CONSTRUCTION PROJECT MANAGEMENT HANDBOOK

FTA

REVISON 1 - APRIL 2007

Construction Project Management Handbook

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Foreword

The Federal Transit Administration (FTA) sponsored and developed the *Construction Project Management Handbook* to provide guidelines to public transit agencies undertaking substantial construction projects either for the first time or with little experience in construction management. Gannett Fleming, Inc., a national engineering and construction firm, developed this Handbook under contract to and with guidance from the FTA Office of Technology. The project managers consisted of Henry Nejako, FTA Program Management Officer; and Kam Shadan, P.E., Author, and Project Manager, Gannett Fleming, Inc.

This Handbooks provides comprehensive coverage of construction project management, including the applicability of the principles of project management and of all phases of project development in sequence and in separate chapters—from project initiation through planning, environmental clearance, real estate acquisition, design, construction, commissioning, and closeout. The Handbook will be of use to transit agencies and their consultants, the FTA Regional Offices, and others responsible for the management of capital projects involving construction of transit facilities or systems. The study is organized to provide the transit agency and the project manager with a clearer understanding of the applicability of the structures and principles of construction project management.

Notice/Disclaimer

This Handbook is intended to be a general reference document for use by public transportation agencies responsible for the management of capital projects involving construction of a transit facility or system.

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government and the Contractor, Gannett Fleming, Inc., assume no liability for the contents or use thereof.

The United States Government does not endorse manufacturers or products. Trade or manufacturers names appear herein solely because they are considered essential to the objective of this report.

Acknowledgements

The FTA Construction Project Management Handbook was sponsored and managed by FTA's Office of Technology. Gannett Fleming, Inc., a national engineering and construction management firm with specialized expertise in transit project planning, design, and construction, developed and produced this Handbook. The lead development team consisted of Henry Nejako, FTA Program Management Officer and Kam Shadan, P.E., Lead Author and Project Manager, Gannett Fleming, Inc.

Rodney Dawson and Scott Zeevaart were the deputy project managers and co-authors. Additional specialized input was provided by Michael Lee, William Plumpton, Charles Norrish, and Mark Hollopeter of Gannett Fleming, and Candy Spitzer of Spitzer and Associates in the areas of facilities, environmental compliance, construction, commissioning, and real estate. Gannett Fleming staff that assisted in editing and document preparation included Kelly Zanzinger, Mary Kissinger, and Marlin Mann.

An Industry Workgroup was created by FTA to specify the content of the Handbook and oversee its development, providing overall guidance and comments on deliverables. Members of the Workgroup included the following:

Mary Anderson, FTA Headquarters, Washington, DC
Lewis Clopton, formerly FTA Headquarters, now Community Transportation Development Center, Silver Spring, MD
Paul Davis, Tri-State Transit Authority, Huntington, WV
William Kalt, FTA Region 7, Kansas City, MO
Matthew Keamy, FTA Region 1, Cambridge, MA
Reinald "Ray" Ledoux, Brockton Area Transit Authority, Brockton, MA
Michael Radbill, Urban Engineers, Inc., Philadelphia, PA
Devendra Soni, FTA Region 3, Philadelphia, PA
Cheryle Tyson, FTA Region 6, Fort Worth, TX
Dale Wegner, FTA Headquarters, Washington, DC
Michael Williams, FTA Region 10, Seattle, WA
Bobby Kuhn, San Joaquin Regional Transit District

The following transit agencies participated in the survey and/or provided photographs:

Capital Area Transit, Harrisburg, PA
Eastern Contra Costa Transit Authority, Antioch, CA
Livermore Amador Valley Transit Authority, Livermore, CA
Piedmont Wagon Transit, Conover, NC
San Joaquin Regional Transit District, Stockton, CA
San Mateo County Transit District, San Carlos, CA
Santa Rosa City Bus, Santa Rosa, CA
SunLine Transit Agency, Thousand Palms, CA
Union/Snyder Transportation Alliance, Lewisburg, PA
Yolo County Transportation District, Woodland, CA

ACRONYM LIST

ADA – Americans with Disabilities Act
ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers
A&E – architectural and engineering
BPPM – Best Practices Procurement Manual
CA – contract administrator
CE – categorical exclusion
CIP – Capital Improvement Plan (Planning)
CM – construction manager
CMAR – construction manager at-risk
CPI – cost performance index
CPM – critical path method
CVS – certified value specialist
D/B – design/build
D/B/B – design/bid/build
DBE – Disadvantaged Business Enterprise
D/B/O/M – design/build/operate/maintain
DEIS – Draft Environmental Impact Statement
EA – Environmental Assessment
ECHO – Electronic Clearing House Operation
EIS – Environmental Impact Statement
FEIS – Final Environmental Impact Statement
FMCSA – Federal Motor Carrier Safety Administration
FONSI – Finding of No Significant Impact
GEC – general engineering consultant
GM – general manager
LEDPA – Least Environmentally Damaging Practicable Alternative
LEED – Leadership in Energy and Environmental Design
MPO – Metropolitan Planning Organization
NCR – non-conformance reports
NEPA – National Environmental Policy Act
OFE – owner furnished equipment
OSHA – Occupational Safety and Health Administration
O&M – operations and maintenance
PM – Project Manager
PMC – program management consultant
PMO – project management oversight
PMP – Project Management Plan
PRD – Project Requirements Definition
QA/QC – quality assurance/quality control
RE – resident engineer
RFC – request for change
RFI – request for information
RFP – request for proposal
ROD – Record of Decision
ROW – right-of-way
SAVE – Society of American Value Engineers
SOW – scope of work
SPI – schedule performance index
STIP – Statewide Transportation Improvement Program
TAB – testing, adjusting, and balancing
TEAM – Transportation Electronic Award Management
USGBC – United States Green Building Council
VE – Value Engineering
WBS – work breakdown structure

CHAPTER 1. INTRODUCTION

1.0 PURPOSE OF THE HANDBOOK

Introduction

The purpose of this Handbook is to provide guidelines for use by public transit agencies (Agencies) undertaking substantial construction projects, either for the first time or with little prior experience with construction project management. It provides a comprehensive introduction to construction project management, including the applicability of the principles of project management and of all phases of project development—from project initiation through planning, environmental clearance, real estate acquisition, design, construction, commissioning, and closeout.

The Federal Transit Administration (FTA) maintains oversight of grant projects and assigns grant administration and management responsibility to the transit Agencies, who then are responsible for planning, managing, and implementing the federally-funded project. Agency project managers need handy tools for project management to make certain that projects are effectively contracted for, completed on time and within budget, and comply with all project specifications. This Handbook is intended to assist the Agency's responsible project manager or lead person to undertake multi-million-dollar construction projects and manage the complexities of specifying, acquiring, and managing contracts for such projects through utilization of in-house and consultant resources.

This Handbook complements the many circulars and publications available on the FTA Website and through the National Transit Institute, in particular: FTA Lessons-Learned documents, Construction Project Management Guidelines, Best Practices Procurement Manual, Quality Assurance and Quality Control Guidelines, and the Manual for the National Transit Institute course entitled "Management of Transit Construction Projects". This Handbook is intended to be used as initial general guidance by transit Agencies and the FTA regional offices who may be contacted for help.

This Handbook provides guidance similar to that in earlier documents but tailored more to Agencies that are constructing maintenance and operational facilities, intermodal terminals, park-and-ride stations, and other similar supporting transit facilities. Throughout the chapters, project management concepts are illustrated with the use of a hypothetical example, a typical project to plan, design, and build a new bus maintenance facility.

