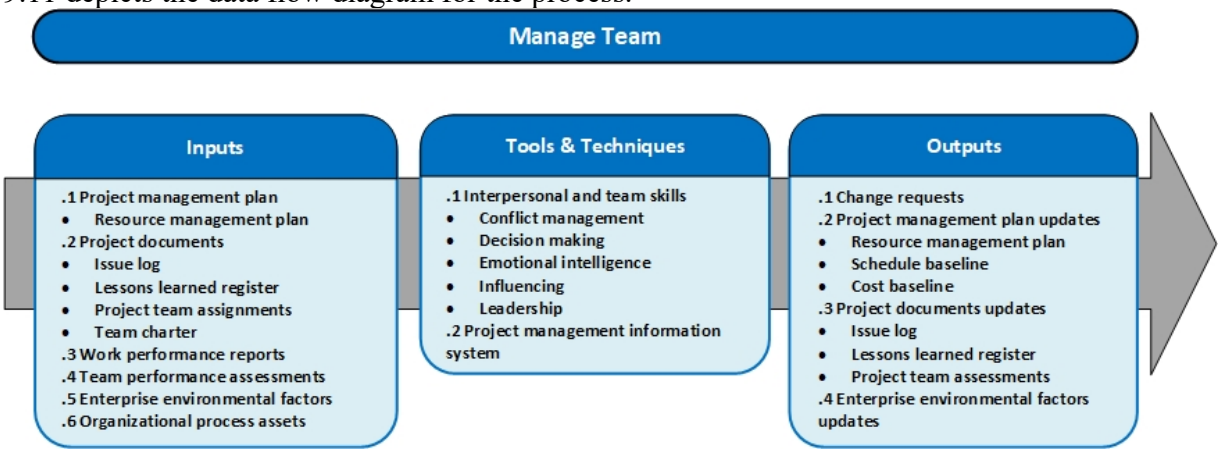

Figure 9.10. Manage Team: Inputs, Tools & Techniques, and Outputs.

Managing the project team requires a variety of management and leadership skills for fostering teamwork and integrating the efforts of team members to create high-performance teams. Team management involves a combination of skills with special emphasis on communication, conflict management, negotiation, and leadership. Project managers should provide challenging assignments to team members and provide recognition for high performance.

The project manager needs to be sensitive to both the willingness and the ability of team members to perform their work and adjust their management and leadership styles accordingly. Team

members with low-skill abilities will require more intensive oversight than those who have demonstrated ability and experience.

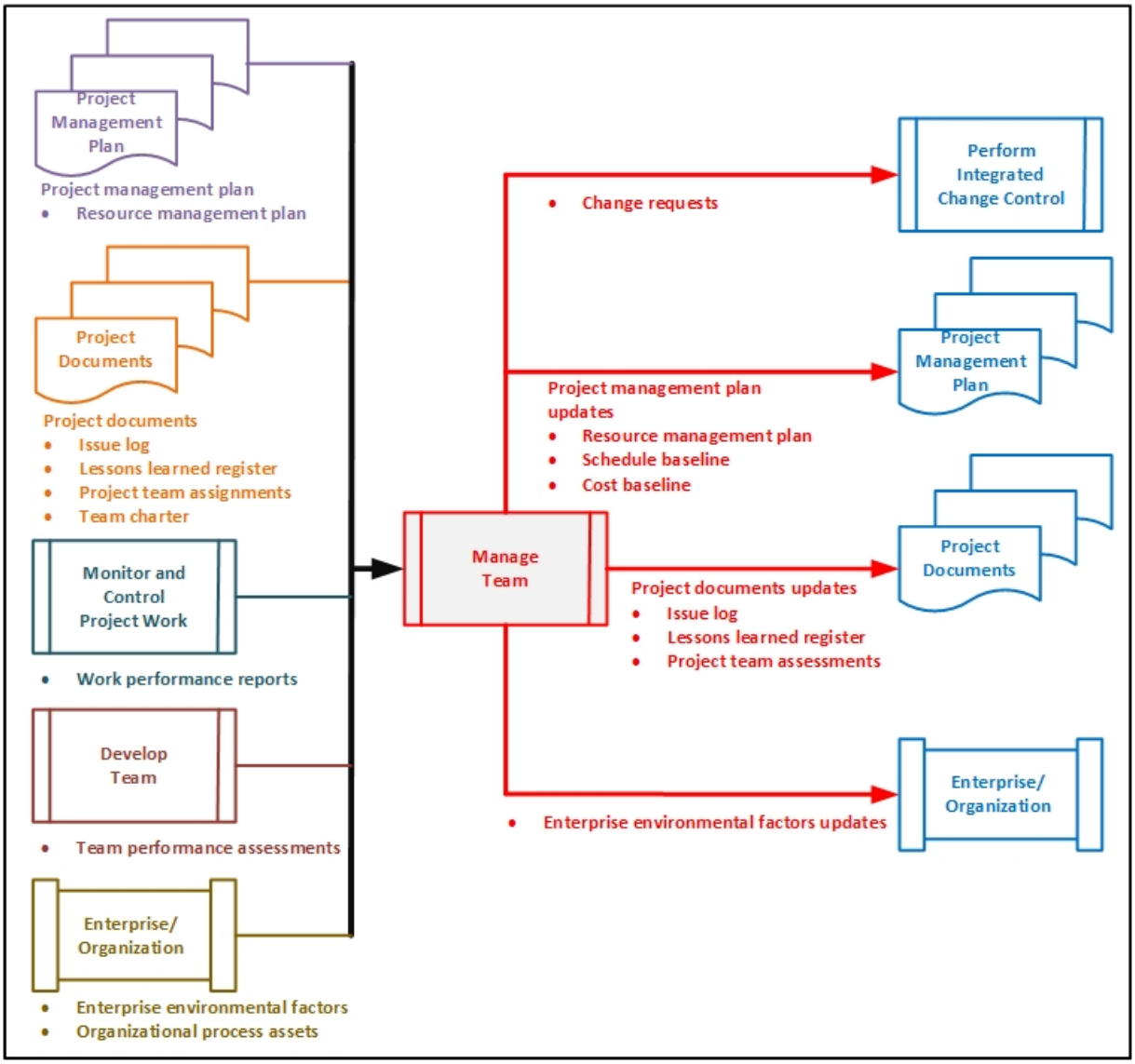

Figure 9.11. Manage Team: Data Flow Diagram.

9.7. Control Resources

Control Resources is the process of ensuring that the physical resources assigned and allocated to the project are available as planned, as well as monitoring the planned versus actual utilization of resources and taking corrective action as necessary. The key benefit of this process is ensuring that the assigned resources are available to the project at the right time and in the right place and are released when no longer needed. This process is performed throughout the project.

The inputs and outputs of this process are depicted in Figure 9.12. Figure 9.13 depicts the data flow diagram for the process.

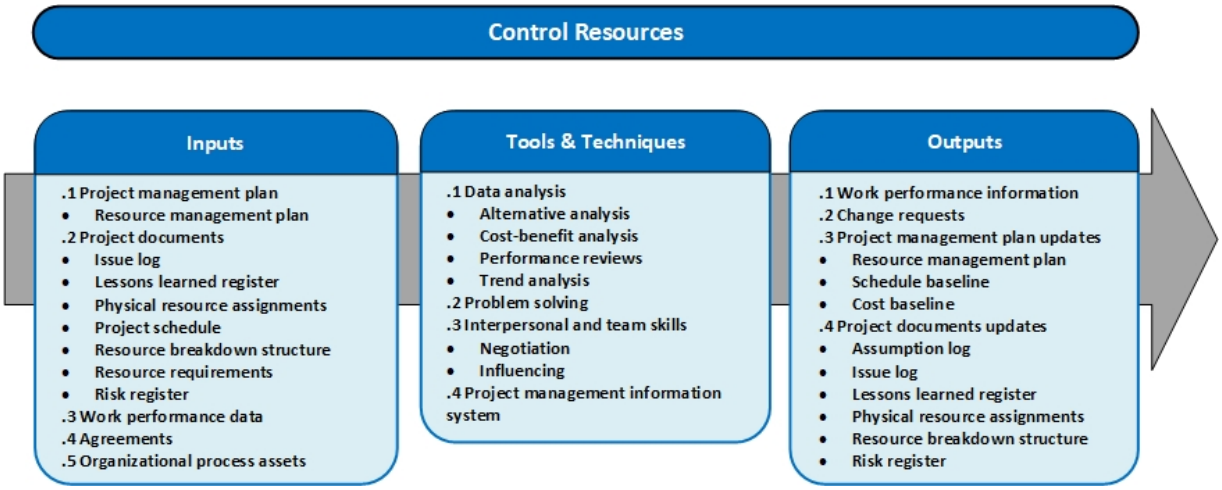

Figure 9.12. Control Resources: Inputs, Tools & Techniques, and Outputs.

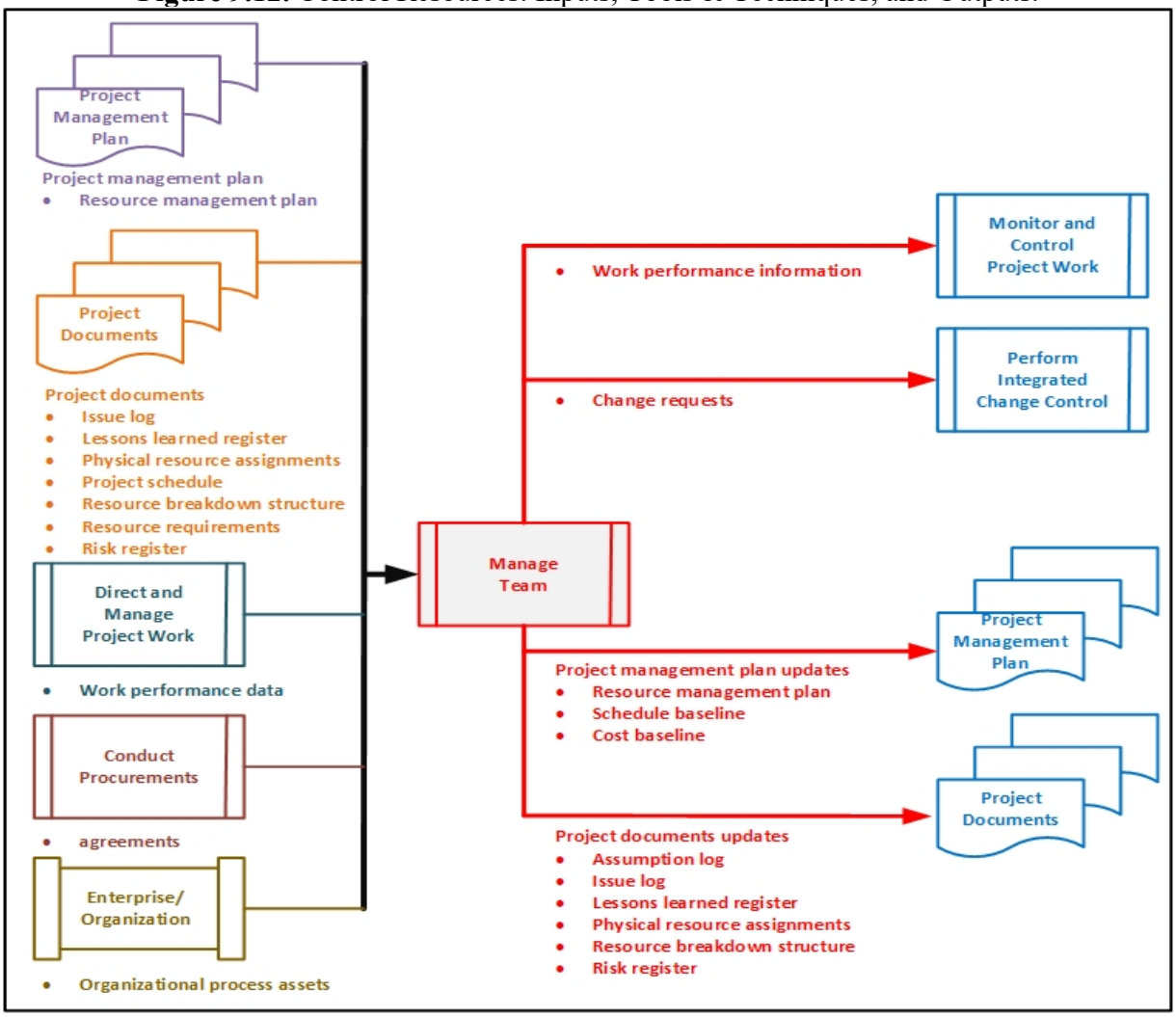

Figure 9.13. Control Resources: Data Flow Diagram.

The Control Resources process should be performed continuously in all project phases and throughout the project life cycle. The resources needed for the project should be assigned and released at the right time, right place, and right amount for the project to continue without delays. The Control Resources process is concerned with physical resources such as equipment, materials, facilities, and infrastructure. Team members are addressed in the Manage Team process.

The Control Resources techniques discussed here are those used most frequently on projects. There are many others that may be useful on certain projects or in some application areas.

Updating resource allocation requires knowing what actual resources have been used to date and what is still needed. This is done mainly by reviewing the performance usage to date. Control Resources is concerned with:

- Monitoring resource expenditures,
- Identifying and dealing with resource shortage/surplus in a timely manner,
- Ensuring that resources are used and released according to the plan and project needs,
- Informing appropriate stakeholders if any issues arise with relevant resources,
- Influencing the factors that can create resources utilization change, and
- Managing the actual changes as they occur.

Questions

1. You've just completed your staffing management plan. What process are you in?
   A. Acquire Project Team
   B. Develop Project Team
   C. Plan Resource Management
   D. Manage Project Team
2. You are writing a performance assessment for your team. Which process are you in?
   A. Develop Project Team
   B. Acquire Project Team
   C. Manage Project Team
   D. Plan Resource Management
3. Tom is using an organization chart to figure out how he'll staff his project. What process is he performing?
   A. Plan Resource Management
   B. Acquire Team
   C. Develop Team
   D. Manage Team
4. All of the following are elements of the resource management plan except:
   A. Project staff assignments
   B. Roles and responsibilities
   C. Project organization charts
   D. Staffing management plan
5. You've just completed your resource histogram. What process are you in?
   A. Acquire Project Team
   B. Develop Project Team
   C. Plan Resource Management
   D. Manage Project Team
6. All of the following statements are true regarding the Human Resource Planning process except for which one?
   A. Human Resource Planning involves determining roles and responsibilities.
   B. One of the Human Resource Planning outputs includes project organization charts that show the project's reporting relationships.
   C. The staffing management plan created in this process describes how and when resources will be acquired and released.
   D. A RAM (or RACI chart) is an output of this process that allows you to see all the people assigned to an activity.
7. All of the following statements describe the activity list except which one?
   A. The activity list is an output of the Activity Definition process.
   B. The activity list includes all activities of the project.
   C. The activity list is an extension of and a component of the WBS.

D. The activity list includes an identifier and description of the activity.

8. This process can directly influence the project schedule.
A. Human Resource Planning
B. Acquire Resources
C. Activity Sequencing
D. Plan Contracting

9. All of the following are determined by the Plan Resources Management process except:
A. Project communication needs for stakeholders
B. Project roles and responsibilities
C. Reporting relationships for the project
D. Staffing management plan

10. Which of the following is not an output of the Develop Resource Plan process?
A. Project organizational chart
B. Roles and responsibilities
C. Project schedule
D. Staff management plan

11. Which of the following is an output of the Estimate Activity Resources process?
A. Resource breakdown structure
B. Risk breakdown structure
C. WBS
D. Activity list

12. Which of the following is not an output of resource planning?
A. Project staff assignments
B. Staffing management plan
C. List of roles and responsibilities
D. Project organization chart

13. Which of the following is not a process of human resource management?
A. Develop Resource Plan
B. Acquire Resources
C. Manage Stakeholder Expectations
D. Develop Project Team

14. Conflict management is a technique used in which of the following processes?
A. Estimate Activity Resources
B. Acquire Resources
C. Plan Resource Management
D. Manage Team

15. Co-location is a technique used in which of the following processes?
A. Plan Resource management
B. Acquire Team
C. Develop Team
D. Manage Team

Chapter 10

Project Communications Management

General Objective of the Chapter:

Trainee will be able to describe and understand the process of Project Communications Management**.**

Detailed Objectives:

1. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Plan Communications Management process.
2. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Manage Communications process.
3. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Monitor Communications process.

10.1. Overview

Project Communications Management includes the processes necessary to ensure that the information needs of the project and its stakeholders are met through development of artifacts and implementation of activities designed to achieve effective information exchange. Project Communications Management consists of two parts. The first part is developing a strategy to ensure communication is effective for stakeholders. The second part is carrying out the activities necessary to implement the communication strategy.

The Project Communications Management processes are:

- **Plan Communications Management.** The process of developing an appropriate approach and plan for project communication activities based on the information needs of each stakeholder or group, available organizational assets, and the needs of the project.
- **Manage Communications.** The process of ensuring timely and appropriate collection, creation, distribution, storage, retrieval, management, monitoring, and the ultimate disposition of project information.
- **.** The **Monitor Communications** process of ensuring the information needs of the project and its stakeholders are met.

Figure 10.1 provides an overview of the Project Communications Management processes.

Communication is the exchange of information, intended or involuntary. The information exchanged can be in the form of ideas, instructions, or emotions. The mechanisms by which information is exchanged can be in:

- **Written form.** Either physical or electronic.
- **Spoken.** Either face-to-face or remote. Formal or informal (as in formal papers or social media).
- **Through gestures.** Tone of voice and facial expressions.
- **Through media.** Pictures, actions, or even just the choice of words.
- **Choice of words.** There is often more than one word to express an idea; there can be subtle differences in the meaning of each of these words and phrases.

Communications describe the possible means by which the information can be sent or received, either through communication activities, such as meetings and presentations, or artifacts, such as emails, social media, project reports, or project documentation.

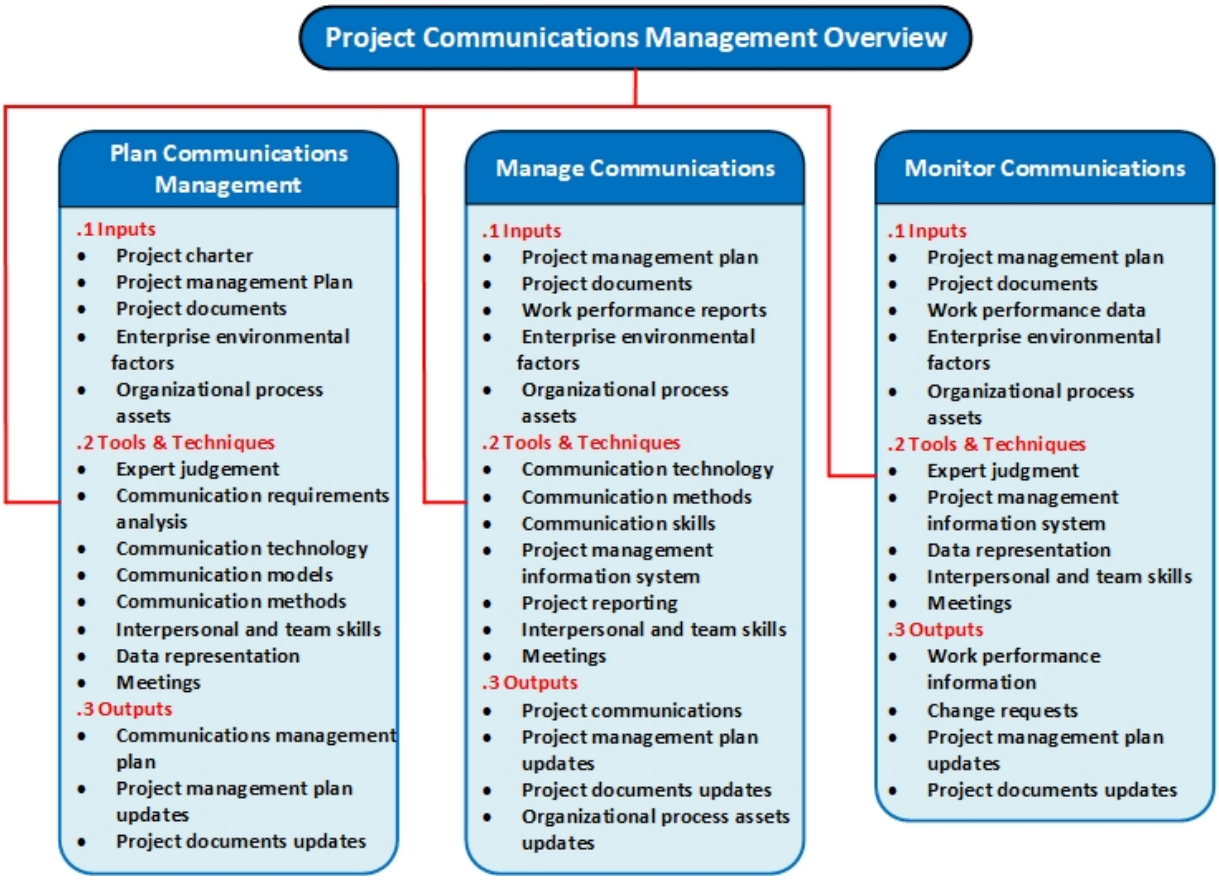

Figure 10.1. Project Communications Management Overview.