How to Use the Handbook

This introductory chapter defines a project and states principles of project management. Chapter 2 discusses the project development process to provide a better understanding of how projects are created. Chapters 3-8 cover the phases of the project in sequence from project initiation, through planning, environmental clearance, real estate acquisition, design, construction, commissioning, and closeout. Chapter 9 addresses project-wide functions that take place throughout the project life cycle.

Each chapter begins by describing the purpose of the chapter and includes a checklist of important things to do. The sections within a chapter include key points of important things to know about project management that are discussed in more detail in the text and supported by pictures, graphics, tables, and charts.

How to Work with the FTA

Generally, the FTA regional office or metropolitan office responsible for your area will take the lead in providing the necessary guidance. Each FTA regional office has personnel assigned for support in areas such as grants, planning, environment, procurement, program management, and legal. The project manager should establish contact with the FTA office and staff that are responsible for the Agency's project.

How to Contact the FTA

FTA's regional and metropolitan offices are responsible for the implementation of grants and the provision of financial assistance to FTA customers, other than specific programs that are the responsibility of headquarters. Inquiries should be directed to either the regional or metropolitan office responsible for the geographic area in which the Agency is located.

To locate the FTA office responsible for serving your region, please see a listing of FTA offices in the reference section at the end of this Handbook or visit the FTA Homepage: http://www.fta.dot.gov.

IMPORTANT TO DO

- ❑ ESTABLISH CONTACT WITH THE FTA OFFICE AND STAFF INVOLVED WITH YOUR PROJECT.
- ❑ UNDERSTAND THE PROJECT MANAGER'S ROLE, AND WHAT MAKES UP A PROJECT.
- ❑ KNOW YOUR PROJECT'S SCOPE, LIFE CYCLE, AND PHASES.

1.1 WHAT IS A PROJECT?

Definition of a Project

A project is made up of a group of interrelated work activities constrained by a specific scope, budget, and schedule to deliver capital assets needed to achieve the strategic goals of an Agency. This Handbook is intended for management of capital projects involving construction of facilities or systems. The word project is synonymous with the words capital project throughout this Handbook.

Important to Know

- All projects must have a beginning and an end.
- Project managers with prior relevant experience help keep projects on track.
- Projects are defined by their scope, budget, and schedule.
- Project life cycle phases for a typical construction project are initiation, planning, design, construction, commissioning, and closeout.
- The level of project management effort depends on project size, type, and phase.

Project Manager's Role

A project's execution is planned and controlled by the project manager. The project manager is assigned by the Agency, i.e., the Agency's executive management. The project manager must have adequate authority to exercise the responsibility of forming and managing a team for support of the project. The project manager must have prior experience managing similar projects in the past. If an Agency cannot commit such an individual with adequate time and resources, the Agency is well advised to outsource project management services for management of the project. The project manager may be tasked with management of multiple projects that may require assignment of additional project managers for support. In such cases the project manager is taking on the role of a program manager. Figure 1-1 shows typical project activities without a project manager. It shows the multiple interactions an Agency faces without a project manager to manage the work activities involved in delivering a new capital asset. Figure 1-2 depicts a typical project organization with a project manager. It shows how a project management organization is structured with the assignment of a project manager to manage project work activities.

Figure 1-1 – A Project without a Project Manager

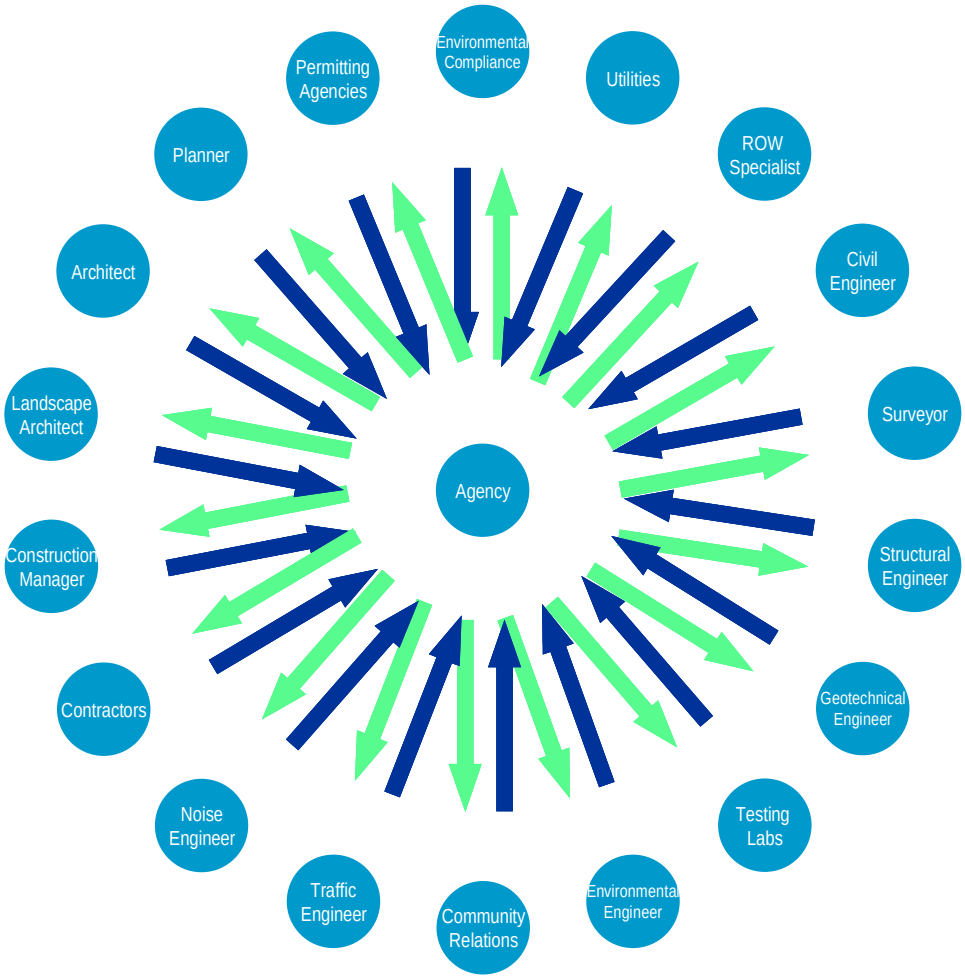
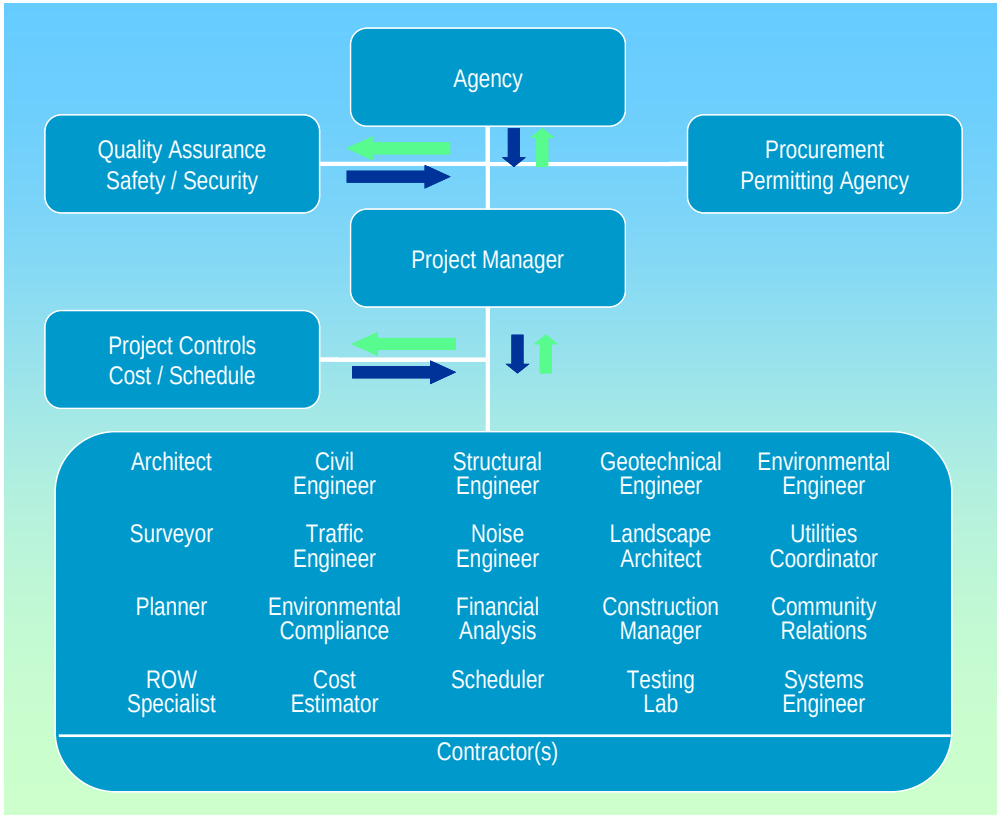