10.2. Plan Communications Management

Plan Communications Management is the process of developing an appropriate approach and plan for project communications activities based on the information needs of each stakeholder or group, available organizational assets, and the needs of the project. The key benefit of this process is a documented approach to effectively and efficiently engage stakeholders by presenting relevant information in a timely manner. This process is performed periodically throughout the project as needed.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 10.2. Figure 10.3 depicts the data flow diagram for the process.

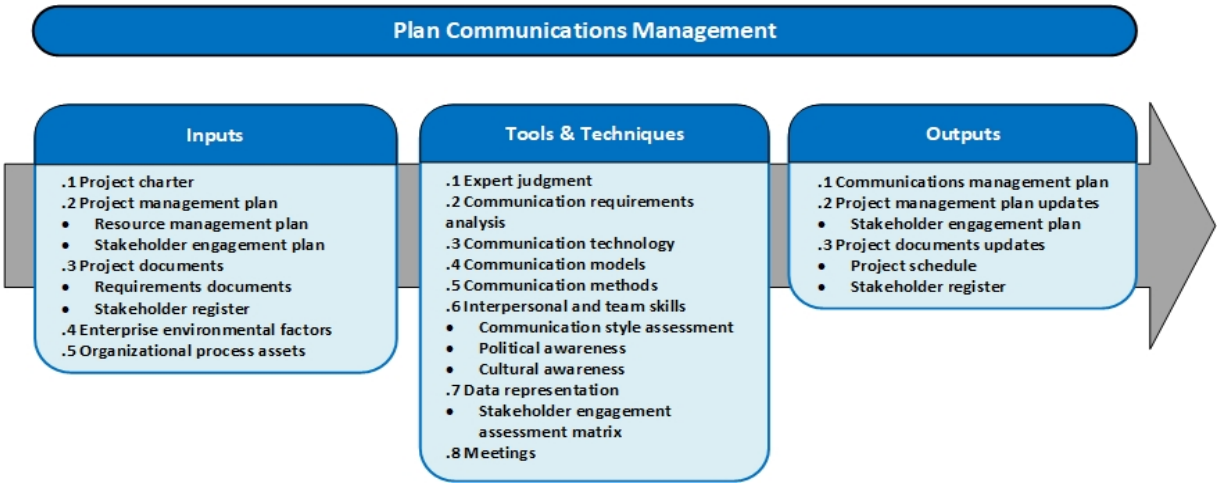

Figure 10.2. Plan Communications Management: Inputs, Tools & Techniques, and Outputs.

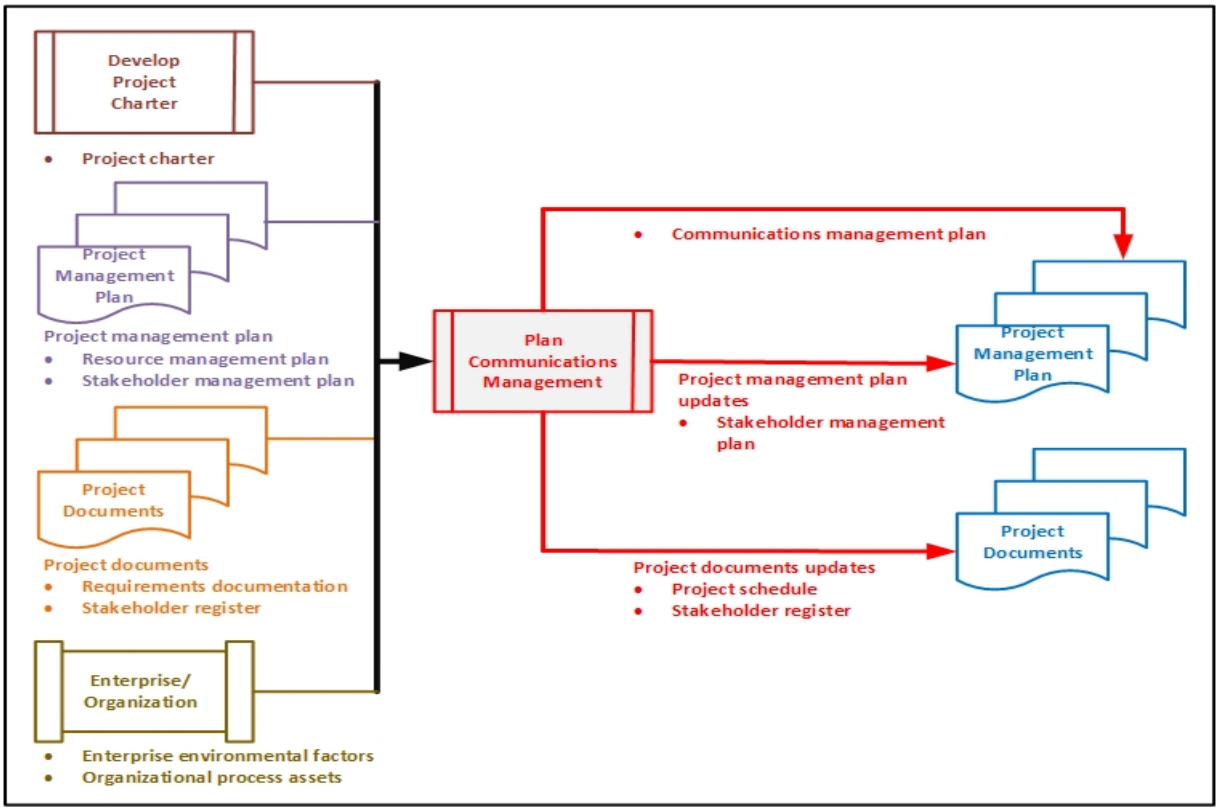

Figure 10.3. Plan Communications Management: Data Flow Diagram.

An effective communications management plan that recognizes the diverse information needs of the project's stakeholders is developed early in the project life cycle. It should be reviewed regularly and modified when necessary, when the stakeholder community changes or at the start of each new project phase.

On most projects, communications planning is performed very early, during stakeholder identification and project management plan development.

While all projects share the need to communicate project information, the information needs and methods of distribution may vary widely. In addition, the methods of storage, retrieval, and ultimate disposition of the project information need to be considered and documented during this process. The results of the Plan Communications Management process should be reviewed regularly throughout the project and revised as needed to ensure continued applicability.

10.3. Manage Communications

Manage Communications is the process of ensuring timely and appropriate collection, creation, distribution, storage, retrieval, management, monitoring, and the ultimate disposition of project information. The key benefit of this process is that it enables an efficient and effective information flow between the project team and the stakeholders. This process is performed throughout the project. The Manage Communications process identifies all aspects of effective communication, including choice of appropriate technologies, methods, and techniques. In addition, it should allow for flexibility in the communications activities, allowing adjustments in the methods and techniques to accommodate the changing needs of stakeholders and the project.
The inputs, tools, techniques, and outputs of this process are depicted in Figure 10.4. Figure 10.5 depicts the data flow diagram of the Manage Communications process.

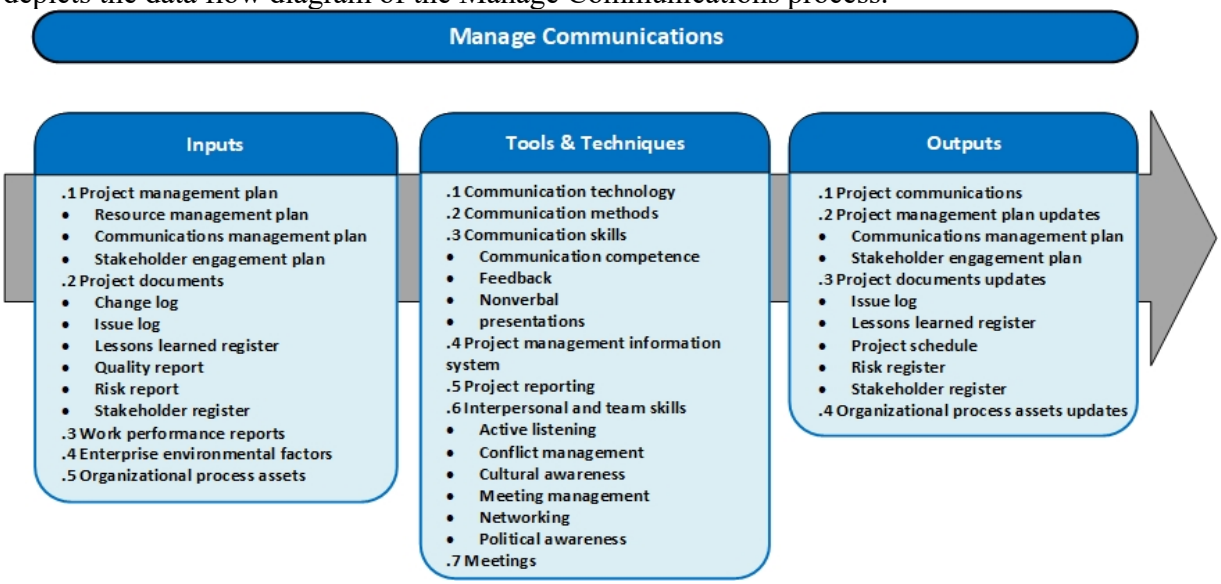

Figure 10.4. Manage Communications: Inputs, Tools & Techniques, and Outputs.

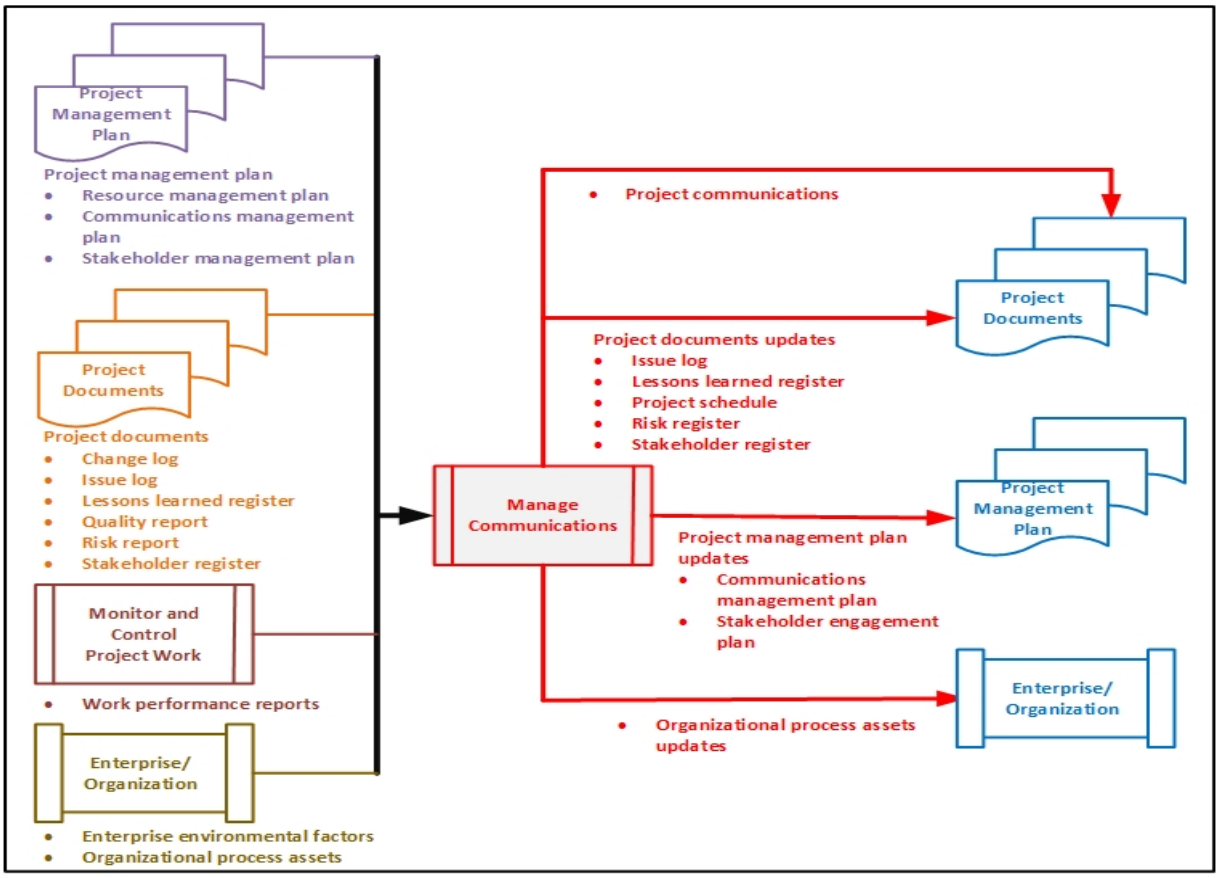

Figure 10.5. Manage Communications: Data Flow Diagram.

This process goes beyond the distribution of relevant information and seeks to ensure that the information being communicated to project stakeholders has been appropriately generated and formatted, and received by the intended audience. It also provides opportunities for stakeholders to make requests for further information, clarification, and discussion. Techniques and considerations for effective communications management include but are not limited to:

- **Sender-receiver models.** Incorporating feedback loops to provide opportunities for interaction/participation and remove barriers to effective communication.
- **Choice of media.** Decisions about application of communications artifacts to meet specific project needs, such as when to communicate in writing versus orally, when to prepare an informal memo versus a formal report, and when to use push/pull options and the choice of appropriate technology.
- **Writing style.** Appropriate use of active versus passive voice, sentence structure, and word choice.
- **Meeting management.** Preparing an agenda, inviting essential participants, and ensuring they attend. Dealing with conflicts within the meeting or resulting from inadequate follow-up of minutes and actions, or attendance of the wrong people.
- **Presentations.** Awareness of the impact of body language and design of visual aids.

- **Facilitation.** Building consensus and overcoming obstacles such as difficult group dynamics, and maintaining interest and enthusiasm among group members.
- **Active listening.** Listening actively involves acknowledging, clarifying and confirming, understanding, and removing barriers that adversely affect comprehension.

10.4. Monitor Communications

Monitor Communications is the process of ensuring the information needs of the project and its stakeholders are met. The key benefit of this process is the optimal information flow as defined in the communications management plan and the stakeholder engagement plan. This process is performed throughout the project.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 10.6. Figure 10.7 depicts the data flow diagram for the process.

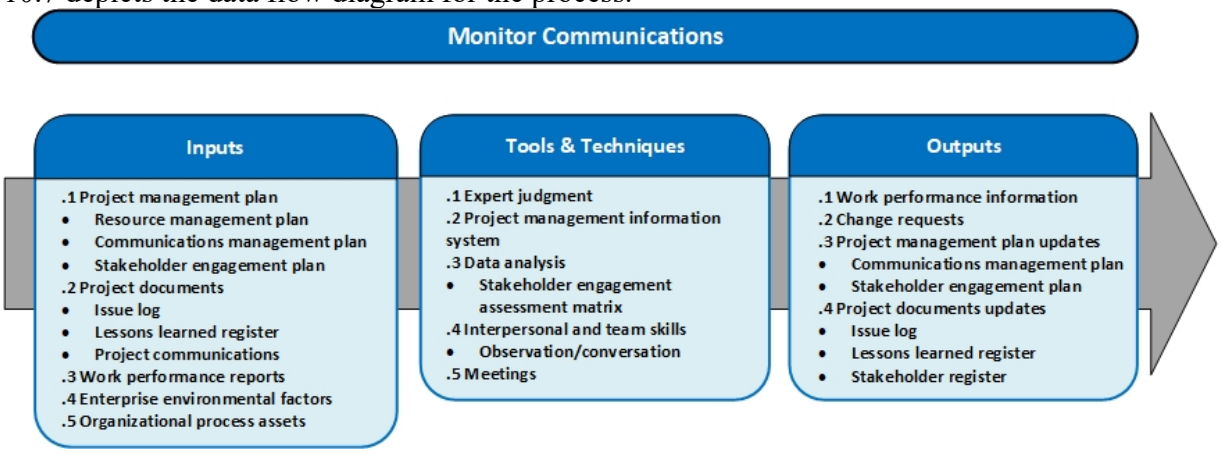

Figure 10.6. Monitor Communications: Inputs, Tools & Techniques, and Outputs.

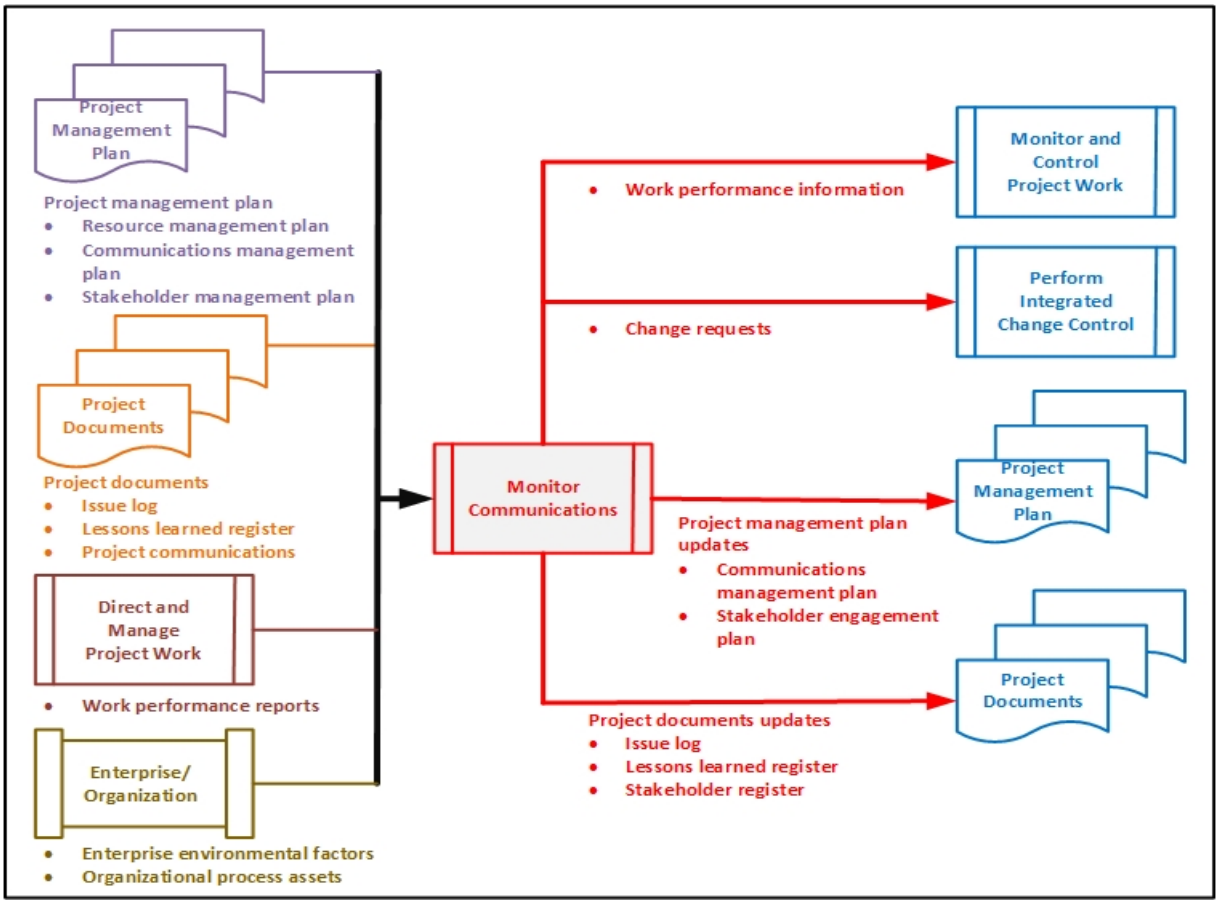

Figure 10.7. Monitor Communications: Data Flow Diagram.

Monitor Communications determines if the planned communications artifacts and activities have had the desired effect of increasing or maintaining stakeholders' support for the project's deliverables and expected outcomes. The impact and consequences of project communications should be carefully evaluated and monitored to ensure that the right message with the right content (the same meaning for sender and receiver) is delivered to the right audience, through the right channel, and at the right time. Monitor Communications may require a variety of methods, such as customer satisfaction surveys, collecting lessons learned, observations of the team, reviewing data from the issue log, or evaluating changes in the stakeholder engagement assessment matrix.

The Monitor Communications process can trigger an iteration of the Plan Communications Management and/or Manage Communications processes to improve effectiveness of communication through additional and possibly amended communications plans and activities. Such iterations illustrate the continuous nature of the Project Communications Management processes. Issues or key performance indicators, risks, or conflicts may trigger an immediate revision.

Questions

1. Which of the following is an input to plan communications?
   A. stakeholder register
   B. team directory
   C. human resource plan
   D. communications plan
2. Which plan is an input to plan communications management?
   A. communications management plan
   B. human resource plan
   C. procurement management plan
   D. project management plan
3. Which of the following is NOT an input to the Plan Communications Management process?
   A. Enterprise environmental factors
   B. Organizational process assets
   C. Information gathering techniques
   D. Project management plan
4. Which communication process is in the Monitoring and Controlling process group?
   A. Manage Communications
   B. None of the communications processes
   C. Plan Communications Management
   D. Monitor Communications
5. You are the project manager for the JHG Project. Management has requested that you create a document detailing what information will be expected from stakeholders and to whom that information will be disseminated. Management is asking for which one of the following?
   A. The roles and responsibilities matrix
   B. The scope management plan
   C. The communications management plan
   D. The communications worksheet
6. All of the following are true regarding Communications Planning except for which one?
   A. It's the only output of the Communications Planning process.
   B. It should be completed as early in the project phases as possible.
   C. It's tightly linked with enterprise environmental factors and organizational influences, and lessons learned and historical information are two inputs that should get a lot of attention during this process.
   D. Communications requirements analysis, communications technology, and PMIS are tools and techniques of this process.
7. Which of the following is not an output of communication planning?
   A. Methods of communication
   B. Communication constraints

C. Frequency of reporting the project status
D. Stakeholder management strategy

8. The communications management process goes beyond distributing relevant information as it……..
A. Focuses on establishing working relationships and standard formats for global communication among stakeholders
B. Enables an effective and efficient information flow between the project team and its stakeholders
C. Establishes individual and group responsibilities and accountabilities for communication management
D. Protects confidential and sensitive information

9. One purpose of the communications management plan is to provide information about the……..
A. Methods that will be used to convey information
B. Methods that will be used for releasing team members from the project when they are no longer needed
C. Project organization and stakeholder responsibility relationships
D. Experience and skill levels of each team member

10. You are managing a project with team members located at customer sites on three different continents. As you plan communications with your stakeholders, you should review……..
A. Stakeholder management plan
B. Stakeholder register
C. Communications model
D. Communications channels

11. Work performance information is an output of which process?
A. Manage risks
B. Manage communications
C. Monitor communications
D. Report performance

12. As an output from Monitor Communications, it may be necessary to update the—
A. Risk register
B. Issue log
C. Corporate policies, procedures, and processes
D. Knowledge management system

13. . Changes in the communications management and stakeholder engagement plans should trigger changes to the……..
A. Project management plan
B. Communications strategy
C. Lessons learned register
D. Change control process

14. The purpose of work performance data in Monitor Communications is to—
A. Obtain data on organizational communications requirements
B. Review distributed information

C. Review stakeholder communication strategies
D. Evaluate deliverable status

15. The key benefit of the Monitor Communications process is—
A. Sharing best practices with other project teams in the organization with lessons learned
B. Ensuring the information needs of stakeholders are met
C. Ensuring an optimal information flow among communication participants
D. Providing stakeholders with information about resolved issues, approved status, and project status

Chapter 11

Project Risk Management

General Objective of the Chapter:

Trainee will be able to describe and understand the process of Project Risk Management**.**

Detailed Objectives:

1. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Plan Risk Management process.
2. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Identify Risks process.
3. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Perform Qualitative Risk Analysis process.
4. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Perform Quantitative Risk Analysis process.
5. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Plan Risk Responses process.
6. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Implement Risk Responses process.
7. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Monitor Risks process.

11.1. Overview

Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project. The objectives of project risk management are to increase the probability and/or impact of positive risks and to decrease the probability and/or impact of negative risks, in order to optimize the chances of project success.

The Project Risk Management processes are:

- **Plan Risk Management.** The process of defining how to conduct risk management activities for a project.
- **Identify Risks.** The process of identifying individual project risks as well as sources of overall project risk, and documenting their characteristics.
- **Perform Qualitative Risk Analysis.** The process of prioritizing individual project risks for further analysis or action by assessing their probability of occurrence and impact as well as other characteristics.
- **Perform Quantitative Risk Analysis.** The process of numerically analyzing the combined effect of identified individual project risks and other sources of uncertainty on overall project objectives.
- **Plan Risk Responses.** The process of developing options, selecting strategies, and agreeing on actions to address overall project risk exposure, as well as to treat individual project risks.
- **Implement Risk Responses.** The process of implementing agreed-upon risk response plans.
- **Monitor Risks.** The process of monitoring the implementation of agreed-upon risk response plans, tracking identified risks, identifying and analyzing new risks, and evaluating risk process effectiveness throughout the project.

Figure 11.1 provides an overview of the Project Risk Management processes.

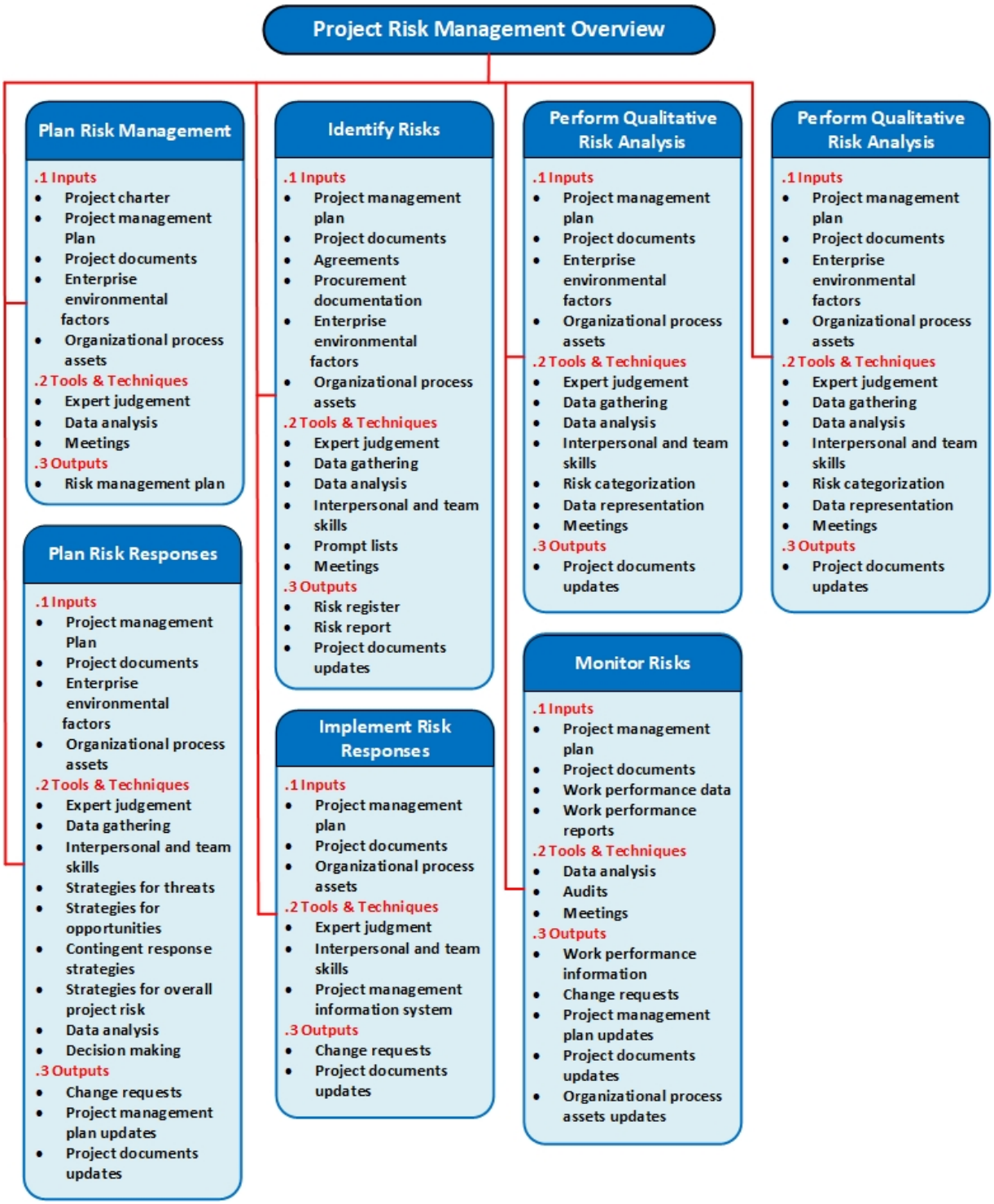

Figure 11.1. Project Communications Management Overview.

11.2. Plan Risk Management

Plan Risk Management is the process of defining how to conduct risk management activities for a project. The key benefit of this process is that it ensures that the degree, type, and visibility of risk management are proportionate to both risks and the importance of the project to the organization and other stakeholders. This process is performed once or at predefined points in the project.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 11.2. Figure 11.3 depicts the data flow diagram for the process.

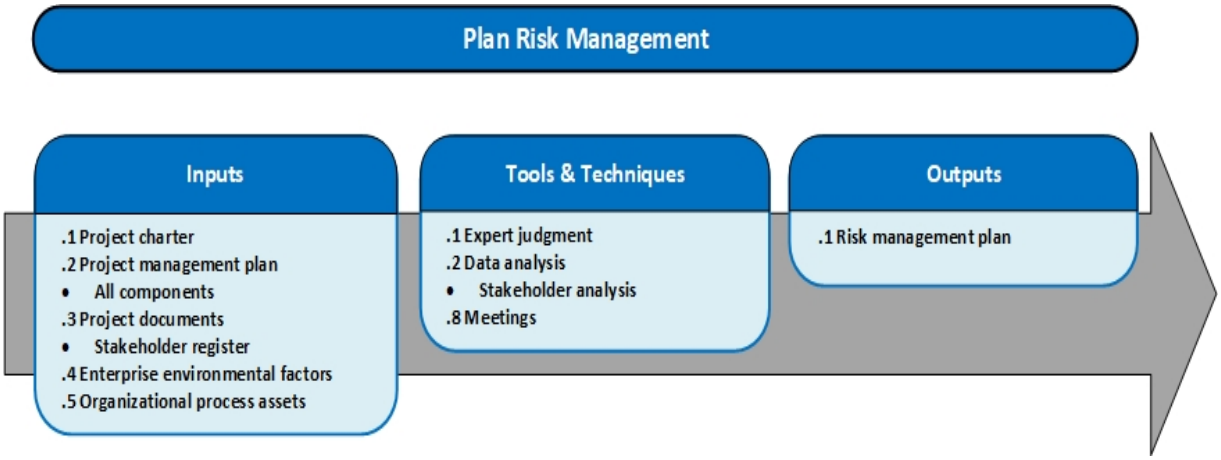

Figure 11.2. Plan Risk Management: Inputs, Tools & Techniques, and Outputs.

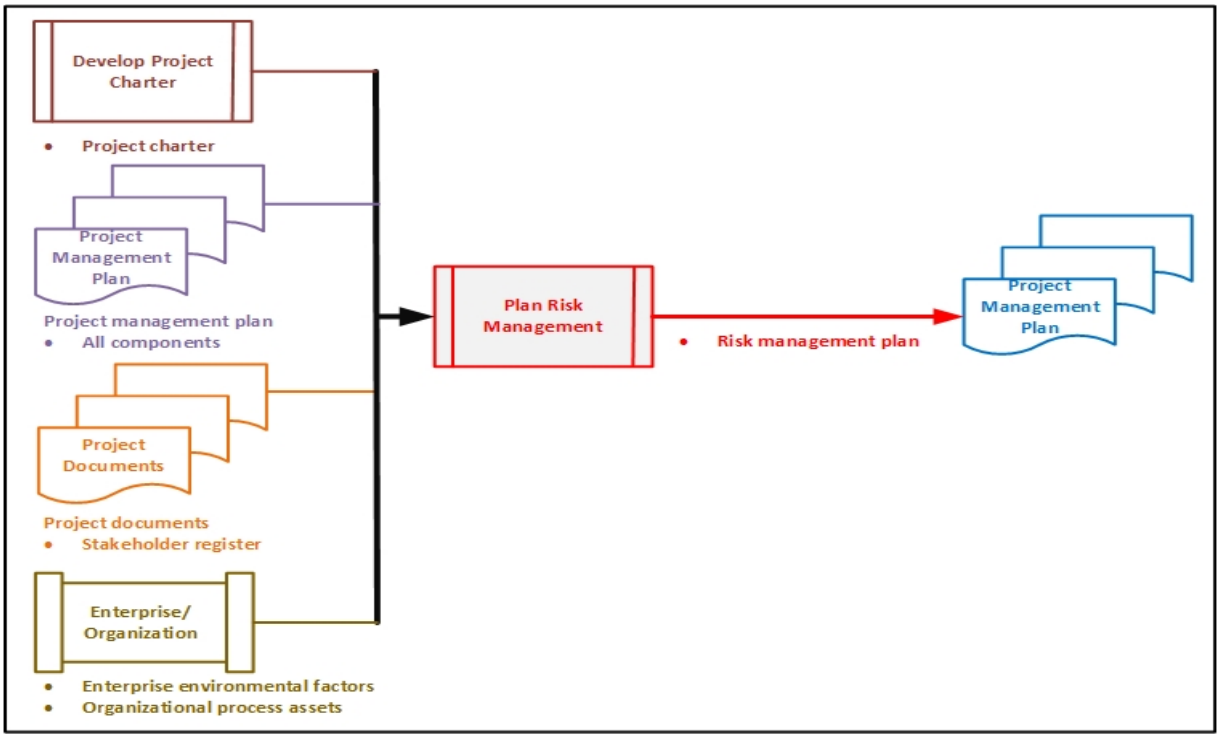

Figure 11.3. Plan Risk Management: Data Flow Diagram.

The Plan Risk Management process should begin when a project is conceived and should be completed early in the project. It may be necessary to revisit this process later in the project life cycle, for example at a major phase change, or if the project scope changes significantly, or if a subsequent review of risk management effectiveness determines that the Project Risk Management process requires modification.

11.3. Identify Risks

Identify Risks is the process of identifying individual project risks as well as sources of overall project risk, and documenting their characteristics. The key benefit of this process is the documentation of existing individual project risks and the sources of overall project risk. It also brings together information so the project team can respond appropriately to identified risks. This process is performed throughout the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 11.4. Figure 11.5 depicts the data flow diagram for the process.

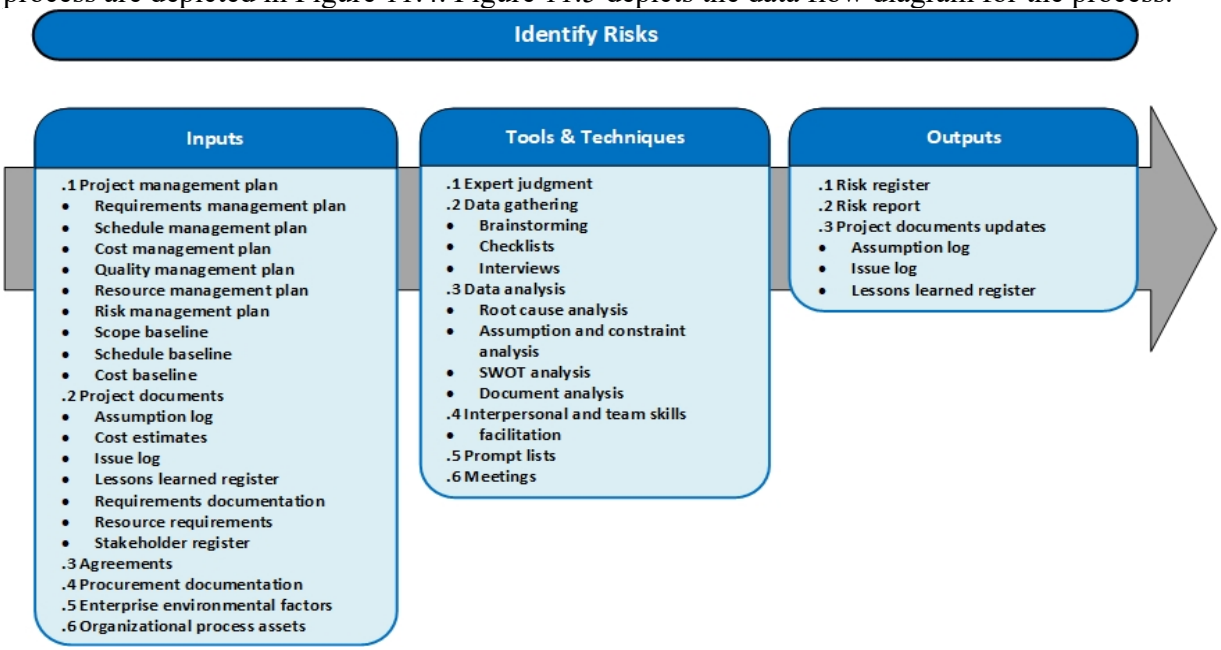

Figure 11.4. Identify Risks: Inputs, Tools & Techniques, and Outputs.

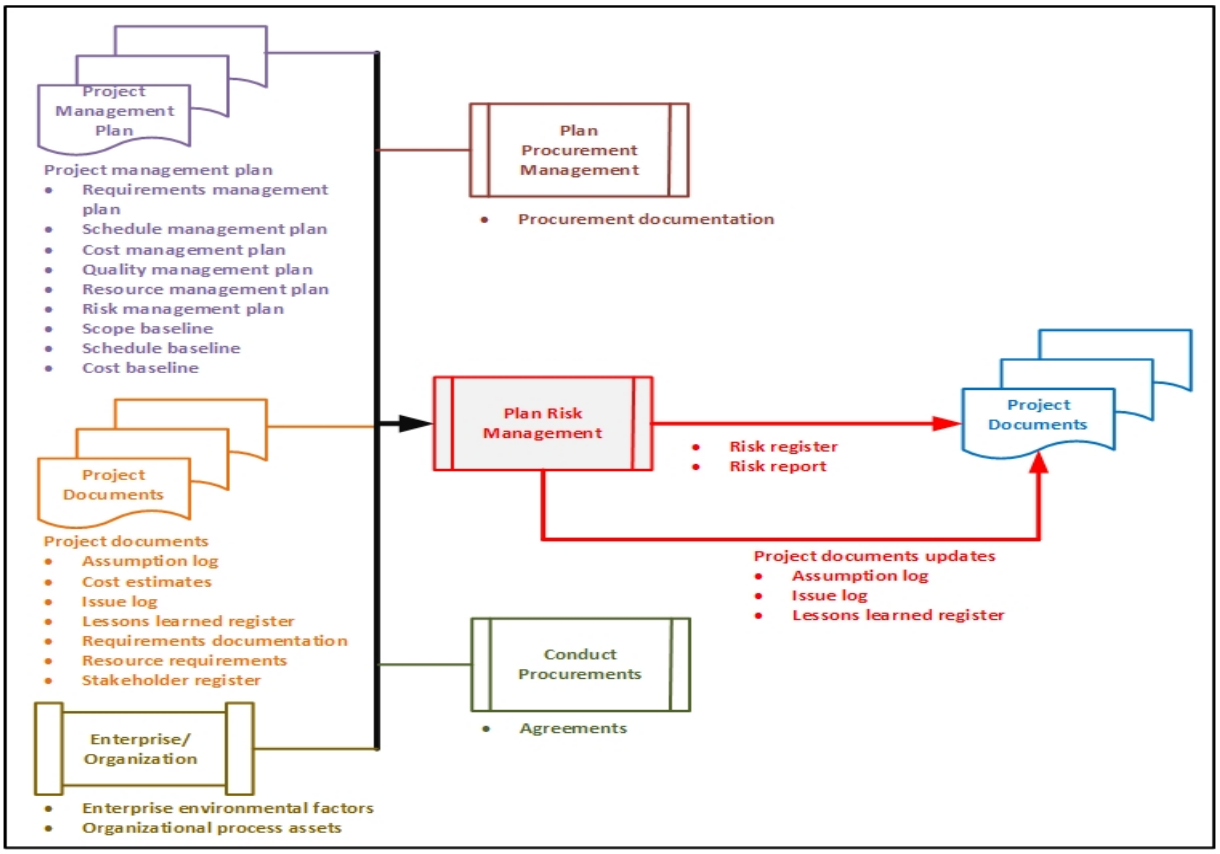

Figure 11.5. Identify Risks: Data Flow Diagram.

Identify Risks considers both individual project risks and sources of overall project risk. Participants in risk identification activities may include the following: project manager, project team members, project risk specialist (if assigned), customers, subject matter experts from outside the project team, end users, other project managers, operations managers, stakeholders, and risk management experts within the organization. While these personnel are often key participants for risk identification, all project stakeholders should be encouraged to identify individual project risks. It is particularly important to involve the project team so they can develop and maintain a sense of ownership and responsibility for identified individual project risks, the level of overall project risk, and associated risk response actions.