Figure 1-2 – A Project with a Project Manager



Note: Depending on the project there may be a need for a professional not listed in the chart, such as an archeologist, etc.

Characteristics of Projects

Projects are defined by their scope, budget, and schedule. For example, an Agency is to undertake a project to design and build a new maintenance facility for its fleet of buses (scope), at an estimate of $30 million (preliminary budget) over a three-year period (schedule). The schedule specifies a defined beginning and end. Projects go through a life cycle of phases between their beginnings and ends that for construction projects are typically: initiation, planning, design, construction, commissioning, and closeout.

Scope: Each project is unique and must have a written requirements document that takes into consideration operational needs, level of service, regulatory requirements such as Americans with Disabilities Act, and quality of deliverables. The scope evolves as new information becomes available through the project life cycle. For example, in the early planning phases of the maintenance facility project, the scope is to have five service bays. Later, as the design progresses, the exact location and the type of service in each bay can be determined. Scope refinement should not be confused with scope creep. Scope creep occurs when the Agency determines part way through the project that operational projections now call for six rather than five service bays. Changing to six bays after the project is underway is a serious change in scope that could impact the budget (larger facility, more land, redesign) and delay the schedule (replan, redesign, longer construction). Scope refinement is a necessary process in the project life cycle while scope creep results from lack of clarity on the Agency's requirements in the original scope for the needs, level of service, and level of quality for the deliverables.

Schedule: All projects must have a definite beginning and end. The Agency's Capital Improvement Plan (CIP) usually provides approximate dates for the beginning of a project and the end date when it is due to go into operation. Once there is a well-defined scope, the Agency needs to determine the time it will take to complete the project by developing the project schedule. Developing the schedule involves breaking down the work into manageable activities needed to accomplish the scope of each deliverable, estimating the duration of each activity, and placing them in a logical sequence. Chapter 9 describes useful techniques for developing a schedule. The result is a project schedule that tells you the expected duration of the project and the logical relationships between the activities, including activities on the "critical path," that controls the end date.

Budget: All projects are constrained by limited monetary funding resources. Consequently, every project needs a budget to initially define its funding requirement. The budget usually provides the preliminary project funding that is established through a CIP covered in Chapter 2. The project manager develops the budget based on the cost estimates at the beginning of each project phase and refines it once there is better information defining the scope. Refining the budget occurs through studies and analysis in the design development process through the preliminary engineering phase. When Agencies try to fix the budget too early in the project life cycle, they are surprised by the significant increases in the budget over what was set forth in the CIP. As explained later, the budget should not be fixed as baseline until after completion of the preliminary engineering phase. Estimating techniques for the costs of the activities needed to accomplish the scope of each deliverable are covered in Chapter 9.

Project Life Cycle

A project is conceived through the organization's strategic planning process and documented in a Capital Improvement Plan (CIP). The main reasons projects are created are to deliver capital assets the Agency needs to:

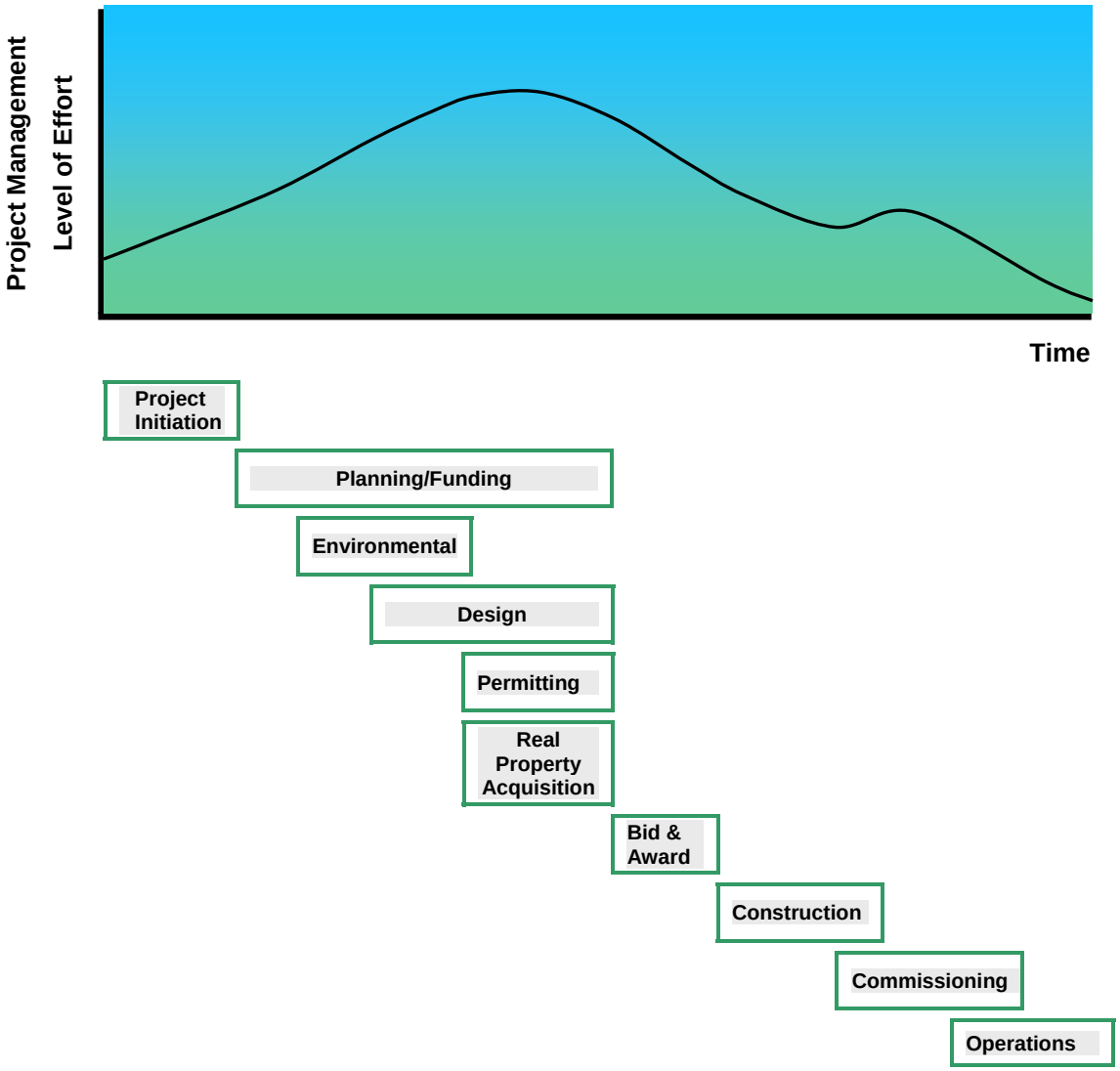
1. Sustain service or improve quality of service,
2. Expand service to meet growing demand, or
3. Comply with regulatory requirements.