When describing and recording individual project risks, a consistent format should be used for risk statements to ensure that each risk is understood clearly and unambiguously in order to support effective analysis and risk response development. Risk owners for individual project risks may be nominated as part of the Identify Risks process, and will be confirmed during the Perform Qualitative Risk Analysis process. Preliminary risk responses may also be identified and recorded and will be reviewed and confirmed as part of the Plan Risk Responses process.

Identify Risks is an iterative process, since new individual project risks may emerge as the project progresses through its life cycle and the level of overall project risk will also change. The frequency of iteration and participation in each risk identification cycle will vary by situation, and this will be defined in the risk management plan.

11.4. Perform Qualitative Risk Analysis

Perform Qualitative Risk Analysis is the process of prioritizing individual project risks for further analysis or action by assessing their probability of occurrence and impact as well as other characteristics. The key benefit of this process is that it focuses efforts on high-priority risks. This process is performed throughout the project.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 11.6. Figure 11.7 depicts the data flow diagram for the process.

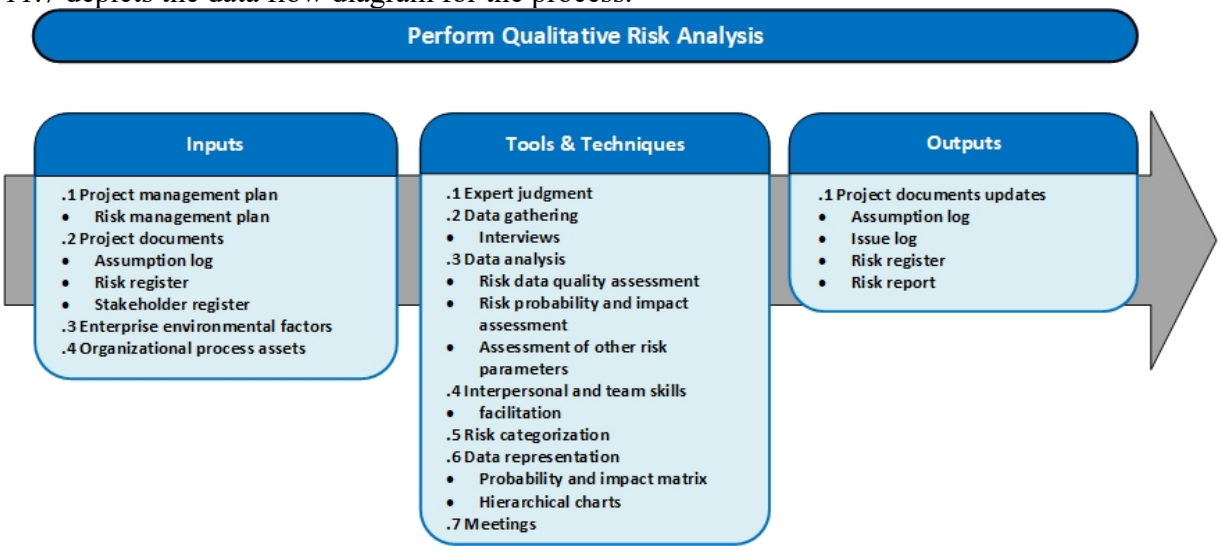

Figure 11.6. Perform Qualitative Risk Analysis: Inputs, Tools & Techniques, and Outputs.

Perform Qualitative Risk Analysis assesses the priority of identified individual project risks using their probability of occurrence, the corresponding impact on project objectives if the risks occur, and other factors. Such assessments are subjective as they are based on perceptions of risk by the project team and other stakeholders. Effective assessment therefore requires explicit identification and management of the risk attitudes of key participants in the Perform Qualitative Risk Analysis process. Risk perception introduces bias into the assessment of identified risks, so attention should be paid to identifying bias and correcting for it. Where a facilitator is used to support the Perform Qualitative Risk Analysis process, addressing bias is a key part of the facilitator's role. An evaluation of the quality of the available information on individual project risks also helps to clarify the assessment of each risk's importance to the project.

Perform Qualitative Risk Analysis establishes the relative priorities of individual project risks for Plan Risk Responses. It identifies a risk owner for each risk who will take responsibility for planning an appropriate risk response and ensuring that it is implemented. Perform Qualitative Risk Analysis also lays the foundation for Perform Quantitative Risk Analysis if this process is required. The Perform Qualitative Risk Analysis process is performed regularly throughout the project life cycle, as defined in the risk management plan. Often, in an agile development environment, the Perform Qualitative Risk Analysis process is conducted before the start of each iteration.

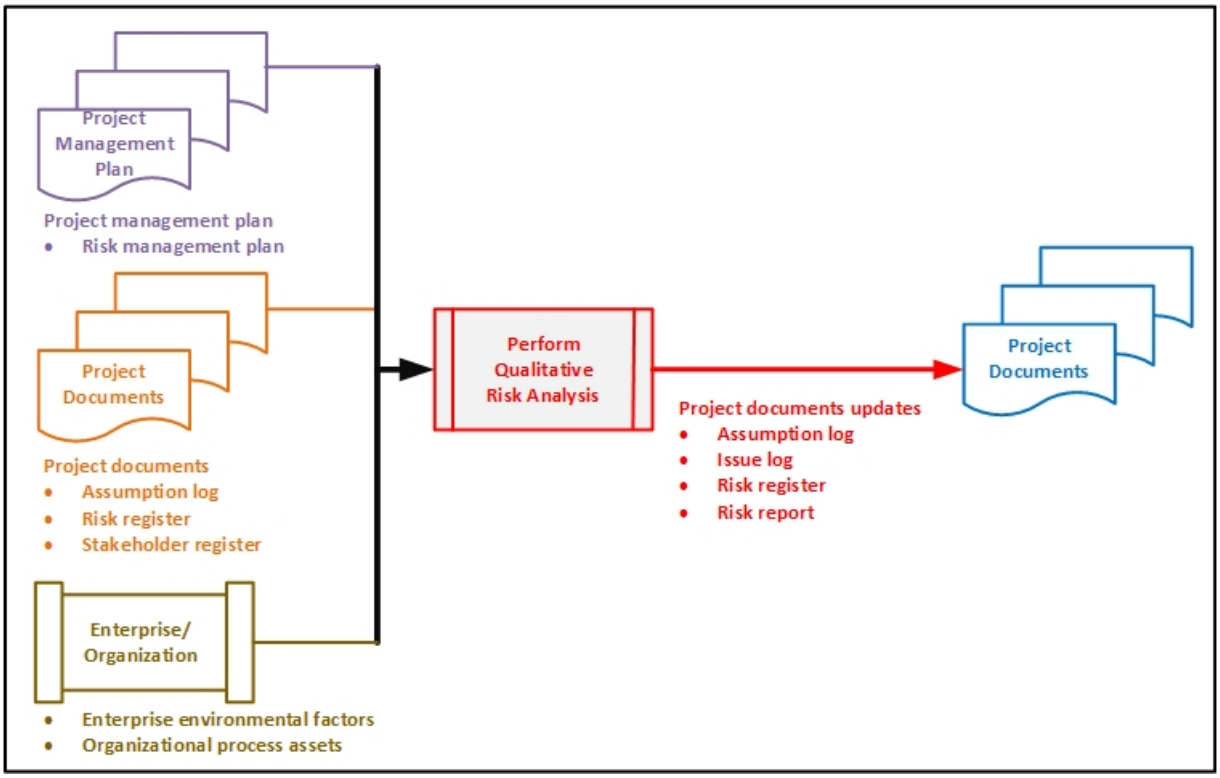

Figure 11.7. Perform Qualitative Risk Analysis: Data Flow Diagram.

11.5. Perform Quantitative Risk Analysis

Perform Quantitative Risk Analysis is the process of numerically analyzing the combined effect of identified individual project risks and other sources of uncertainty on overall project objectives. The key benefit of this process is that it quantifies overall project risk exposure, and it can also provide additional quantitative risk information to support risk response planning. This process is not required for every project, but where it is used, it is performed throughout the project.

The inputs and outputs of this process are depicted in Figure 11.8. Figure 11.9 depicts the data flow diagram for the process.

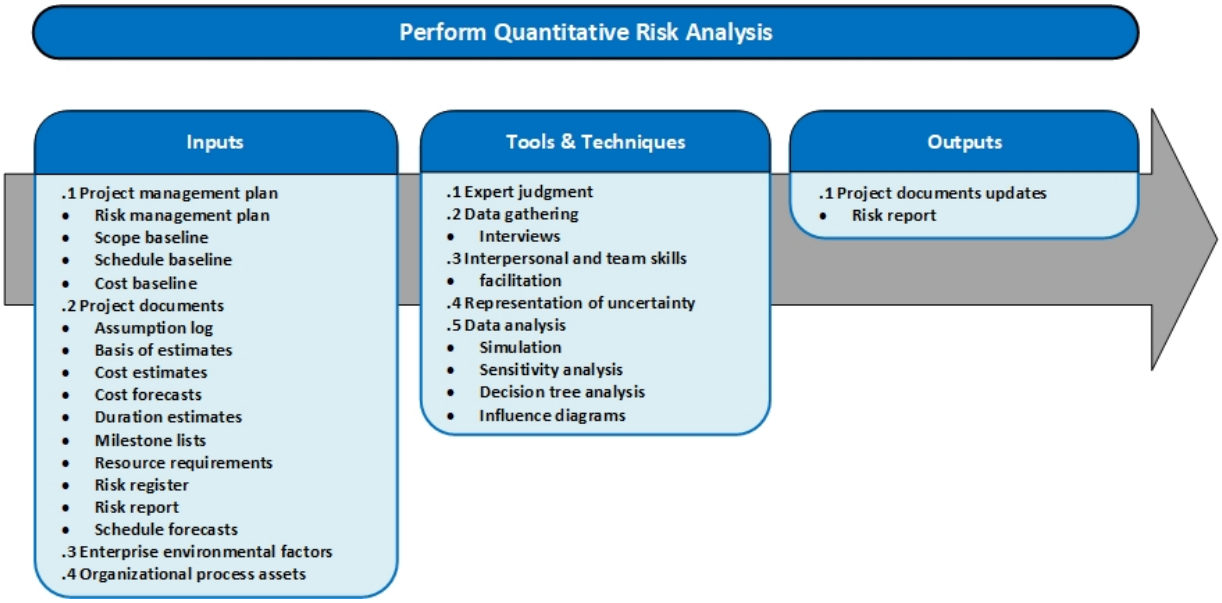

Figure 11.8. Perform Quantitative Risk Analysis: Inputs, Tools & Techniques, and Outputs.

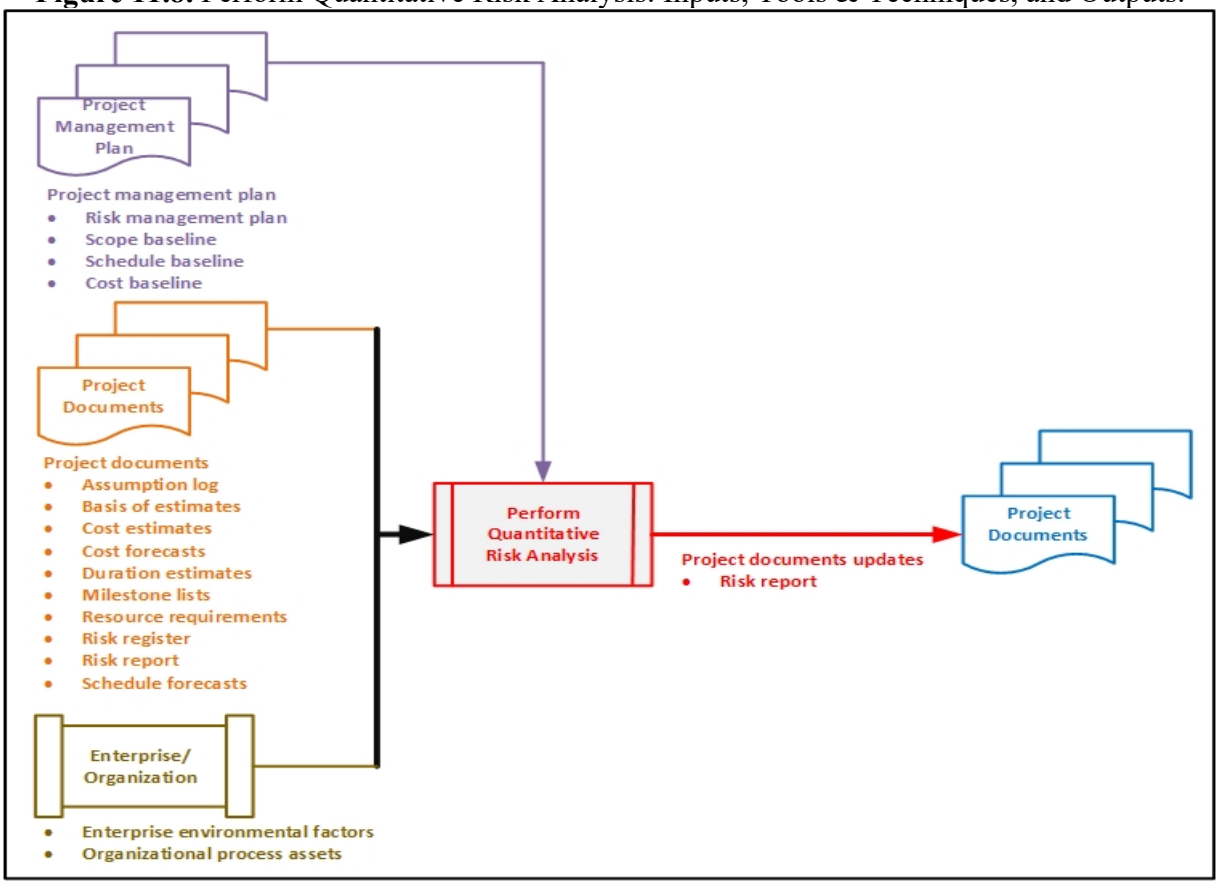

Figure 11.9. Perform Quantitative Risk Analysis: Data Flow Diagram.

Perform Quantitative Risk Analysis is not required for all projects. Undertaking a robust analysis depends on the availability of high-quality data about individual project risks and other sources of uncertainty, as well as a sound underlying project baseline for scope, schedule, and cost. Quantitative risk analysis usually requires specialized risk software and expertise in the development and interpretation of risk models. It also consumes additional time and cost. The use of quantitative risk analysis for a project will be specified in the project's risk management plan. It is most likely appropriate for large or complex projects, strategically important projects, projects for which it is a contractual requirement, or projects in which a key stakeholder requires it. Quantitative risk analysis is the only reliable method to assess overall project risk through evaluating the aggregated effect on project outcomes of all individual project risks and other sources of uncertainty.

Perform Quantitative Risk Analysis uses information on individual project risks that have been assessed by the Perform Qualitative Risk Analysis process as having a significant potential to affect the project's objectives.

Outputs from Perform Quantitative Risk Analysis are used as inputs to the Plan Risk Responses process, particularly in recommending responses to the level of overall project risk and key individual risks. A quantitative risk analysis may also be undertaken following the Plan Risk Responses process, to determine the likely effectiveness of planned responses in reducing overall project risk exposure.

11.6. Plan Risk Responses

Plan Risk Responses is the process of developing options, selecting strategies, and agreeing on actions to address overall project risk exposure, as well as to treat individual project risks. The key benefit of this process is that it identifies appropriate ways to address overall project risk and individual project risks. This process also allocates resources and inserts activities into project documents and the project management plan as needed. This process is performed throughout the project.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 11.10. Figure 11.11 depicts the data flow diagram for the process.

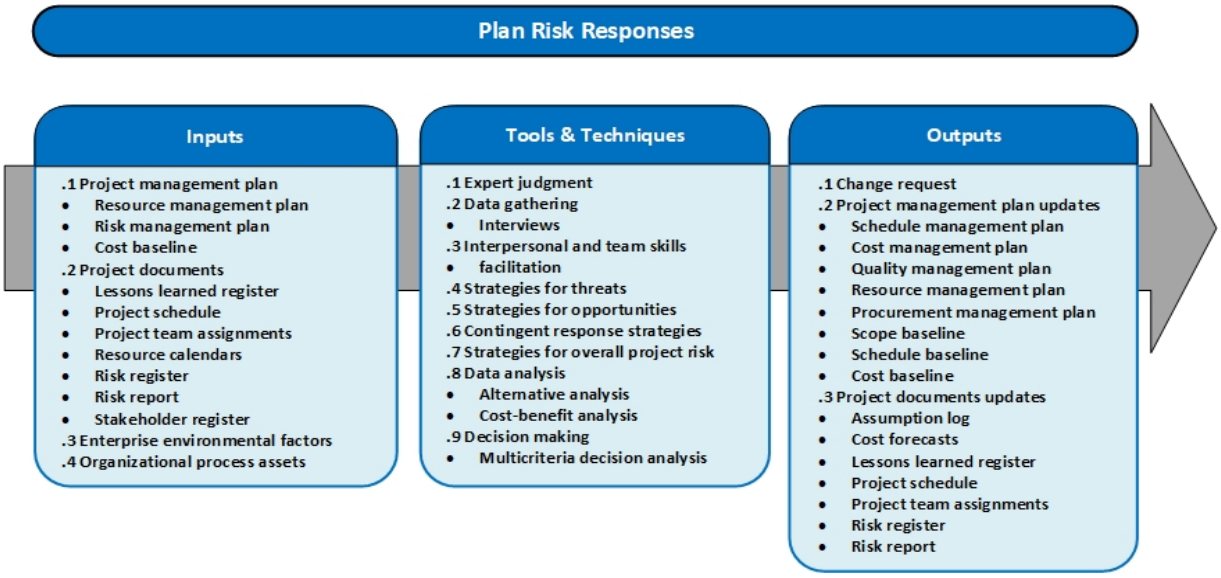

Figure 11.10. Plan Risk Responses: Inputs, Tools & Techniques, and Outputs.

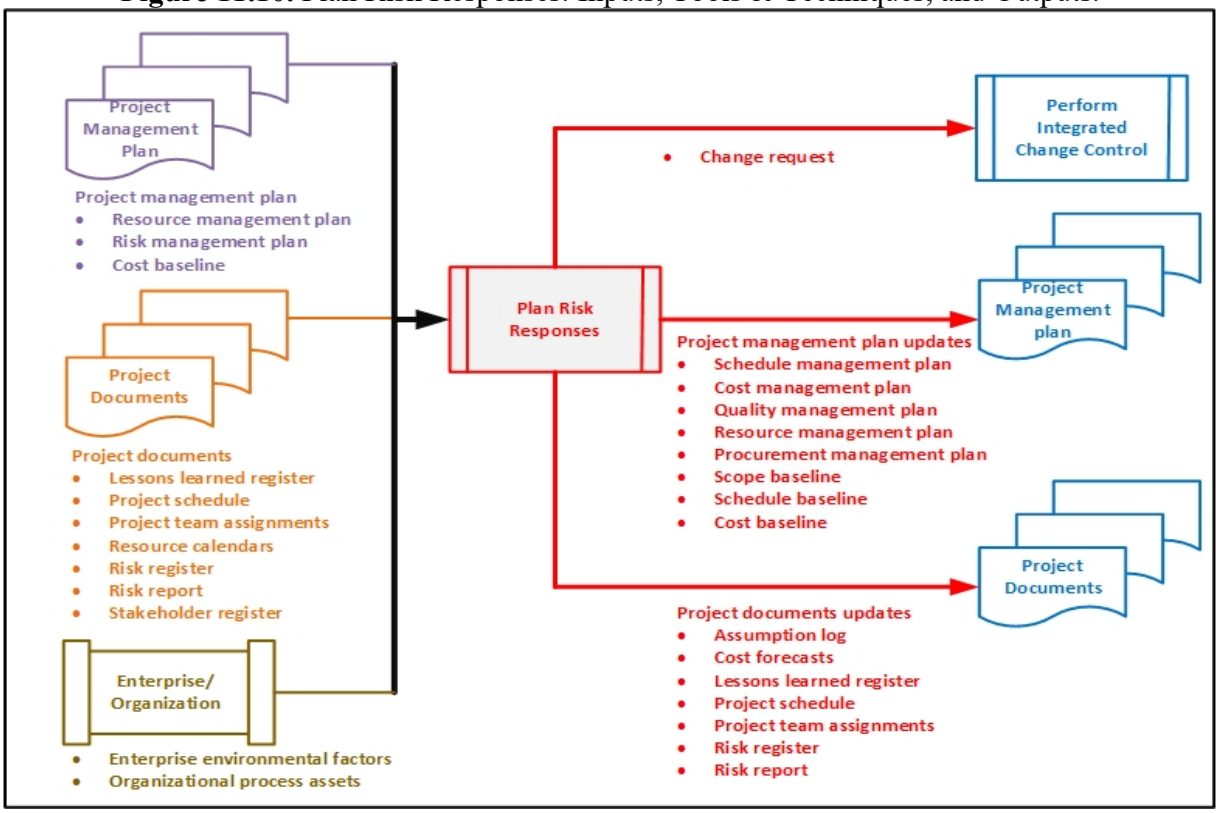

Figure 11.11. Plan Risk Responses: Data Flow Diagram.

Effective and appropriate risk responses can minimize individual threats, maximize individual opportunities, and reduce overall project risk exposure. Unsuitable risk responses can have the converse effect. Once risks have been identified, analyzed, and prioritized, plans should be developed by the nominated risk owner for addressing every individual project risk the project

team considers to be sufficiently important, either because of the threat it poses to the project objectives or the opportunity it offers. The project manager should also consider how to respond appropriately to the current level of overall project risk.

Risk responses should be appropriate for the significance of the risk, cost-effective in meeting the challenge, realistic within the project context, agreed upon by all parties involved, and owned by a responsible person. Selecting the optimal risk response from several options is often required. The strategy or mix of strategies most likely to be effective should be selected for each risk. Structured decision-making techniques may be used to choose the most appropriate response. For large or complex projects, it may be appropriate to use a mathematical optimization model or real options analysis as a basis for a more robust economic analysis of alternative risk response strategies.

Specific actions are developed to implement the agreed-upon risk response strategy, including primary and backup strategies, as necessary. A contingency plan (or fallback plan) can be developed for implementation if the selected strategy turns out not to be fully effective or if an accepted risk occurs. Secondary risks should also be identified. Secondary risks are risks that arise as a direct result of implementing a risk response. A contingency reserve is often allocated for time or cost. If developed, it may include identification of the conditions that trigger its use.

11.7. Implement Risk Responses

Implement Risk Responses is the process of implementing agreed-upon risk response plans. The key benefit of this process is that it ensures that agreed-upon risk responses are executed as planned in order to address overall project risk exposure, minimize individual project threats, and maximize individual project opportunities. This process is performed throughout the project.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 11.12. Figure 11.13 depicts the data flow diagram for the process.

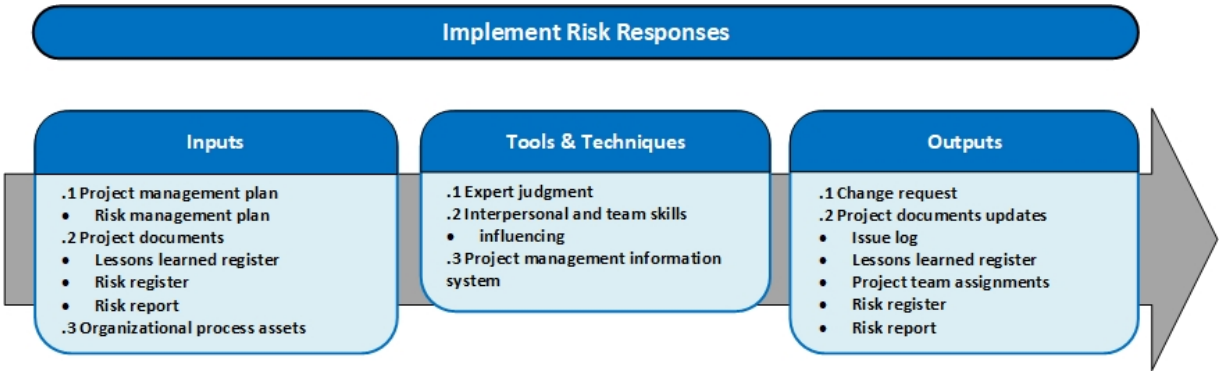

Figure 11.12. Implement Risk Responses: Inputs, Tools & Techniques, and Outputs.

Proper attention to the Implement Risk Responses process will ensure that agreed-upon risk responses are actually executed. A common problem with Project Risk Management is that project teams spend effort in identifying and analyzing risks and developing risk responses, then risk responses are agreed upon and documented in the risk register and risk report, but no action is taken to manage the risk.

Only if risk owners give the required level of effort to implementing the agreed-upon responses will the overall risk exposure of the project and individual threats and opportunities be managed proactively.

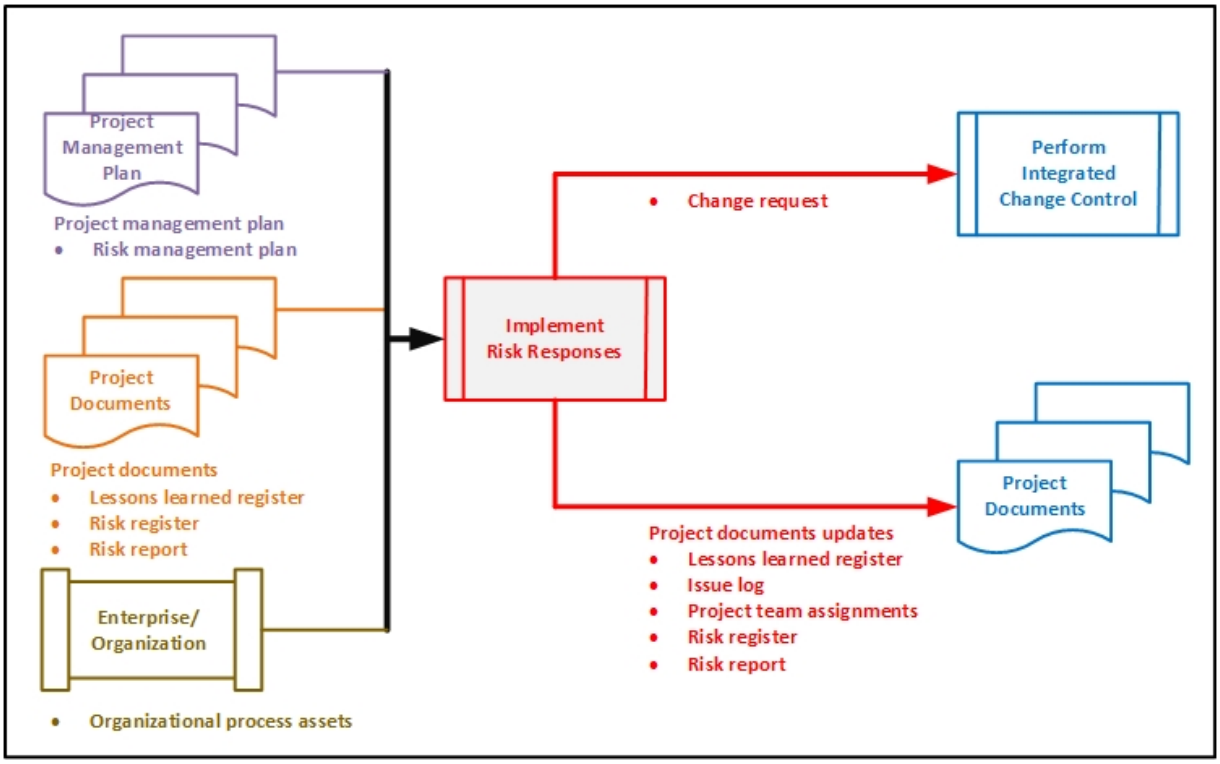

Figure 11.13. Implement Risk Responses: Data Flow Diagram.

11.8. Monitor Risks

Monitor Risks is the process of monitoring the implementation of agreed-upon risk response plans, tracking identified risks, identifying and analyzing new risks, and evaluating risk process effectiveness throughout the project. The key benefit of this process is that it enables project decisions to be based on current information about overall project risk exposure and individual project risks. This process is performed throughout the project.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 11.14. Figure 11.15 depicts the data flow diagram for the process.

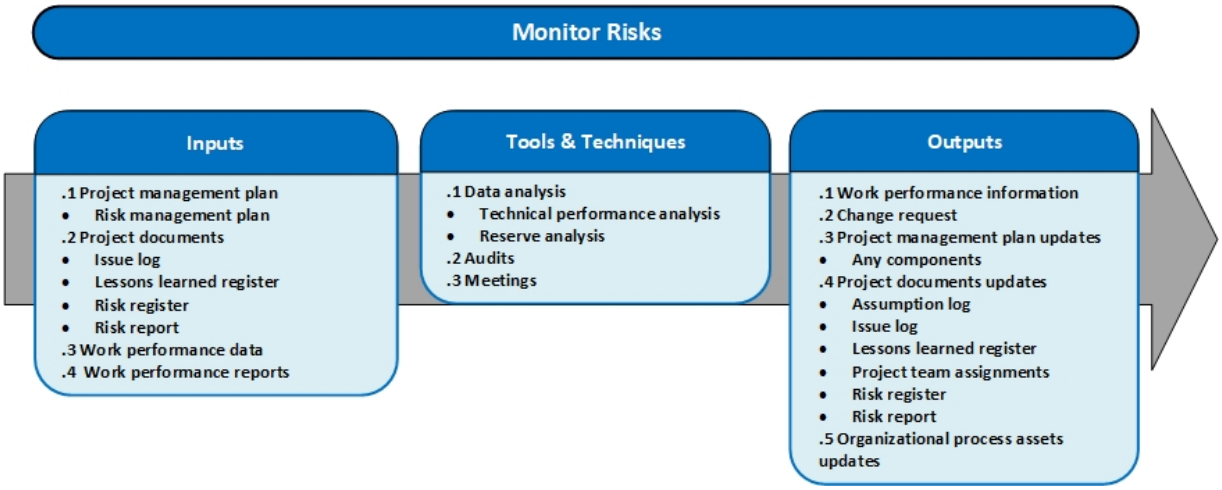

Figure 11.14. Monitor Risks: Inputs, Tools & Techniques, and Outputs.

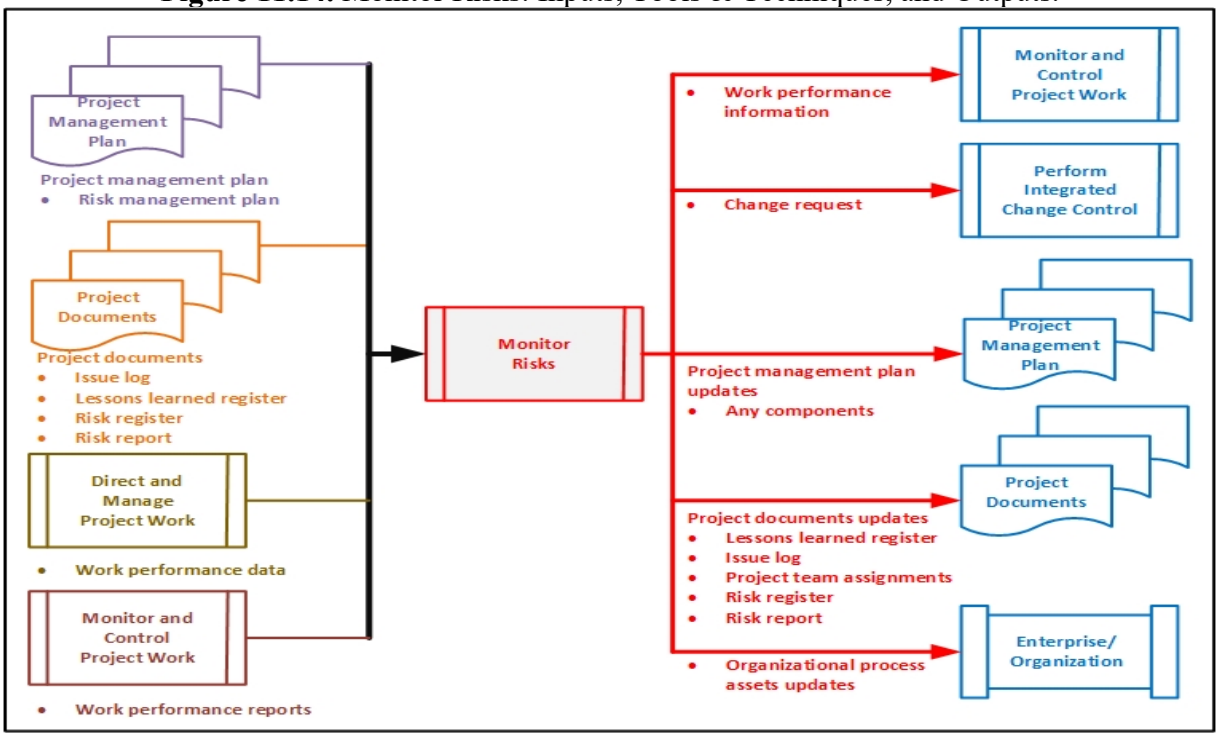

Figure 11.15. Monitor Risks: Data Flow Diagram.

In order to ensure that the project team and key stakeholders are aware of the current level of risk exposure, project work should be continuously monitored for new, changing, and outdated individual project risks and for changes in the level of overall project risk by applying the Monitor Risks process. The Monitor Risks process uses performance information generated during project execution to determine if:

- Implemented risk responses are effective,
- Level of overall project risk has changed,
- Status of identified individual project risks has changed,

- New individual project risks have arisen,
- Risk management approach is still appropriate,
- Project assumptions are still valid,
- Risk management policies and procedures are being followed,
- Contingency reserves for cost or schedule require modification, and
- Project strategy is still valid.

Questions

1. What's the main output of the Risk Management processes?
   A. The Risk Management plan
   B. The risk breakdown structure
   C. Work performance information
   D. The risk register and project documents updates
2. The process of assessing the probability and consequences of identified risks to the project objectives, assigning a risk score to each risk, and creating a list of prioritized risks describes which of the following processes?
   A. Quantitative Risk Analysis
   B. Risk Identification
   C. Qualitative Risk Analysis
   D. Risk Management Planning
3. Each of the following statements is true regarding the risk management plan except for which one?
   A. The risk management plan is an output of the Risk Management Planning process.
   B. The risk management plan includes a description of the responses to risks and triggers.
   C. The risk management plan includes thresholds, scoring and interpretation methods, responsible parties, and budgets.
   D. The risk management plan is an input to all the remaining risk-planning processes.
4. Which of the following processes assesses the likelihood of risk occurrences and their consequences using a numerical rating?
   A. Qualitative Risk Analysis
   B. Risk Identification
   C. Quantitative Risk Analysis
   D. Risk Response Planning
5. Projects are particularly susceptible to risk because—
   A. People assume there will be problems
   B. There is uncertainty in all projects
   C. Project management tools are generally unavailable at the project team level
   D. There are never enough resources to do the job
6. Two key inputs to the Perform Quantitative Risk Analysis process are the—
   A. WBS and milestone list
   B. Scope management plan and process improvement plan
   C. Schedule management plan and cost management plan
   D. Procurement management plan and quality baseline
7. On a typical project, when are risks highest and the cost of changes the lowest?
   A. During the concept phase
   B. At or near completion of the project
   C. During the implementation phase
   D. When the project manager is replaced

8. The project scope statement should be used in the Identify Risk process because it—
A. Identifies project assumptions
B. Identifies all the work that must be done and, therefore, includes all the risks on the project
C. Helps to organize all the work that must be done on the project
D. Contains information on risks from prior projects

9. Most of the project risks will be identified during which risk management processes?
A. Perform Quantitative Risk Analysis and Identify Risks
B. Identify Risks and Monitor Risks
C. Perform Qualitative Risk Analysis and Monitor Risks
D. Identify Risks and Perform Qualitative Risk Analysis

10. Beta is the Project Manager of a Road construction project. During a project review, Beta realizes that one particular risk has occurred. To take appropriate action against risk that has happened, Beta needs to refer to which document?
A. Risk response plan
B. Risk management plan
C. Risk breakdown structure
D. Risk register

11. During which stage of Risk planning are risks prioritized based on probability and impact?
A. Identify Risks
B. Plan Risk responses
C. Perform Qualitative risk analysis
D. Perform Quantitative risk analysis

12. During which stage of Risk planning are modeling techniques used to determine overall effects of risks on project objectives for high probability, high impact risks?
A. Identify Risks
B. Plan Risk responses
C. Perform Qualitative risk analysis
D. Perform Quantitative risk analysis

13. Andrew is a Project Manager for Green Valley project. A risk management plan has been prepared for the project. Which of the following should Andrew do next?
A. Perform Qualitative risk analysis
B. Perform Quantitative risk analysis
C. Identify Risks
D. Plan Risk responses

14. Which of the following processes has risk register as the primary output?
A. Plan Risk Management
B. Identify Risks
C. Monitoring and Control Risks
D. Perform Qualitative Risk Analysis

15. A process that involves prioritizing risks for further action or analysis by assessing the impact and the probability of occurrence is called
A. Qualitative Risk Analysis
B. Risk Brainstorming

C. Quantitative Risk Analysis
D. Risk Retrospective

Chapter 12

Project Procurement Management

General Objective of the Chapter:

Trainee will be able to describe and understand the process of Project Procurement Management**.**

Detailed Objectives:

1. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Plan Procurement Management process.
2. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Conduct Procurements process.
3. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Control Procurements process.

12.1. Overview

Project Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team. Project Procurement Management includes the management and control processes required to develop and administer agreements such as contracts, purchase orders, memoranda of agreements (MOAs), or internal service level agreements (SLAs). The personnel authorized to procure the goods and/or services required for the project may be members of the project team, management, or part of the organization's purchasing department if applicable.

Project Procurement Management processes include the following:

- **Plan Procurement Management.** The process of documenting project procurement decisions, specifying the approach, and identifying potential sellers.
- **Conduct Procurements.** The process of obtaining seller responses, selecting a seller, and awarding a contract.
- **Control Procurements.** The process of managing procurement relationships, monitoring contract performance, making changes and corrections as appropriate, and closing out contracts.

Figure 12.1 provides an overview of the Project Procurement processes.

More than most other project management processes, there can be significant legal obligations and penalties tied to the procurement process. The project manager does not have to be a trained expert in procurement management laws and regulations but should be familiar enough with the procurement process to make intelligent decisions regarding contracts and contractual relationships. The project manager is typically not authorized to sign legal agreements binding the organization; this is reserved for those who have the authority to do so.

The Project Procurement Management processes involve agreements that describe the relationship between two parties—a buyer and a seller. Agreements can be as simple as the purchase of a defined quantity of labour hours at a specified labour rate, or they can be as complex as multiyear international construction contracts. The contracting approach and the contract itself should reflect the simplicity or complexity of the deliverables or required effort and should be written in a manner that complies with local, national, and international laws regarding contracts.

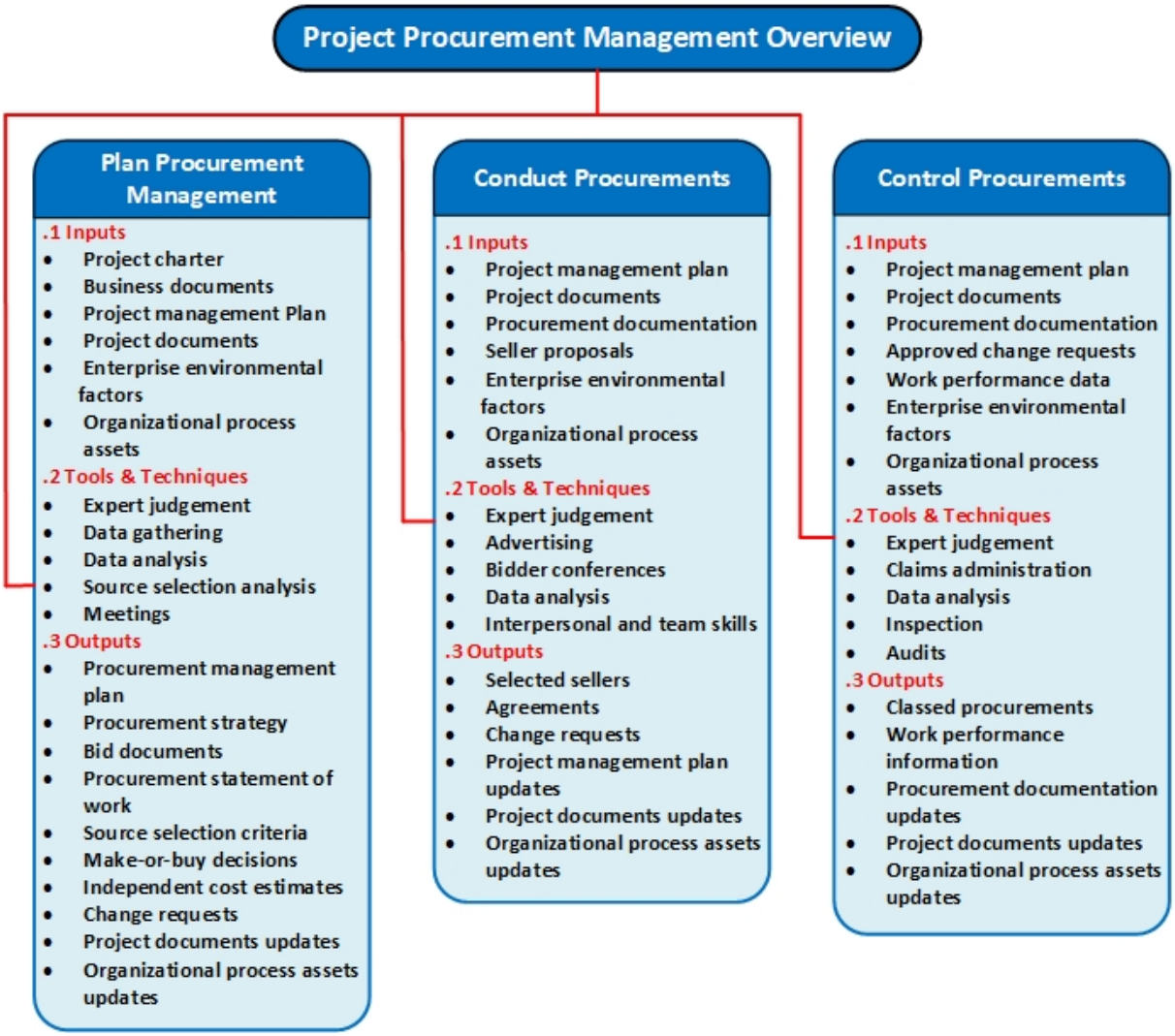

Figure 12.1. Project Procurement Management Overview.