A CIP consists of a number of planned projects that when implemented will provide the Agency with the assets needed to achieve its strategic objectives. A project begins its life cycle when it is authorized to move from the CIP into implementation. For an Agency, authorization is often a resolution approved by the Agency's board to apply for funds or hire consultants to work on the project. The board resolution is the project's authorization to proceed to the next phase. In most cases, the Agency will have to come back to the board prior to beginning the next phase of the project, because the scope and costs will be more defined through the efforts made in the preceding phases.

In a traditional design/bid/build (D/B/B) project, the project life cycle begins with the initiation of planning (including environmental and funding), and design (including conceptual design). These phases overlap to some extent. During these phases the project evolves through consideration of various alternatives and the concept for the preferred alternative is formed. The design phase continues through the preliminary engineering effort to further analyze, validate, and define the preferred alternative and arrive at the baseline scope, budget, and schedule. Then the design phase concludes with the final design, which further details out the design features to provide the permitting agencies and the contractor a set of construction drawings and specifications to permit and build the project. The construction phase proceeds with the bid and award process. At the end of the construction phase, the work of the contractor needs to be integrated with operations and Agency furnished activities, technology, and equipment, and evaluated for acceptance through the commissioning phase to bring the project to a successful completion. Figure 1-3 shows a typical project life cycle for traditional design/bid/build delivery.

There are many alternative delivery methods, such as design/build (D/B) and design/build/operate/maintain (D/B/O/M). These delivery methods assign multiple phases of work, such as design and construction, to a single contractor. In the D/B/O/M method the Agency also contracts out the operations and maintenance of the completed project to the contractor.

Figure 1-3 – Typical Project Life Cycle –Traditional Design/Bid/Build



1.2 PRINCIPLES OF PROJECT MANAGEMENT

Project Management Objectives

The objectives of project management are to execute a project so that deliverables can meet scope requirements on budget and schedule, and at acceptable risk, quality, safety, and security levels. The example maintenance facility project is to deliver a five bay facility that meets pre-determined performance specifications within the three year schedule.

Many times project objectives compete with each other and require skillful balancing throughout the project life cycle by the project manager. For example, unexpected soil conditions delay the maintenance facility construction contractor. The schedule can be made up by paying additional costs for contractor overtime to make up the delay. This is a cost/schedule trade-off.

The greatest threat to project success is scope creep. The addition of a sixth bay to the maintenance facility we mentioned earlier is a clear example of added scope. Often projects face more subtle scope creep because the project manager allows the users to "piggy back" additional requirements on the project. For example, it may be that originally in the CIP process the maintenance of non-revenue vehicles was to be done in a different location. During the project life cycle the lease on the non-revenue location was lost and the maintenance department wants them maintained at a new bay at the new facility. The project manager will need to address such changes through retracing of the CIP process and obtaining new project authorization.

Important to Know

- Successful projects balance project scope, cost, and schedule with user needs and project constraints.
- Identification of the user needs, project constraints, and resource requirements early in the project life cycle help projects meet their objectives.
- The greatest risk to project success is scope creep.
- Well-defined configuration management and change procedures are needed to control scope.

In addition to scope, budget, and schedule, it is extremely important that the project manager facilitates a discussion of the project risk, quality, and safety and security objectives and incorporates the outcome in the Project Management Plan (PMP). Projects require well-defined configuration management, change control systems, and procedures for scope and change control, as described in Chapter 9.

Project Management Process

The project management process begins with identification of the user requirement, project constraints, resource needs, and establishment of realistic objectives to meet the strategic goals. Many times this will be an iterative process as new information becomes available through efforts by various professionals on the project and input from third parties, communities, users, and agencies having jurisdiction.

The strategic goals that relate to capital projects are summarized in CIPs. Many times this information is in the Agency's short range and long range transit plans. The approval of the project by the governing body will establish the project authorization. The project manager uses the project authorization to develop project management plans for implementation of the project.

The project manager must have prior experience (or should consult with peers with prior experience) with the particular project type to balance the above competing objectives in a timely manner to adequately plan the project. Lack of prior experience will increase risks of not achieving

the project objectives. In Chapter 3 – Project Initiation, we cover a discussion of project authorization and the PMP. In addition to scope, budget, and schedule, it is extremely important that the project manager facilitates a discussion of the project risk, quality, and safety and security objectives for the project and incorporates the outcome in the PMP.

Where to Find Additional Help and Resources

You can find at the end of the Handbook a list of FTA offices nationwide, and a general listing of readily available Web sites and reference publications. Shown below are some of the more general references that span over several topics:

Web sites:

Federal Transit Administration: www.fta.dot.gov
National Transit Institute: www.ntionline.com
American Public Transportation Association: www.apta.com
Transportation Research Board: www.trb.org
International Association of Public Transport: www.uitp.com

References:

Federal Transit Administration, "49 CFR Part 611-Major Capital Investment Projects"
http://www.access.gpo.gov/nara/cfr/waisidx_03/49cfr611_03.html

Federal Transit Administration, "Project and Construction Management Guidelines", 2003 Update.
http://www.fta.dot.gov/publications/reports/publications_3875.html

Federal Transit Administration "Best Practices Procurement Manual"
http://www.fta.dot.gov/library/admin/BPPM/

Project Management Institute, *A Guide to the Project Management Body of Knowledge* (PMBOK® Guide) -Third Edition Project Management Institute, 2004. http://www.pmi.org/prod/groups/public/documents/info/pp_stnd_productexcerpts.asp

CHAPTER 2. PROJECT DEVELOPMENT

2.0 PURPOSE OF THIS CHAPTER

Introduction

It is important to understand how projects are developed. This chapter discusses the process for developing a Capital Improvement Plan (CIP) including: how a CIP is prepared, the organization needed to support a CIP, the identification of capital asset needs, how to prioritize projects within a CIP, financial planning to balance capital expenditures with other uses of funds and sources of available funding, and ways in which projects are authorized.