12.2. Plan Procurement Management

Plan Procurement Management is the process of documenting project procurement decisions, specifying the approach and identifying potential sellers. The key benefit of this process is that it determines whether to acquire goods and services from outside the project and, if so, what to acquire as well as how and when to acquire it. Goods and services may be procured from other parts of the performing organization or from external sources. This process is performed once or at predefined points in the project.

The inputs, tools and techniques, and outputs of this process are depicted in Figure 12.2. Figure 12.3 depicts the data flow diagram of the process.

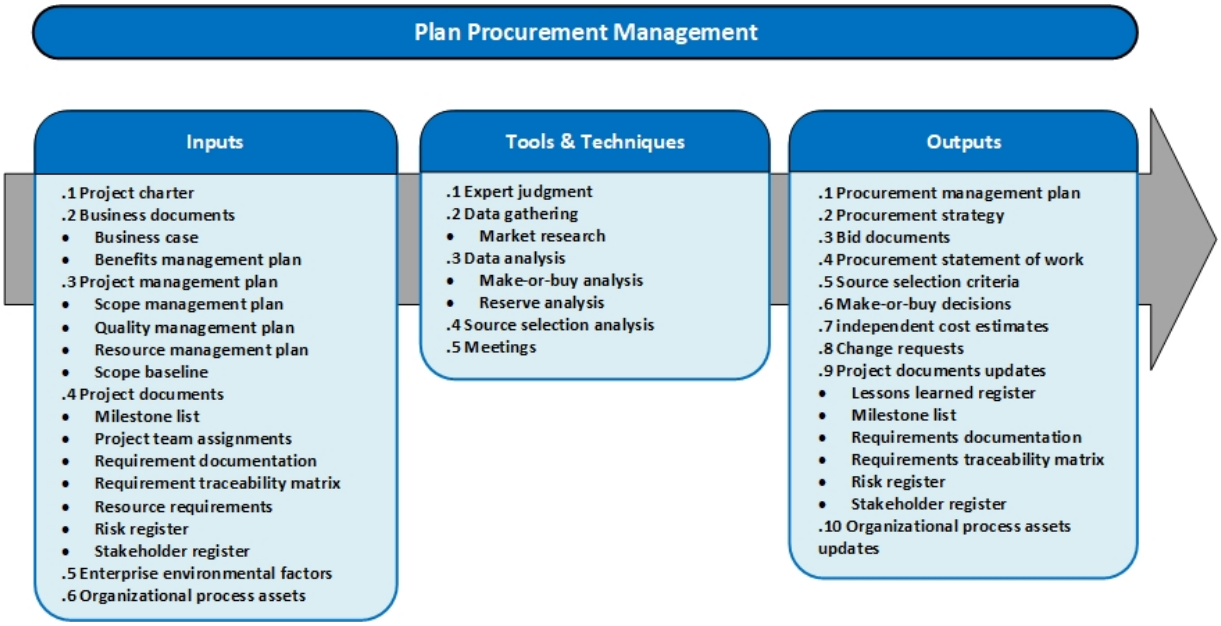

Figure 12.2. Plan Procurement Management: Inputs, Tools & Techniques, and Outputs.

Defining roles and responsibilities related to procurement should be done early in the Plan Procurement Management process. The project manager should ensure that the project team is staffed with procurement expertise at the level required for the project. Participants in the procurement process may include personnel from the purchasing or procurement department as well as personnel from the buying organization's legal department. These responsibilities should be documented in the procurement management plan. Typical steps might be:

- Prepare the procurement statement of work (SOW) or terms of reference (TOR).
- Prepare a high-level cost estimate to determine the budget. Advertise the opportunity.
- Identify a short list of qualified sellers.
- Prepare and issue bid documents.
- Prepare and submit proposals by the seller.
- Conduct a technical evaluation of the proposals including quality.
- Perform a cost evaluation of the proposals.
- Prepare the final combined quality and cost evaluation to select the winning proposal.
- Finalize negotiations and sign contract between the buyer and the seller.

The requirements of the project schedule can significantly influence the strategy during the Plan Procurement Management process. Decisions made in developing the procurement management plan can also influence the project schedule and are integrated with the Develop Schedule process, the Estimate Activity Resources process, and make-or-buy decisions.

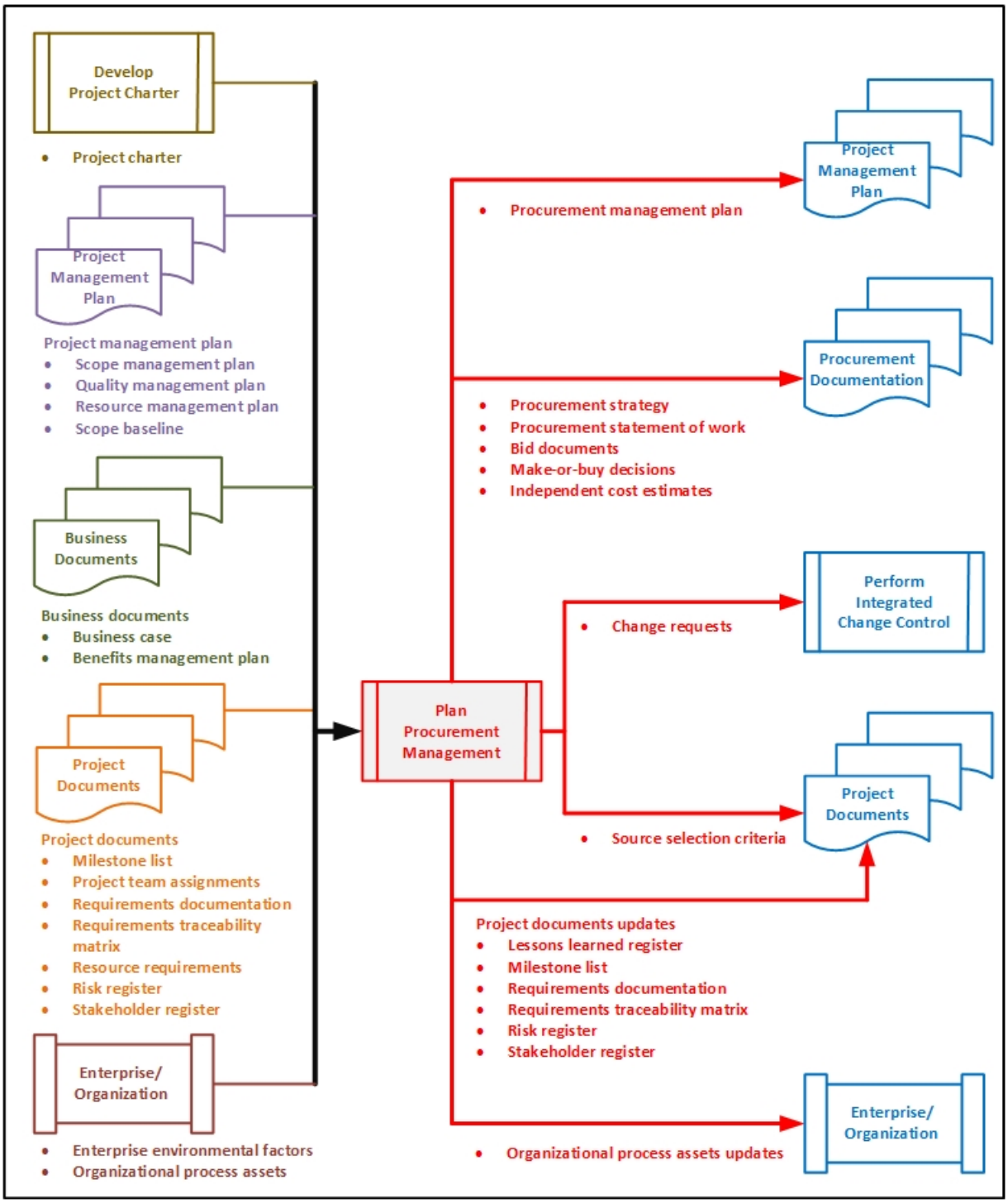

Figure 12.3. Plan Procurement Management: Data Flow Diagram.

12.3. Conduct Procurements

Conduct Procurements is the process of obtaining seller responses, selecting a seller, and awarding a contract. The key benefit of this process is that it selects a qualified seller and implements the legal agreement for delivery. The end results of the process are the established agreements including formal contracts. This process is performed periodically throughout the project as needed.

The inputs, tools and techniques, and outputs of the Conduct Procurements process are depicted in Figure 12.4. Figure 12.5 depicts the data flow diagram for the process.

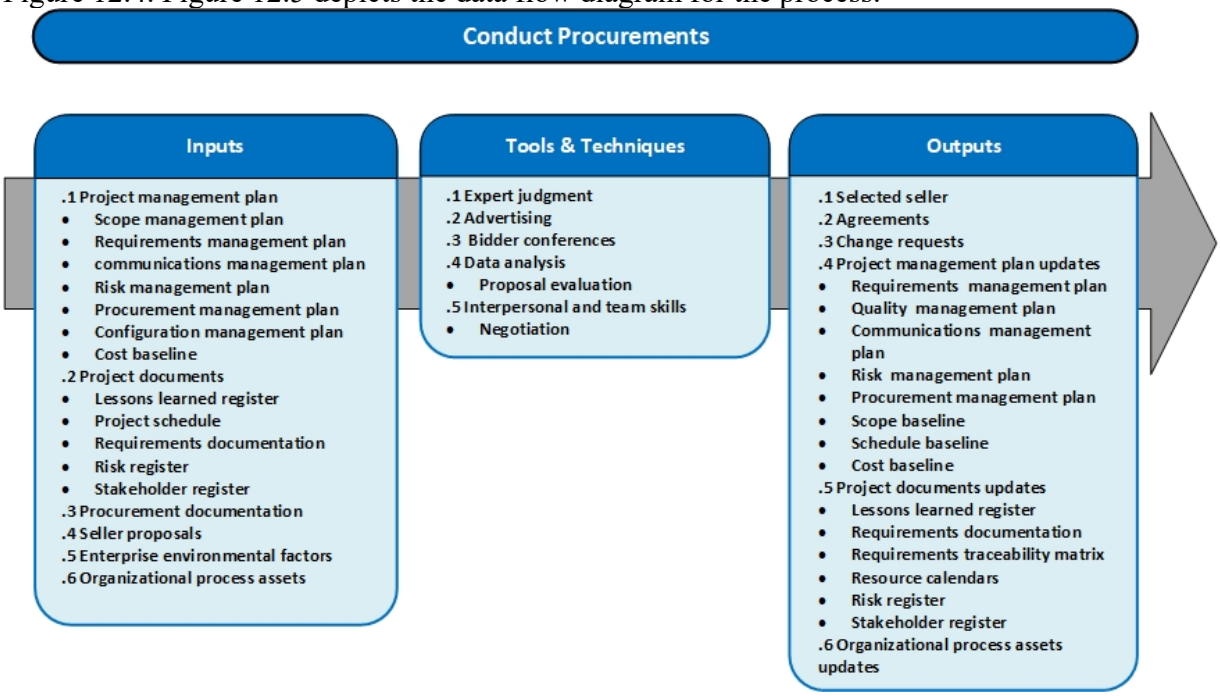

Figure 12.4. Conduct Procurements: Inputs, Tools & Techniques, and Outputs.

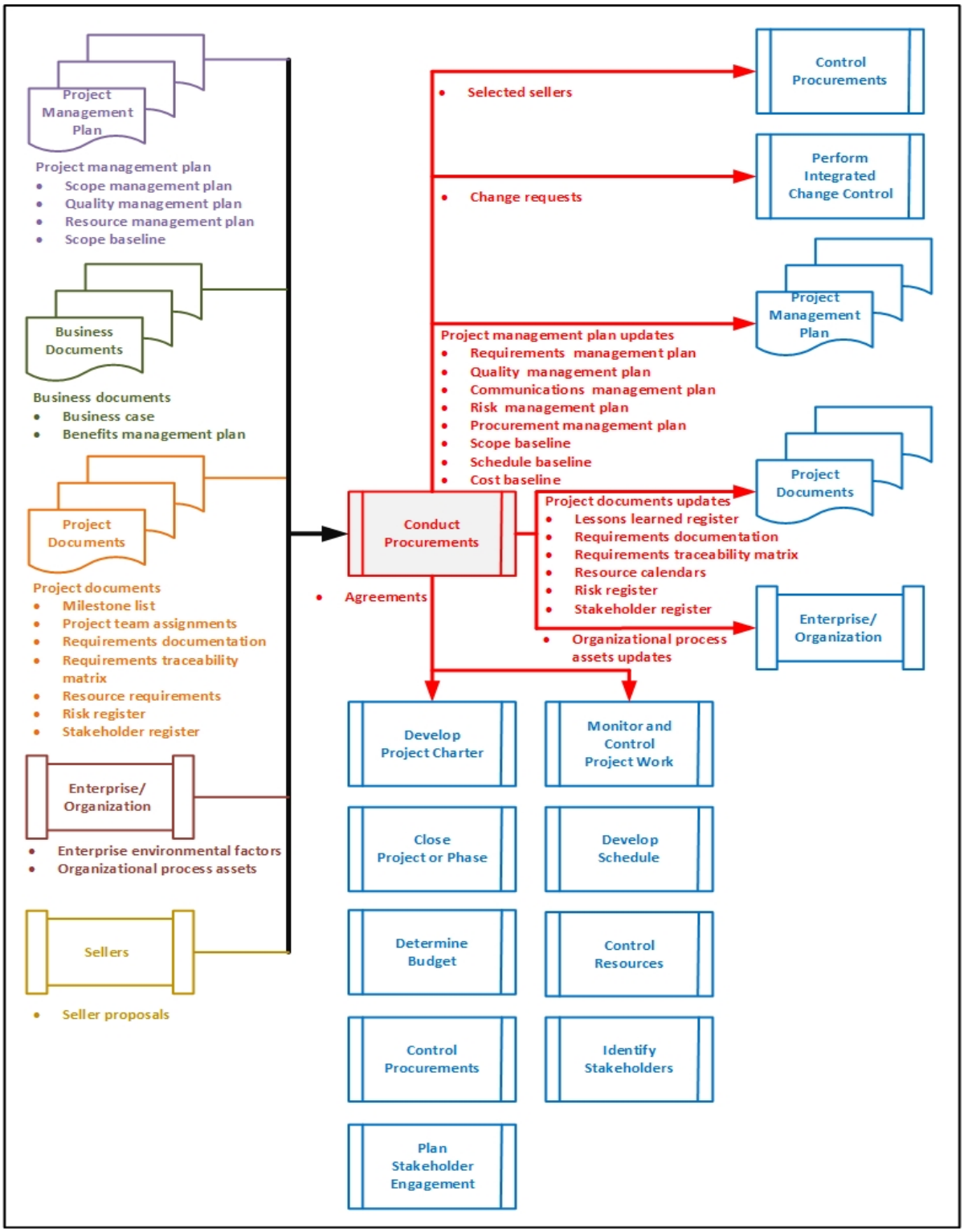

Figure 12.5. Identify Risks: Data Flow Diagram.

12.4. Control Procurements

Control Procurements is the process of managing procurement relationships; monitoring contract performance, and making changes and corrections as appropriate; and closing out contracts. The key benefit of this process is that it ensures that both the seller's and buyer's performance meet the project's requirements according to the terms of the legal agreement. This process is performed throughout the project as needed.

The inputs, tools and techniques, and outputs of this process are depicted in Figure 12.6. Figure 12.7 depicts the data flow diagram of the process.

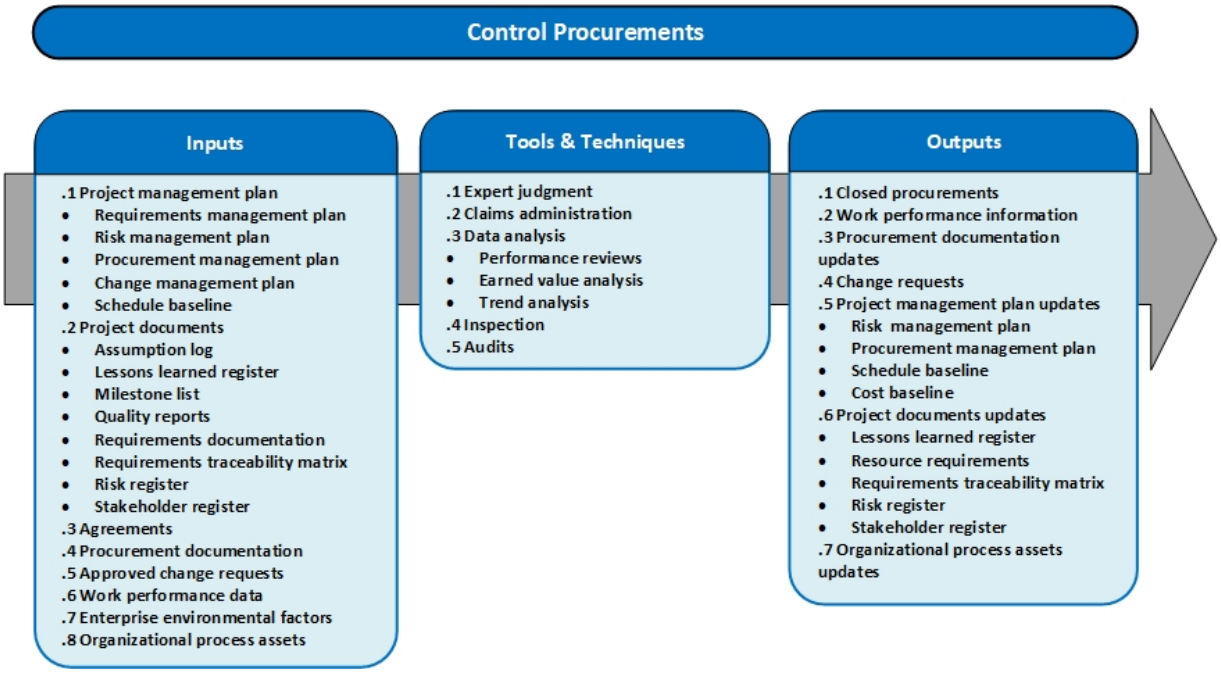

Figure 12.6. Control Procurements: Inputs, Tools & Techniques, and Outputs.