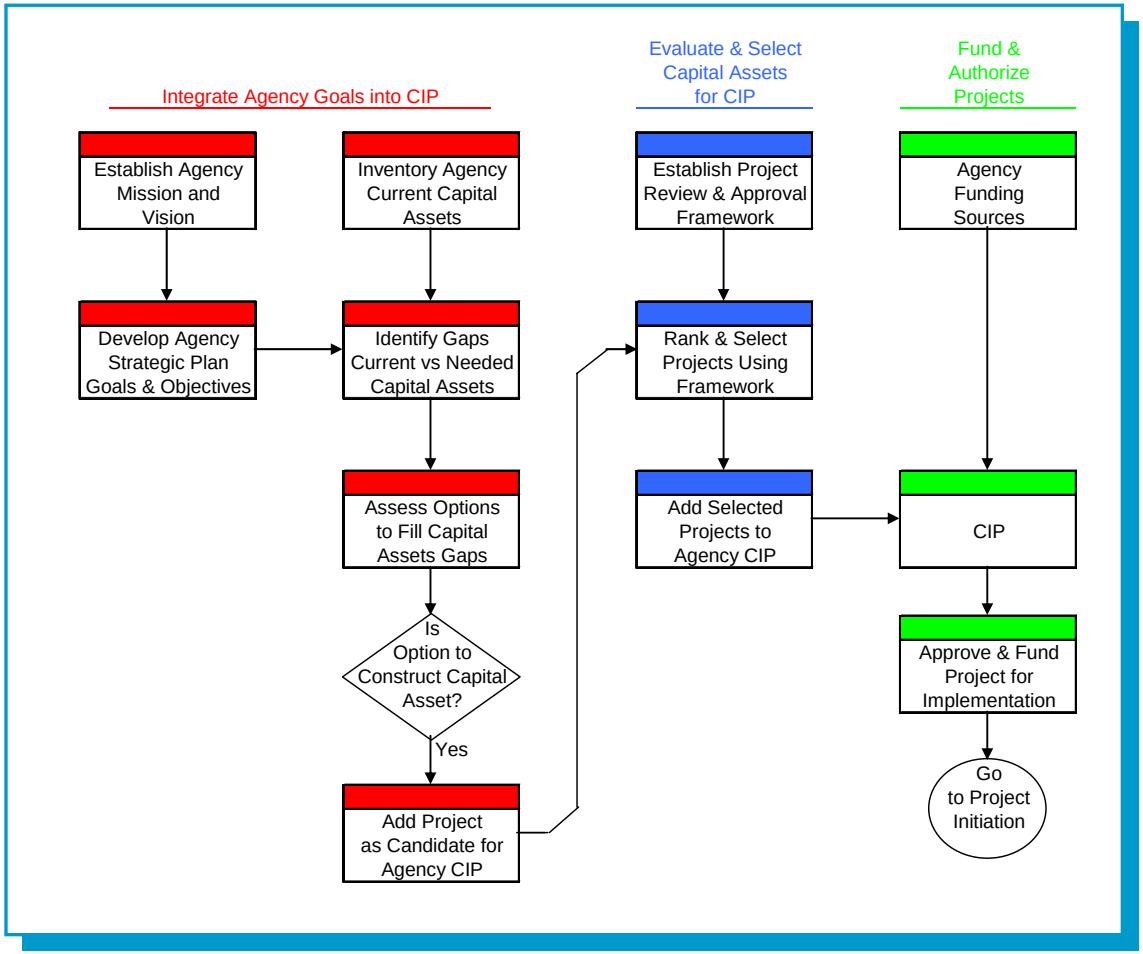
Project Development

During project development, the Agency identifies the need for a project, assesses the project's ranking in importance relative to other projects, analyzes its funding requirements, and decides whether to authorize the project for implementation. Planning how to manage an authorized project is discussed in Chapter 3 – Project Initiation.

The Agency's mission, vision, and resulting strategic plan govern the development of the CIP. The strategic plan looks to the Agency's mission that in turn defines its vision for the future and the strategies it will adopt to achieve the mission's goals and objectives. The Agency can then determine what assets it needs to accomplish its strategies and identify any gaps between its existing and needed assets. Simply stated, a capital project is developed as a means of filling the gap between the needed and the existing assets. The CIP is a prioritized list of projects to meet the Agency's capital asset needs. Figure 2-1 depicts the project development and CIP process.

Not all projects in a CIP can be immediately implemented due to funding and other constraints. The Agency has to rank the relative importance of the projects and make hard choices to select which projects can be implemented, and which must be deferred along with the strategic objectives that depend on them. This part of the project development process requires a careful balancing of project costs against available financing and is a complex mix of public policy, public financing, and capital and operational budgeting.

Figure 2-1 – Project Development and Capital Improvement Plan Process



Role of Agency and Consultant Staff in Project Development

Strategic planning and the CIP process is the responsibility of the Agency's senior executive supported by its planning and financial staff with information input by operating departments. Due to the long-term nature of Agency strategies and capital projects, the FTA Guidance for

Transit Financial Plans calls for a 20-year CIP planning horizon. Each year the Agency re-examines the plan particularly for the near term years and also develops a budget for the upcoming financial year.

IMPORTANT TO DO

- ❑ ASSESS ASSETS NEEDED TO ACHIEVE AGENCY GOALS.
- ❑ IDENTIFY GAPS BETWEEN NEEDED AND CURRENT ASSETS.
- ❑ EVALUATE ALTERNATIVES TO FILLING ASSET GAPS.
- ❑ ADOPT A STANDARD PROJECT REVIEW/APPROVAL FRAMEWORK.
- ❑ ESTABLISH CRITERIA TO RANK AND SELECT PROJECTS.
- ❑ MAINTAIN A LONG-TERM CAPITAL IMPROVEMENT PLAN.
- ❑ BALANCE CAPITAL NEEDS TO FUNDING SOURCES.
- ❑ AUTHORIZE PROJECTS IN USEFUL SEGMENTS.

Depending on the size of the Agency, a number of new capital projects may be authorized for implementation in the upcoming financial year. The budget to complete each newly authorized project is identified and the financing needed over the project life is committed. The budget for the upcoming year includes funding to cover new and continuing projects. Figure 2-2 shows a typical Capital Improvement Plan.

Figure 2-2 Capital Improvement Plan

	Total Prior Yrs	Current Fiscal Yr	FY1	FY2	FY3	Future Fiscal Years FY4	FY5	----------	Project Total
Current Projects									
~~	xx	xx							xx
~~	xx	xx	xx	xx					xx
~~	xx	xx	xx	xx	xx				xx
~~	xx	xx	xx						xx
~~	xx	xx	xx						xx
Total	xx	xx	xx	xx	xx				xx
Proposed Projects									
~~			xx	xx					xx
~~				xx	xx	xx	xx		xx
Maintenance Facility				xx	xx	xx			xx
~~						xx	xx		xx
Total			xx	xx	xx	xx	xx		xx
Total CIP Projects	xx	xx	xx	xx	xx	xx	xx		

The Agency may choose to retain the services of qualified consultants to assist in: strategic planning; applying to local, state, and federal levels of government for funding; securing funding through debt and innovative financing; and preparing a CIP. The role of the consultant is to assist the Agency planning, finance, and operations staff to prepare the CIP by providing specialized expertise and experience not available within the Agency staff.

2.1 INTEGRATE AGENCY GOALS INTO CAPITAL IMPROVEMENT PLAN

If you are charged with managing the Agency's project development process, it is important that you ensure that the resulting CIP is consistent with the Agency's goals. Steps you should take to integrate the Agency goals into the CIP include:

- Assessing the capital resources needed to achieve the Agency's goals
- Identifying gaps between current and needed capital resources
- Evaluating alternative approaches to filling the gaps.

Success in assessing capital resource needs requires you to first confirm that the Agency's goals and objectives align with the Agency's mission. To do this you will need to put in place a strategic planning process where the Agency's policy setting executive can re-examine the Agency's mission in response to changing needs in community requirements, government mandates, board priorities, operations, and organizational strengths and weaknesses; and set policy goals and objectives consistent with the mission. With the goals and objectives in place, you can then assess what capital resources the Agency will need to accomplish each goal and objective.

To identify any gaps between current and needed resources you will need an inventory of current capital assets.

Soliciting the opinions of operations, maintenance, and engineering personnel who work directly with a current asset will provide you with a good source of information on the use and performance of an asset usually defined in terms of:

- Asset type, location, and status
- Physical condition and maintenance needs
- Use and level of performance
- Ownership of the asset when the service is contracted out.

Comparing resources available with resources needed with enable you to identify any gaps and begin planning to fill them.

As part of the project development process it is prudent to consider a range of alternatives to filling identified asset gaps. Not all strategic needs have to be filled with assets that are owned and operated by the Agency. In many cases it may be beneficial to outsource work or lease facilities. In our example maintenance facility project, it may be more beneficial to outsource heavy body work and painting to a local paint facility and avoid building a paint and body shop that does not get much use. Alternatively, adjacent Agencies may want to pool resources for certain functions and perform the work in shared facilities. Alternatives that you should consider to fill asset gaps include:

- Construct the capital asset
- Purchase the asset
- Modify and/or renovate an existing asset(s)
- Contract out the activity the asset would support
- Lease the asset
- Share the asset with adjacent agencies
- Privatize the activity the asset would support.

When the first of these options, constructing the capital asset, is selected, then the project is added to the list of candidate projects for the Agency's CIP.

Returning to our example maintenance facility scenario, the project had been put forward for development to support the Agency's mission to provide quality transit service to the community. The Agency's service area was experiencing rapid growth due to a population expansion that is predicted to continue in the immediate future. To adequately serve the community, the size of the bus fleet is predicted to double. The existing maintenance facility is too small to effectively handle the predicted fleet size, and its antiquated facilities and equipment would also need updating to support maintenance of a modern fleet. As alternatives to constructing a new facility, the Agency also examined the option of expanding and renovating the existing facility and the option of contracting out the maintenance operations. Cost-benefit analysis over the life cycle of the maintenance facility demonstrated that constructing a new facility was the best option because the higher operating costs of a renovated facility outweighed the lower capital costs of renovation, and the absence of competition of experienced service providers if the maintenance were contracted out resulted in a high risk of unreliable contracted-out service and high service prices.

Important to Know

- Agency's strategic plan is helpful for aligning the Capital Improvement Plan to Agency goals.
- Operating, maintenance, and engineering personnel are a good source of information on the status of current assets and new assets needed.
- There are alternatives to filling strategic needs with Agency owned and operated assets.

2.2 EVALUATE AND SELECT CAPITAL ASSETS FOR CAPITAL IMPROVEMENT PLAN

Managing the selection of which capital assets to develop and, correspondingly, which projects to implement requires the Agency to:

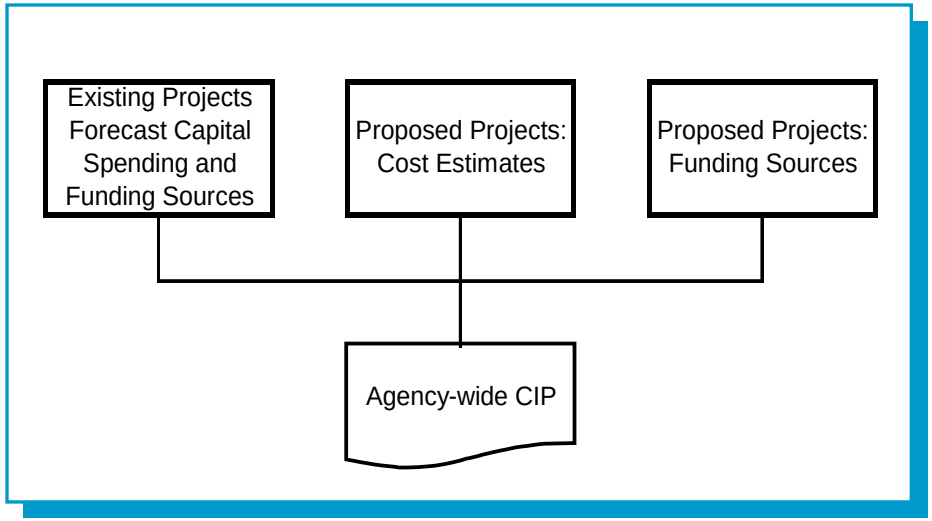
- Adopt a standard review and approval framework
- Use established criteria to rank and select projects
- Maintain a long-term CIP.

You can create a standard review and approval framework for your Agency by establishing some form of standard "Project Request Package" for review by the Agency's management responsible for its CIP. The topics to be addressed in a "Project Request Package" include:

- Project overview
- Benefits discussed in terms of support of Agency goals and objectives (addressing asset gap)
- Economic assessment (net present value, full life cycle cost, and funding requirement)
- Financing (grant, debt, and/or innovative financing)
- Project budget estimate
- Major milestones and deliverables
- Risk assessment.

With the above standard review and approval framework in place, criteria can be established with which to rank the projects. Ranking is necessary because public Agencies rarely, if ever, have sufficient funds to undertake all proposed projects. The highest ranked projects for which proposed funds are available can then be inserted into the Agency's CIP as proposed projects to join ongoing authorized capital projects. Figure 2-3 shows the relationships amongst the components of a CIP as presented in the FTA Guidance for Transit Financial Plans.

Figure 2-3 – Components of Capital Improvement Plan



The Agency-wide CIP allows the Agency to manage its resources and debt so as to maintain focus on the Agency's goals and objectives to accomplish its mission. The management of the CIP will determine the timing of when a project is to be authorized for implementation as discussed next.

Important to Know

- Projects need to be ranked and selected because Agencies face funding and other constraints.
- Established criteria are necessary for ranking projects.
- A project priority is established based on a complex mix of community requirements, government mandates, board priorities, operations, and organizational strengths and weaknesses.

2.3 FUND AND AUTHORIZE PROJECTS

Financial Planning

Limited available funding requires the Agency's CIP to carefully balance the full costs of the projects within the CIP against the available funds both over the long-term and on a year-by-year basis.

It is important that the CIP includes the full costs and funding requirement for projects when making decisions on which projects to select for authorization based on their ranking. Knowledge of a project's full costs and funding requirement is necessary to assess the financial impact in future years of implementing the project, and the Agency can verify that it has the financial resources to complete all authorized projects. It also allows the Agency's decision makers to compare the long-term costs and funding requirements of alternative projects of similar ranking to better understand the financial consequences of the CIP decisions.

The financial planning that balances the CIP's sources and uses of funds also needs to take into account uses of funds for debt service and the balance of funds from operations. Figure 2-4 shows a typical CIP financial plan incorporating debt service and balance from operations.

Figure 2-4 – Financial Plan - Balance Funding Sources to Capital Improvement Plan Capital Expenditures

	Prior Years Actual			Current Year Budget	Future Years Forecast Forecst					
Fiscal Year	**PY-3**	**PY-2**	**PY-1**	**CY**	**FY1**	**FY2**	**FY3**		**FY19**	**FY20**
Capital Funding Sources										
Local										
Balance from operations										
Tax (Sales, Other)										
Bond proceeds										
Current Debt Financing										
Proposed Debt Finanacing										
Investment Income										
State										
Current Funding										
Proposed Funding										
Federal										
Current Funding										
Proposed Funding										
Total Revenues										
Capital Expenditures										
CIP										
Current Projects										
Proposed Projects										
Total CIP										
Debt Service										
Current Debt Service Costs										
Proposed Debt Service Costs										
Total Expenditures										
Cash Balance										
Beginning Cash Balance										
Change (Revenues less Expenditures)										
Closing Cash Balance										

Staged Authorization

It is frequently beneficial to manage the authorization of projects in stages. Staged authorization is when project funding and implementation are authorized to take the project to a certain stage of completion. On reaching this stage, the project is re-reviewed within the context of the CIP and a further decision is made as to whether or not to authorize the next stage of a project. Stages are selected based on completing a useful segment of the project that either:

- Provides better information on the costs, risks, and benefits of the project before committing the Agency to the full costs and funding of the project; or
- Delivers a component of the total project that itself is a useful asset that fills an identified asset gap where the resulting benefits exceed the staged project costs.