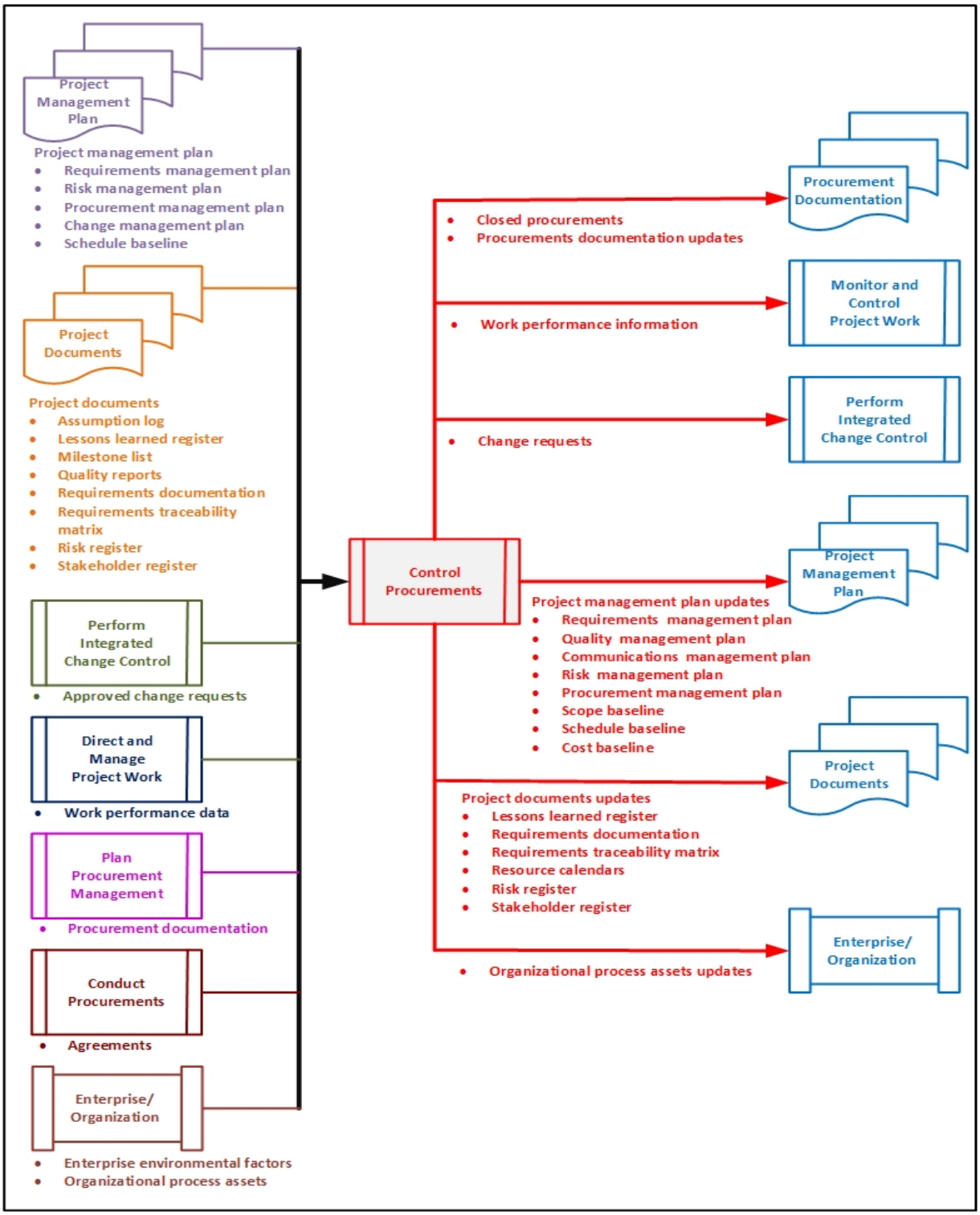

Figure 12.7. Control Procurements: Data Flow Diagram.

Both the buyer and the seller administer the procurement contract for similar purposes. Each is required to ensure that both parties meet their contractual obligations and that their own legal rights are protected. The legal nature of the relationship makes it imperative that the project management team is aware of the implications of actions taken when controlling any procurement. On larger projects with multiple providers, a key aspect of contract administration is managing communication among the various providers.

Because of the legal aspect, many organizations treat contract administration as an organizational function that is separate from the project. While a procurement administrator may be on the project team, this individual typically reports to a supervisor from a different department.

Control Procurements includes application of the appropriate project management processes to the contractual relationship(s) and integration of the outputs from these processes into the overall management of the project. This integration often occurs at multiple levels when there are multiple sellers and multiple products, services, or results involved.

Administrative activities may include:

- Collection of data and managing project records, including maintenance of detailed records of physical and financial performance and establishment of measurable procurement performance indicators;
- Refinement of procurement plans and schedules;
- Set up for gathering, analysing, and reporting procurement-related project data and preparation of periodic reports to the organization;
- Monitoring the procurement environment so that implementation can be facilitated or adjustments made; and
- Payment of invoices.

The quality of the controls, including the independence and credibility of procurement audits, is critical to the reliability of the procurement system. The organization's code of ethics, its legal counsel, and external legal advisory arrangements including any ongoing anti-corruption initiatives can contribute to proper procurement controls.

Control Procurements has a financial management component that involves monitoring payments to the seller. This ensures that payment terms defined within the contract are met and that compensation is linked to the seller's progress as defined in the contract. A principal concern when making payments is to ensure there is a close relationship of payments made to the work accomplished. A contract that requires payments linked to project output and deliverables rather than inputs such as labour hours has better controls.

Agreements can be amended at any time prior to contract closure by mutual consent, in accordance with the change control terms of the agreement. Such amendments are typically captured in writing.

Questions

1. You're managing a project that might have to contract out work, and you're comparing the relative advantages and disadvantages of finding a seller versus having your company do the work itself. Which process are you in?
   A. Plan Procurement Management
   B. Plan Contracting
   C. Conduct Procurements
   D. Request Seller Responses
2. You're using a qualified seller list. Which process are you in?
   A. Plan Procurement Management
   B. Plan Contracting
   C. Conduct Procurements
   D. Request Seller Responses
3. You're creating source selection criteria for your contract. What process are you in?
   A. Conduct Procurements
   B. Control Procurements
   C. Monitor Procurements
   D. Plan Procurement Management
4. The process of Control Procurements falls under which process group
   A. Planning
   B. Closing
   C. Monitoring and Control
   D. Executing
5. Alice is a Project Manager. She is coordinating a bidder conference to allow vendors to get clarification on the work that needs to be performed. Which phase of Project Management is in progress?
   A. Conduct Procurements
   B. Plan Procurements
   C. Control Procurements
   D. Close Procurements
6. The inputs used in the process of Conduct Procurements includes all except
   A. Seller Proposals
   B. Procurement statement of work - Given
   C. Source Selection Criteria
   D. Agreements
7. The tools and techniques used in the process of Plan Procurement Management includes all but
   A. Make-or-buy analysis
   B. Market Research
   C. Bidder Conferences
   D. Expert Judgment
8. The component of the project management plan that describes how a project team will acquire goods and services from outside the performing organization is called

A. Procurement Management Plan
B. Procurement Statement of Work
C. Procurement Documents
D. None of the above

9. A general management technique used to determine whether particular work can best be accomplished by the project team or should be purchased from outside sources is called
A. Market Research
B. Make-or-buy Analysis
C. Expert Judgment
D. None of the above

10. The process that includes the contract management and change control processes required to develop and administer contracts or purchase orders issued by authorized project team members is known as:
A. Project Procurement Management
B. Project Time management
C. Project Cost Management
D. Project Risk Management

11. The process of managing procurement relationships, monitoring contract performance, and making changes as appropriate is called
A. Plan Procurement Management
B. Control Procurements
C. Close Procurements
D. Conduct Procurements

12. In what part of the procurement process are you in if you are attempting to complete procurement negotiations?
A. Plan procurement management
B. Conduct procurements
C. Control procurements
D. Close procurements

13. Vendor selection, vendor management, and documentation of lessons learned are tasks that fall under this process:
A. Scope management
B. Conduct Procurements
C. Procurement management
D. Deliverable management

Chapter 13

Project Stakeholder Management

General Objective of the Chapter:

Trainee will be able to describe and understand the process of Project Stakeholder Management**.**

Detailed Objectives:

1. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Identify Stakeholders process.
2. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Plan Stakeholder Engagement process.
3. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Manage Stakeholder Engagement process.
4. Trainee will be able to identify and understand the role, the inputs, the tools & techniques, and outputs of the Monitor Stakeholder Engagement process.

13.1. Overview

Project Stakeholder Management includes the processes required to identify the people, groups, or organizations that could impact or be impacted by the project, to analyze stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders in project decisions and execution. The processes support the work of the project team to analyze stakeholder expectations, assess the degree to which they impact or are impacted by the project, and develop strategies to effectively engage stakeholders in support of project decisions and the planning and execution of the work of the project.

The Project Stakeholder Management processes are:

- **Identify Stakeholders.** The process of identifying project stakeholders regularly and analyzing and documenting relevant information regarding their interests, involvement, interdependencies, influence, and potential impact on project success.
- **Plan Stakeholder Engagement.** The process of developing approaches to involve project stakeholders based on their needs, expectation, interests, and potential impact on the project.
- **Manage Stakeholder Engagement.** The process of communicating and working with stakeholders to meet their needs and expectations, address issues, and foster appropriate stakeholder engagement involvement.
- **Monitor Stakeholder Engagement.** The process of monitoring project stakeholder relationships and tailoring strategies for engaging stakeholders through the modification of engagement strategies and plans.

Figure 13.1 provides an overview of the Project Stakeholder Management processes.

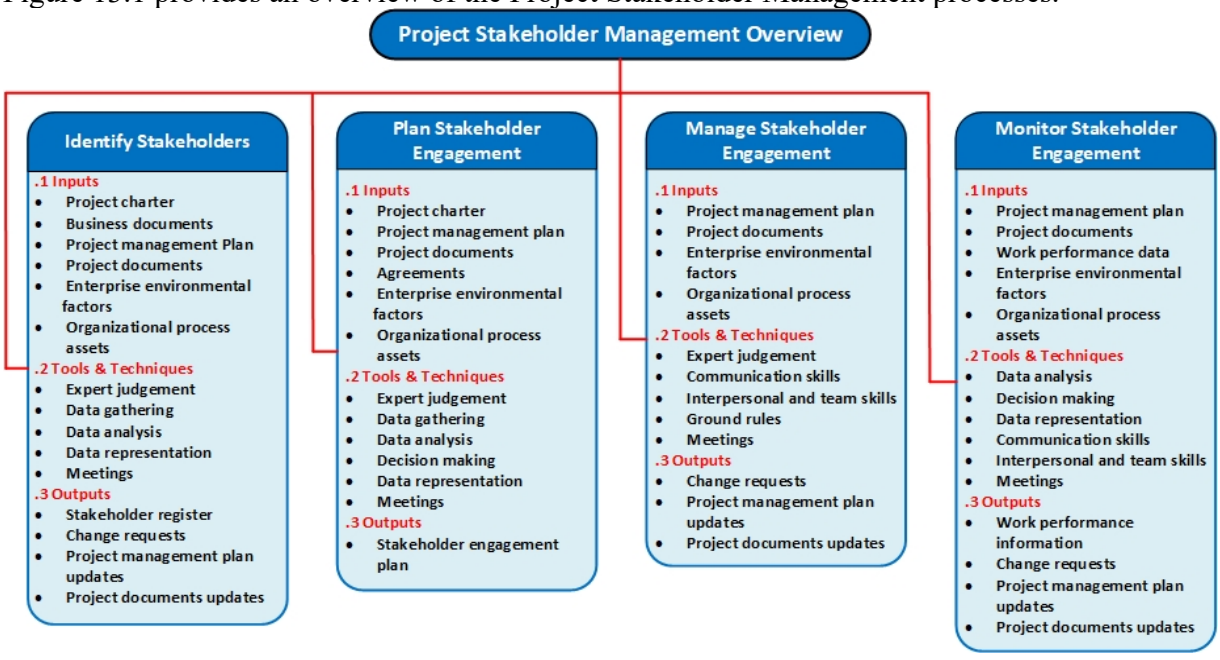

Figure 13.1. Project Stakeholder Management Overview.

Every project has stakeholders who are impacted by or can impact the project in a positive or negative way. Some stakeholders may have a limited ability to influence the project's work or outcomes; others may have significant influence on the project and its expected outcomes.

Academic research and analyses of high-profile project disasters highlight the importance of a structured approach to the identification, prioritization, and engagement of all stakeholders. The ability of the project manager and team to correctly identify and engage all stakeholders in an appropriate way can mean the difference between project success and failure. To increase the chances of success, the process of stakeholder identification and engagement should commence as soon as possible after the project charter has been approved, the project manager has been assigned and the team begins to form.

Stakeholder satisfaction should be identified and managed as a project objective. The key to effective stakeholder engagement is a focus on continuous communication with all stakeholders, including team members, to understand their needs and expectations, address issues as they occur, manage conflicting interests, and foster appropriate stakeholder engagement in project decisions and activities. The process of identifying and engaging stakeholders for the benefit of the project is iterative. Although the processes in Project Stakeholder Management are described only once, the activities of identification, prioritization, and engagement should be reviewed and updated routinely, and at least at the following times when:

- The project moves through different phases in its life cycle,
- Current stakeholders are no longer involved in the work of the project or new stakeholders become members of the project's stakeholder community, or
- There are significant changes in the organization or the wider stakeholder community.

13.2. Identify Stakeholders

Identify Stakeholders is the process of identifying project stakeholders regularly and analyzing and documenting relevant information regarding their interests, involvement, interdependencies, influence, and potential impact on project success. The key benefit of this process is that it enables the project team to identify the appropriate focus for engagement of each stakeholder or group of stakeholders. This process is performed periodically throughout the project as needed. The inputs, tools and techniques, and outputs of the process are depicted in Figure 13.2. Figure 13.3 depicts the data flow diagram for the process.

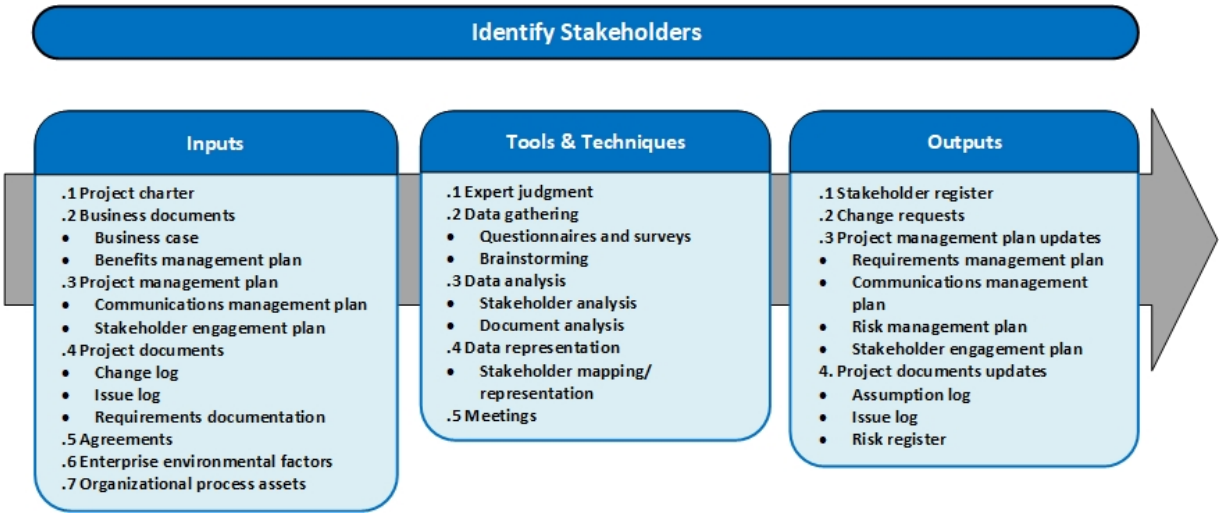

Figure 13.2. Identify Stakeholders: Inputs, Tools & Techniques, and Outputs.

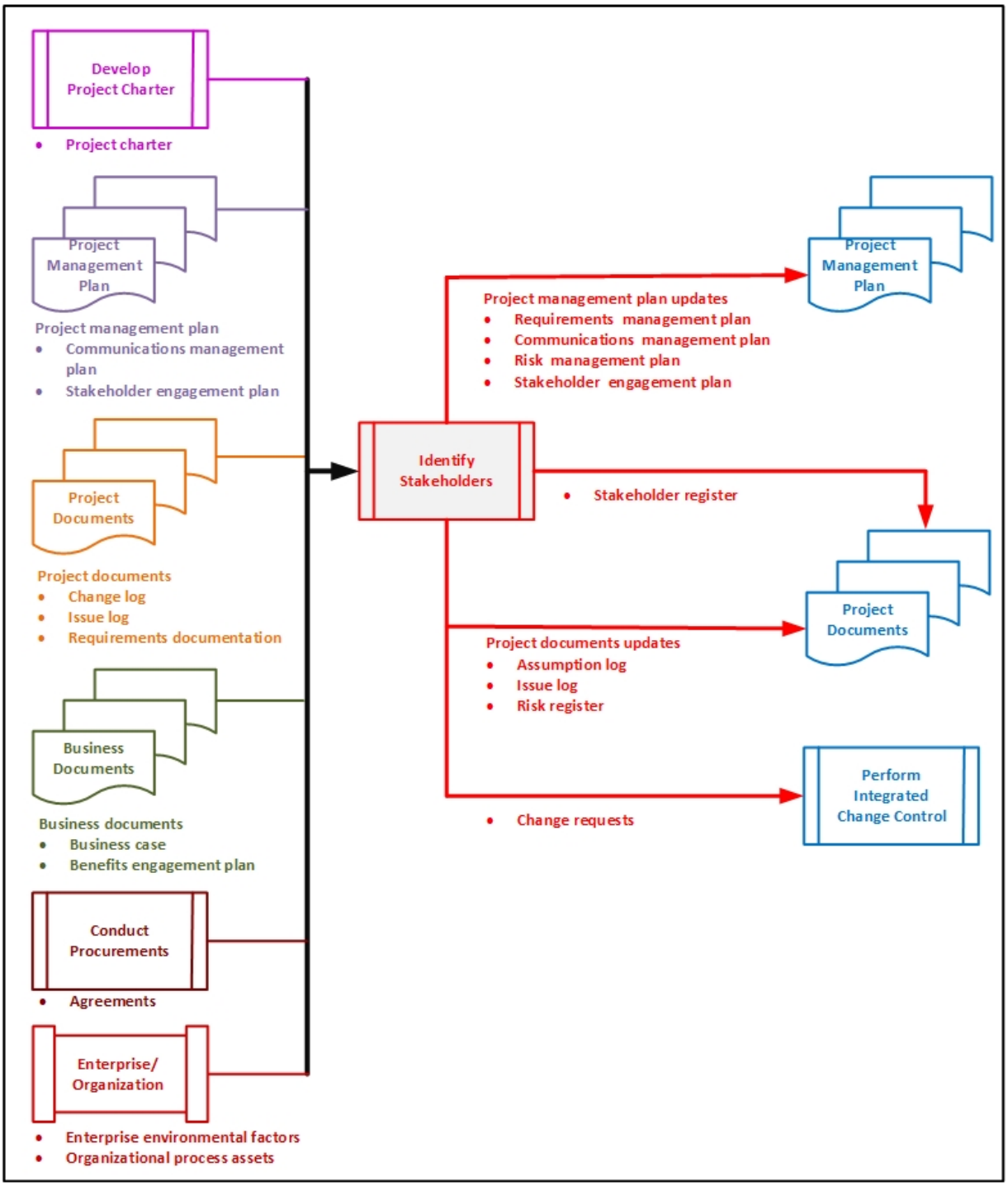

Figure 13.3. Identify Stakeholders: Data Flow Diagram.

This process frequently occurs for the first time in a project either prior to or at the same time the project charter is developed and approved. It is repeated as necessary, but should be performed at

the start of each phase and when a significant change in the project or the organization occurs. Each time the identification process is repeated, the project management plan components and project documents should be consulted to identify relevant project stakeholders.

13.3. Plan Stakeholder Engagement

Plan Stakeholder Engagement is the process of developing approaches to involve project stakeholders based on their needs, expectations, interests, and potential impact on the project. The key benefit is that it provides an actionable plan to interact effectively with stakeholders. This process is performed periodically throughout the project as needed.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 13.4. Figure 13.5 depicts the data flow diagram for the process.

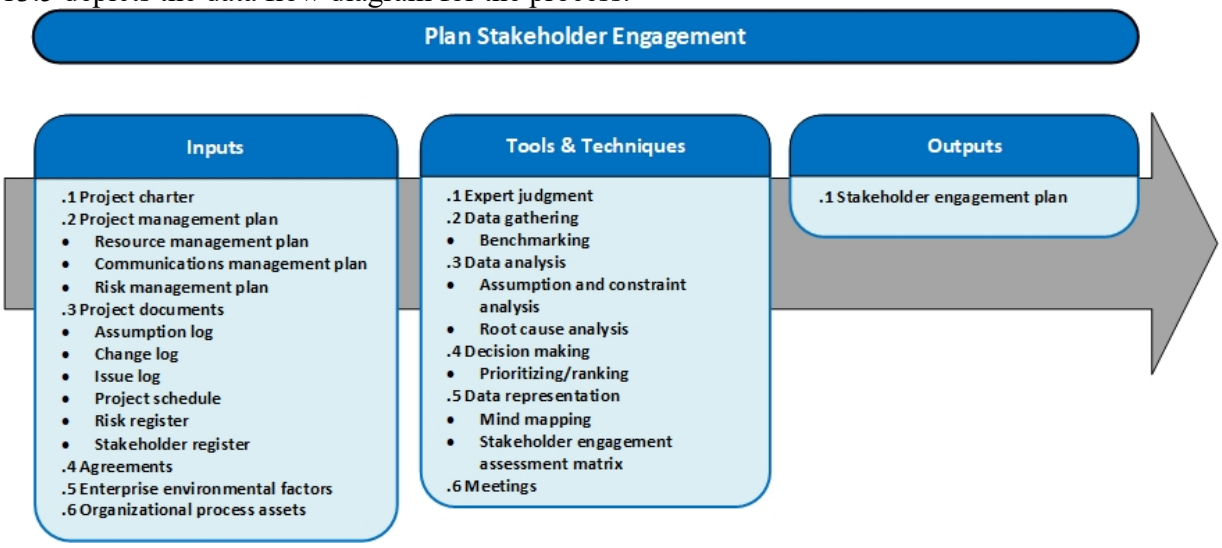

Figure 13.4. Plan Stakeholder Engagement: Inputs, Tools & Techniques, and Outputs.