In our example maintenance facility project, two authorization stages were planned. The first stage was to authorize the project to the completion of preliminary engineering. At that point, the Agency would gain better information on the project's cost, the Agency's ability to fund the project, and the Agency's plan and ability to manage the project through design and construction (as discussed in Chapter 3). With this information in hand, the Agency will re-review the project and determine whether to commit its resources to design and construction. The second stage was to complete the design and construction of the example maintenance facility but defer installation of the paint booth until additional funding became available in future years. The Agency determined that completion of the components of the maintenance facility excluding the paint booth resulted in operational benefits that exceeded the project costs.

FTA Funding Requirements

The funding plan for our example maintenance facility project included the receipt of FTA grant funds to share a portion of the project costs. Receipt of FTA funds for a project places certain requirements and conditions on the Agency as summarized below:

- Legal filing with the FTA of documents describing the Agency's statutory authority, authorized powers, and eligibility to receive federal funds.
- Assurance of compliance with Civil Rights – Title VI nondiscrimination.
- Civil Rights Disadvantaged Business Enterprise (DBE) Plan and Annual Goal.
- Civil Rights Equal Employment Opportunity Plan.
- FTA Annual Certifications and Assurances.
- Use of FTA Transportation Electronic Award Management (TEAM) computer system to apply for grants and submit required quarterly financial and narrative reports.
- Use of FTA Electronic Clearing House Operation (ECHO) computer system to draw down grant funds for reimbursement of project expenses.
- Grant application containing the following project information
  - Description of project
  - Planning of project in Statewide Transportation Improvement Program (STIP)
  - Environmental impact analysis under National Environmental Policy Act (NEPA), as discussed further in Chapter 4
  - Description of transit system in the Agency's service area.

Project Authorization Documentation

The final step in managing the project development process is to formally document the authorization of the project using a project authorization document. Concurrent with preparing the project authorization, it is good practice to assign the project manager to the project so that, with the project authorization in hand, the project manager can begin planning the management of the project's implementation, as discussed in Chapter 3.

The project authorization documents the information generated during the project development process together with the Agency's decision to implement the project including:

- The topics addressed in the "Project Request Package" that resulted in the project being selected, incorporated into the CIP, and authorized for implementation.
- Attachment or reference to Agency decision to implement the project (such as Board action item).
- Description of project.
- Summary budget and funding.
- Summary milestone schedule.
- Assigned project manager.
- Authority delegated to project manager.

Important to Know

- Knowledge of a project's full cost and funding is necessary to assess its financial impact.
- Financial planning for capital expenditures also needs to consider debt service and the balance of funds from operations.
- Use of federal funds on a project places certain obligations and conditions on the Agency.

CHAPTER 3. PROJECT INITIATION

IMPORTANT TO DO

- ❑ RECEIVE PROJECT AUTHORIZATION.
- ❑ WRITE PROJECT REQUIREMENTS DOCUMENT.
- ❑ ASSESS AGENCY CAPABILITY AND CAPACITY.
- ❑ SELECT DELIVERY STRATEGY.
- ❑ ESTABLISH PROJECT ORGANIZATION STRUCTURE.
- ❑ WRITE PROJECT MANAGEMENT PLAN.
- ❑ WRITE SUPPORTING PLANS
  - QUALITY MANAGEMENT
  - RISK MANAGEMENT
  - CONTRACT MANAGEMENT.

3.0 PURPOSE OF THIS CHAPTER

Introduction

In this Chapter we turn our attention on how to plan an authorized project. We will discuss two important project planning documents: (i) the Project Requirements Definition (PRD) that documents *what* the project will deliver (alternatively referred to in the literature as the Statement of Work); and (ii) the Project Management Plan (PMP) that documents *how* the project is to be delivered. We will also look at the use of supporting planning documents, including the quality management, risk management, and contract plans.

Project Initiation Phase

During project initiation, the Agency plans how the authorized project is to be implemented. Planning begins by fleshing out what the project is to deliver and documenting the result in the PRD. The Agency then considers what approach to take to manage and carry out the work to implement the project, selects the project delivery method, assesses the type and size of resources needed for the project, and documents these in the PMP. Planning concludes with establishing the selected project management organization through the assignment of Agency staff to the project and retaining of a Program Management Consultant (PMC) for the project management work where the Agency does not have staff resources with the necessary skill and experience.

Role of the Agency in Project Initiation

Planning the project in the initiation phase is usually the Agency's sole responsibility carried out by the Agency's project manager. However if the project is of such a size and complexity that the Agency is unsure how to plan its implementation, the Agency can retain a PMC during the initiation phase.

Role of the Program Management Consultant

Where an Agency lacks the necessary project management expertise and resources the Agency retains a PMC to:

- Advise on project planning and delivery together with the production of the PRD and PMP documents.
- Provide project management services during the subsequent project implementation phases.

3.1 DEFINING THE PROJECT

Project Requirements Definition

The Agency assigns a project manager to lead an authorized project. The project authorization is the project manager's corporate authority to implement the project and gives the project manager a broad narrative description of the project's goals and objectives. (Chapter 2 discusses project authorization and project manager assignment.) The project manager's task now is to prepare the PRD.

In the PRD the project manager refines and details the project authorization and details *what* the project is required to accomplish in terms of the products/services the project will deliver and the scope of work that needs to be done. Figure 3-1 describes these and other topics a PRD should address. Through a well-written PRD, the project manager provides project team members, corporate sponsors, and other stakeholders with a common understanding of *what* the project is all about, and is the authoritative reference document that defines the project. Review and acceptance of the PRD by the Agency's executive responsible for the project's authorization helps make certain that the executive, the project manager, and the project team have a common understanding of the project's objectives. Whether by formal sign-off or less formal email, it is important that the project manager receives a record of the acceptance of the PRD by the Agency's executive so there is no misunderstanding at the outset of what the project is intended to accomplish.

Important to Know

- A Project Requirements Definition defines *what* the project will accomplish.
- The Project Requirements Definition is the authoritative reference document of *what* the project is all about.
- Acceptance of the Project Requirements Definition by Agency executives confirms a common understanding of the project between the executives and the project manager.