An effective plan that recognizes the diverse information needs of the project's stakeholders is developed early in the project life cycle and is reviewed and updated regularly as the stakeholder community changes. The first version of the stakeholder engagement plan is developed after the initial stakeholder community has been identified by the Identify Stakeholder process. The stakeholder engagement plan is updated regularly to reflect changes to the stakeholder community. Typical trigger situations requiring updates to the plan include but are not limited to:

- When it is the start of a new phase of the project;
- When there are changes to the organization structure or within the industry;
- When new individuals or groups become stakeholders, current stakeholders are no longer part of the stakeholder community, or the importance of particular stakeholders to the project's success changes; and
- When outputs of other project process areas, such as change management, risk management, or issue management, require a review of stakeholder engagement strategies.

The results of these adjustments may be changes to the relative importance of the stakeholders who have been identified.

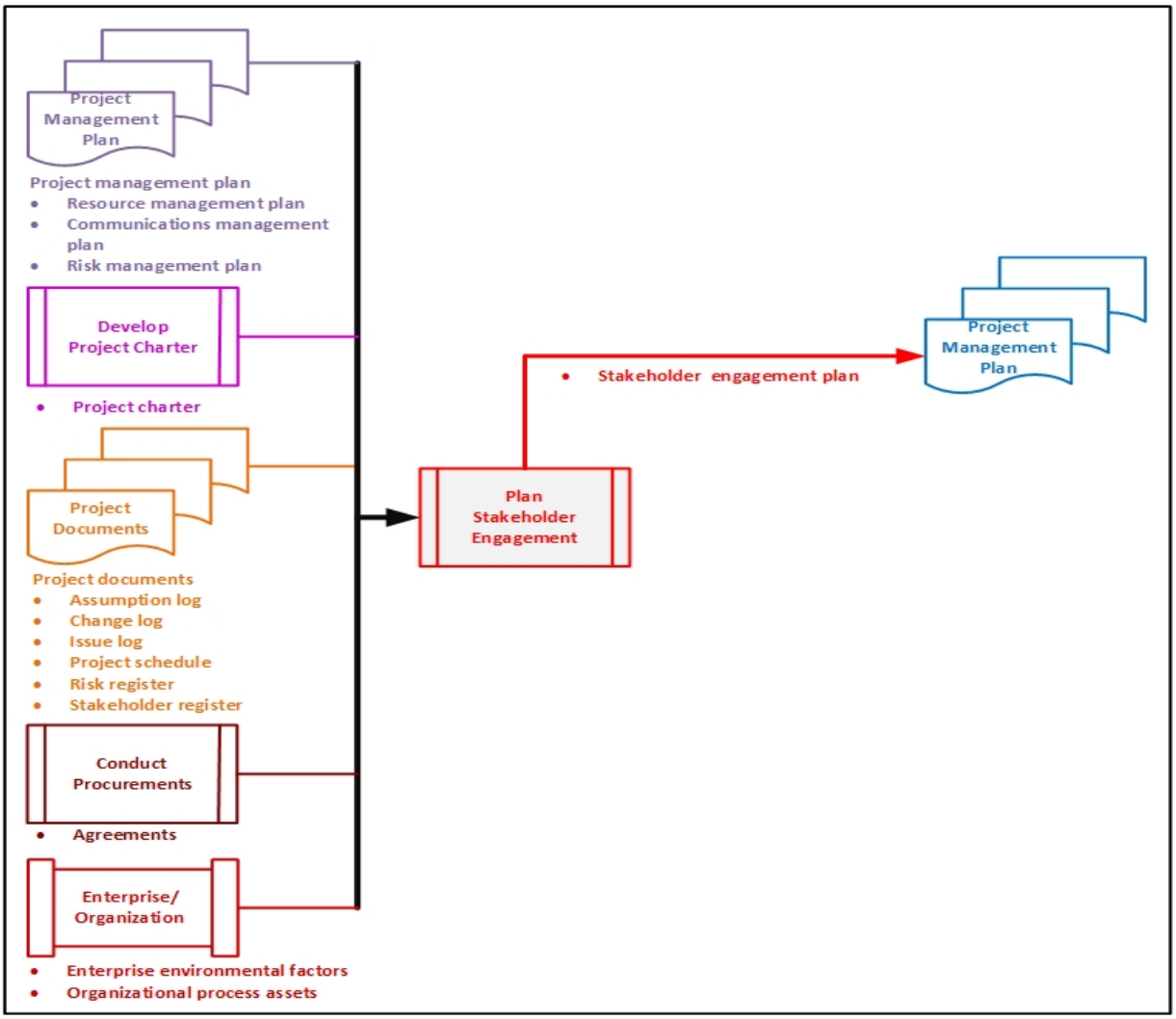

Figure 13.5. Plan Stakeholder Engagement: Data Flow Diagram.

13.4. Manage Stakeholder Engagement

Manage Stakeholder Engagement is the process of communicating and working with stakeholders to meet their needs and expectations, address issues, and foster appropriate stakeholder involvement. The key benefit of this process is that it allows the project manager to increase support and minimize resistance from stakeholders. This process is performed throughout the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 13.6. Figure 13.7 depicts the data flow diagram for the process.

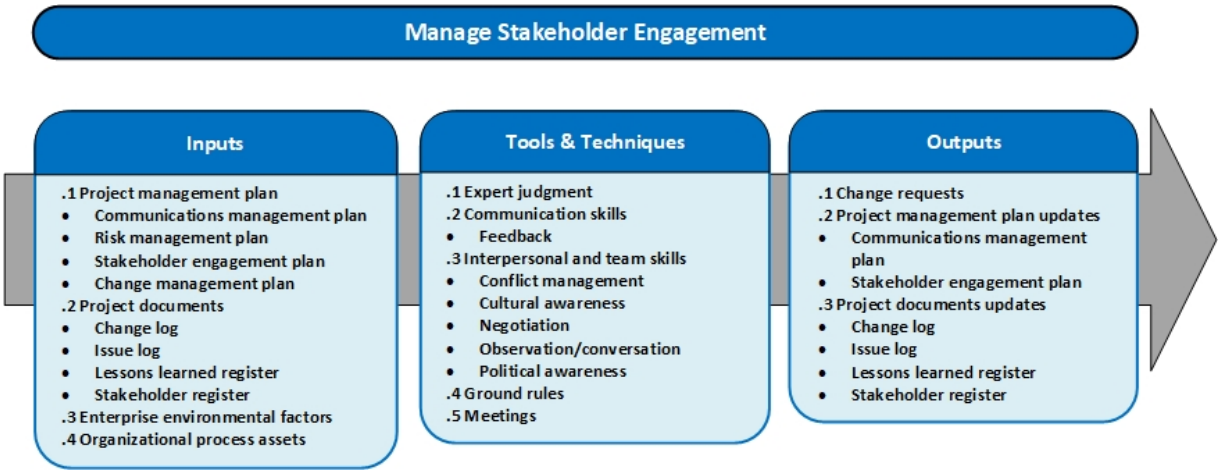

Figure 13.6. Manage Stakeholder Engagement: Inputs, Tools & Techniques, and Outputs.

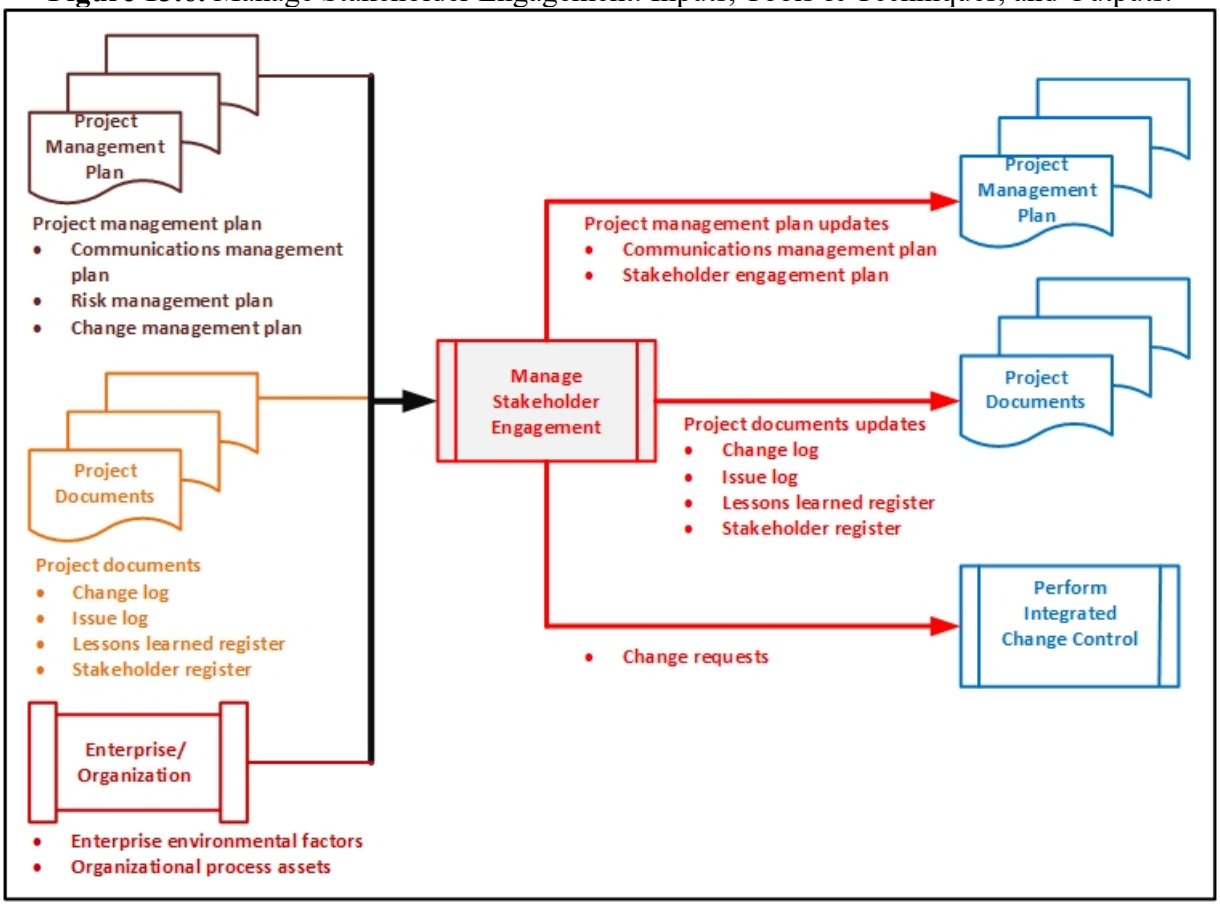

Figure 13.7. Manage Stakeholder Engagement: Data Flow Diagram.

Manage Stakeholder Engagement involves activities such as:

- Engaging stakeholders at appropriate project stages to obtain, confirm, or maintain their continued commitment to the success of the project;

- Managing stakeholder expectations through negotiation and communication;
- Addressing any risks or potential concerns related to stakeholder management and anticipating future issues that may be raised by stakeholders; and
- Clarifying and resolving issues that have been identified.

Managing stakeholder engagement helps to ensure that stakeholders clearly understand the project goals, objectives, benefits, and risks for the project, as well as how their contribution will enhance project success.

13.5. Monitor Stakeholder Engagement

Monitor Stakeholder Engagement is the process of monitoring project stakeholder relationships and tailoring strategies for engaging stakeholders through modification of engagement strategies and plans. The key benefit of this process is that it maintains or increases the efficiency and effectiveness of stakeholder engagement activities as the project evolves and its environment changes. This process is performed throughout the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 13.8. Figure 13.9 depicts the data flow diagram for the process.

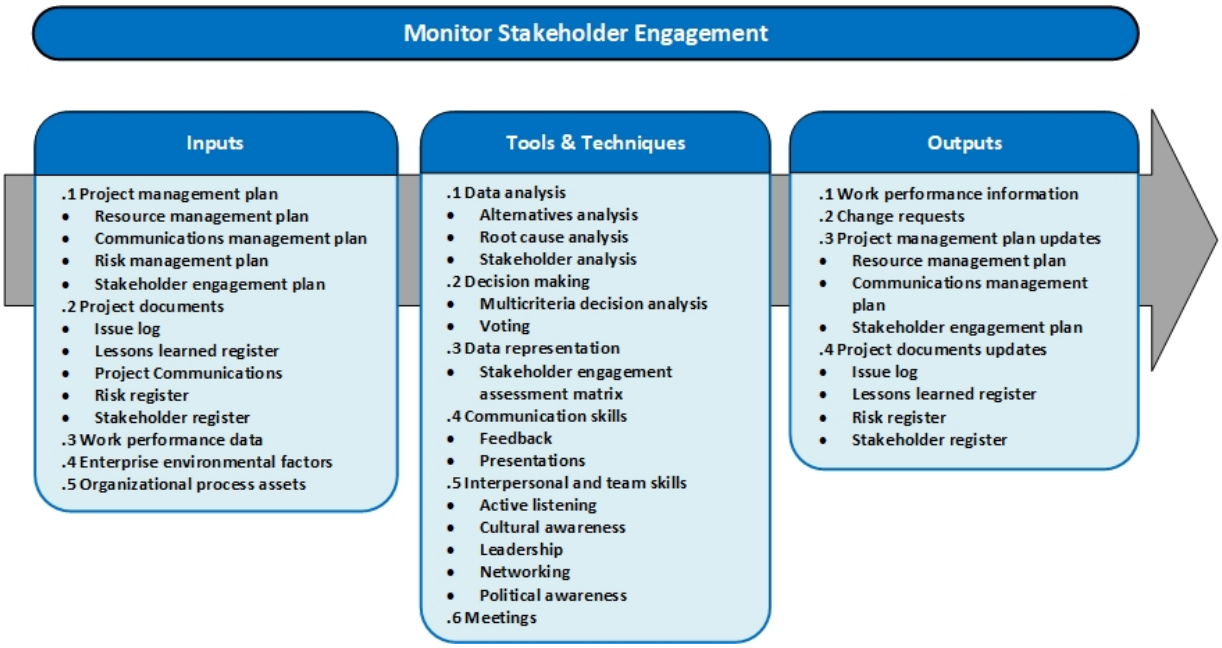

Figure 13.8. Monitor Stakeholder Engagement: Inputs, Tools & Techniques, and Outputs.

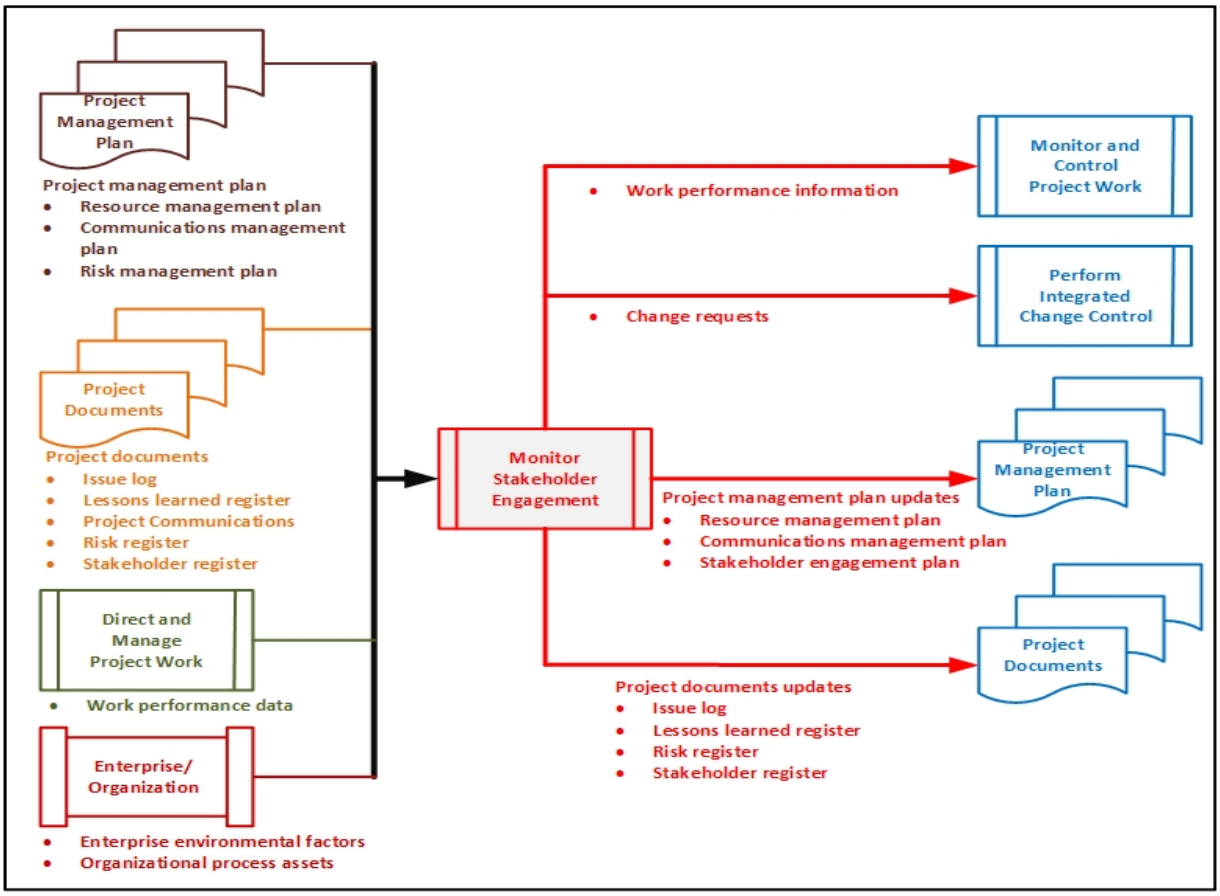

Figure 13.9. Monitor Stakeholder Engagement: Data Flow Diagram.

Questions

1. The stakeholder management plan is used to:
   A. Increase stakeholder support and decrease their negative impact
   B. Identify all project stakeholders
   C. Prioritize project stakeholders
   D. assess how stakeholders will react to various scenarios
2. Which of the following is not an input to the Plan Stakeholder Engagement process?
   A. Enterprise environmental factors
   B. Organizational process assets
   C. Work performance data
   D. Stakeholder register
3. You take over for a project manager who has left the company, and realize that there are stakeholders in the project who haven't been included in any of the status meetings so far. Some upper managers think the project is not going to succeed, and others are actively thinking of canceling it. Which document is the FIRST one that you should create to solve this problem?
   A. Stakeholder register
   B. Status report
   C. Budget forecast
   D. Performance report
4. Which Stakeholder Management process is in the Initiating process group?
   A. Manage Stakeholder Engagement
   B. Identify Stakeholders
   C. Plan Stakeholder Engagement
   D. Register Stakeholder
5. Which is NOT an input of the Identify Stakeholders process?
   A. Agreements
   B. Enterprise environmental factors
   C. Project charter
   D. Project Management plan
6. Which Stakeholder Management process is in the Monitoring and Controlling process group?
   A. Distribute Information
   B. Manage Stakeholder Engagement
   C. Plan Communications
   D. Monitor Stakeholder Engagement
7. Work performance information is an output of Monitor Stakeholder Engagement. It includes a number of items, one of which is—
   A. Change requests
   B. Issue log

C. Documented lessons learned
D. Status of stakeholder engagement

8. Identifying strategies to promote productive involvement of stakeholders is useful to the project manager as he or she works with stakeholders. It should be documented as part of the—
A. Stakeholder register
B. Stakeholder engagement strategy
C. Stakeholder engagement plan
D. Stakeholder engagement assessment matrix

9. Multi-criteria decision analysis and voting are examples of—
A. Project reports as an input to Monitor Stakeholder Engagement
B. Work performance information as an output of Monitor Stakeholder Engagement
C. Tools and techniques used in Monitor Stakeholder Engagement
D. Updates from the Plan Stakeholder Engagement process

10. Which of the following is not included in the Stakeholder Management Plan?
A. Project lifecycle
B. Communications requirements
C. Impact of scope changes to stakeholders
D. Stakeholder management strategy

11. The implementation of which of the following processes decreases the risk of project failure?
A. Manage stakeholder engagement
B. Control stakeholder engagement
C. Plan stakeholder management
D. Develop stakeholder engagement

12. Which of the following is not a tool used to manage the stakeholder engagement?
A. Communication methods
B. Interpersonal skills
C. Management skills
D. Issue log

13. Which of the following is/are not required for manage stakeholder engagement process?
A. Change management plan
B. Communications management plan
C. Stakeholder management plan
D. Change log

14. Which of the following knowledge area deals with identifying people, groups or organizations that could impact or be impacted by a project that required building a 3-mile long bridge connecting two island cities of a country?
A. Project Communications Management
B. Project Stakeholder Management
C. Project Integration Management
D. Communication Plan

15. Which one of the following is the best way to manage stakeholders?
A. Ensuring, they don't get to meet outside of work

B. Meeting all of them when a milestone is ready
C. Keeping them informed throughout the project
D. Sending them gifts

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