Figure 3-1 – Project Requirements Definition

Topic	Description
Authorization	Reference to project authorization that selected and authorized the project
Stakeholders	Corporate sponsors, customers, third parties impacted, project team
Deliverables	Products/services the project will deliver
Scope of Work	Work to be done to deliver the products/services (high-level summary)
Cost Estimate	Initial order of magnitude estimate of the project budget
Schedule Milestones	Initial project schedule in terms of key project milestones
Finance	Project financial requirements and sources of funding
Risks	Threats to the project (e.g. adverse environmental factors)
Resources	Resources needed to accomplish the project
Constraints	Constraints such as limited resources/funding, sites available, etc.
Acceptance Criteria	What determines acceptable products/services and their approval

The project manager for our example bus maintenance facility project scenario approached the PRD as follows:

Authorization:	Incorporated references to the project authorizations: Capital Improvement Program recommending example project, Agency Board action approving the project, and FTA agreement for funding a share of the project.
Stakeholders:	Identified parties with an interest in or impacted by the project, including: Agency Board, FTA, Agency operations, elected officials in whose area the project is located, and the community and businesses adjacent to project.
Deliverables:	Prepared a high-level description of the example project: facilities, equipment, and systems.
Scope of Work:	Developed a high-level work breakdown structure (WBS) of the project work phases: acquire land for garage facility, obtain environmental clearance, design facility and equipment, construct facility and supply/install equipment, test and start-up, and accept completed facility.
Cost Estimate:	Allocated the $30 million budget across the high-level WBS.
Schedule Milestones:	Estimated the initial project schedule milestones for accomplishing the high-level WBS phases.
Finance:	Costed out project requirements for funds from Agency, state and FTA grant sources, and debt financing.
Risks:	Identified potential threats to project success, such as unknown ground conditions at the proposed facility site.
Resources:	Listed the types of staff and other resources needed for the project, e.g., environmental specialists, architects and engineers, construction contractors, and equipment suppliers.
Constraints:	Identified project constraints: limited cash flow from debt financing, shortage of experienced contractors.
Acceptance Criteria:	Specified requirements to take occupancy of the building and approve the performance of the equipment.

3.2 PLANNING THE PROJECT

Capability and Capacity Assessment

The project manager assesses the levels of resource capabilities and capacities needed to accomplish the project defined by the PRD. Capability is a measure of a resource's skill levels, experience, and ability to perform. Capacity is a measure of the quantity of the resources. The project manager may need to consult with peers or consultants who have prior experience with similar projects to accurately determine the necessary resources. Figure 3-2 shows the typical resource capabilities needed for an engineering and construction project such as the example bus maintenance facility project.

Figure 3-2 – Typical Engineering and Construction Project Resource Needs

Capability	Resource	Function
Management and Control	Project Management	Manage the overall project and its phases – initiation, planning, design, construction, and closeout
	Project Management Oversight	Oversee project performance by a party independent of the project team and report to project sponsor(s)
	Configuration Management	Control changes to project deliverables/scope of work
	Cost Control	Control project costs within budget
	Schedule Control	Control project progress within schedule
	Accounting	Record project expenditures, issue payments, and manage project funding
	Records Management	Capture, store, control, and retrieve project records/documents
	Procurement/Administration	Procure and administer project contracts
Planning, Engineering, and Technical	Architectural	Develop architectural and design concepts
	Engineering	Prepare detailed engineering and final design documents
	Environmental	Undertake environmental planning and clearance
	Real Estate	Acquire real estate and ROW
	Communications	Communicate with the community/media/government
Construction and Supply	Construction Contractor	Construct facilities
	Third Party Agency	Relocate or gain access to public and private utilities
	Equipment Supplier	Supply/install equipment

Important to Know

- The *project delivery strategy* should fit the Agency's capability and capacity to deliver the project taking into consideration the strategy's associated risks.
- Project *capability* is a measure of the experience and skill levels of project team resources.
- Project *capacity* is a measure of the quantity of project team resources.
- A Project Management Plan defines *how* the project is to be managed.
- Scope, schedule, and cost baselines are the yardsticks against which project scope, schedule, and cost performance can be measured and controlled.

Project Delivery Strategy

For Agencies that infrequently undertake capital projects, the project manager will almost certainly find that the required levels of capability and capacity are not available within the Agency's own forces. The project manager has to look outside the organization and plan a project delivery strategy that contracts out the work that the Agency lacks the capability and capacity to undertake.

A project delivery strategy determines the:

- Work done by the Agency and the work that is contracted out to consultant and/or construction contractors
- Degree of control the Agency maintains over how the work is done and the control transferred to contractors through contracting out
- Assignment of risks associated with the project work undertaken by the Agency and contractors.

What alternative delivery strategies are available to a project manager? A project manager may contract out any one or all of the project management, design, and construction functions to acquire the capability and capacity needed for the project. Contracting out a function also results in transferring, from the Agency to the contractor, responsibility for and control of the means and methods of how the work is executed, as well as the risks associated with the performance of the work. Figure 3-3 describes alternative project delivery strategies along with the corresponding transfers of control and risk from the owner organization to the contractor. Figure 3-4 illustrates the sharing of control and risk between the Agency and the contractor for different delivery strategies.

For the example bus maintenance facility project, the project manager plans a design/bid/build (D/B/B) delivery strategy where: the project manager and other Agency staff will manage the project; design and design management will be contracted out to a General Engineering Consultant (GEC); and a Construction Manager (CM) will be retained to manage construction carried out by various construction contractors and suppliers.

For smaller Agencies it is often expedient for the project manager to choose delivery strategies similar to the example above, that contract out the project work rather than hire an entire project staff. It is difficult to recruit qualified project staff for a single project. Using contracted services allows the project manager to better match resources to project needs. A contractor can be retained when the need arises and the project manager can immediately terminate their involvement and expense when the project need is over. Whatever delivery strategy the project manager selects, it is important that the Agency, through the project manager, retains the ultimate authority and accountability for the effective management of the project. This is the case even where the Agency's project manager chooses to retain a Program Management Consultant (PMC) to manage the project on behalf of the Agency.

Figure 3-3 – Project Delivery Strategies

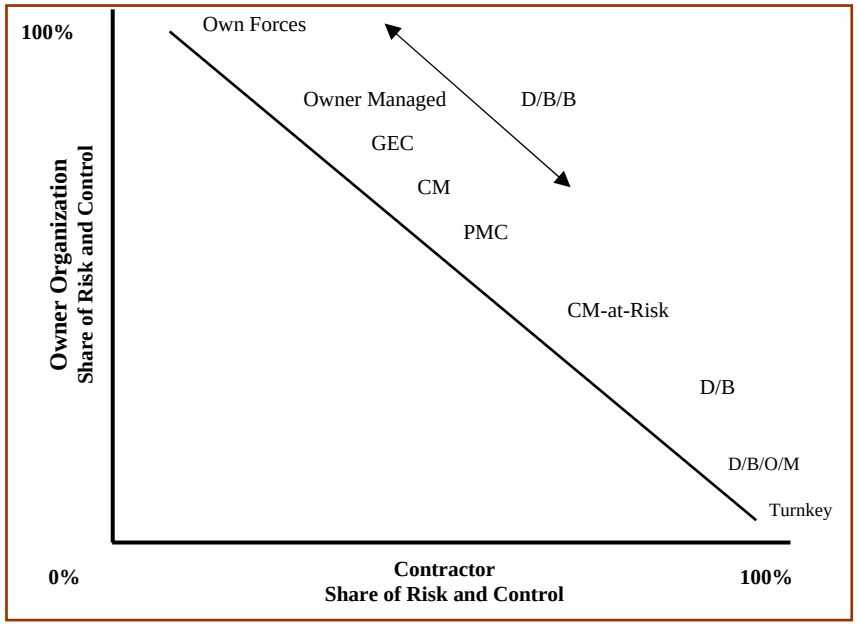
Strategy	Sub-Strategy	Description	Owner Control/Risk
Own Forces	Total Project	Owner manages, designs, and constructs project with own forces	Owner has total control and accepts all risks
	Construction	Owner manages and constructs project with own forces, and retains design consultant for design work	Owner has total control and accepts all risks except for design errors or omissions
D/B/B Design/Bid/Build	Owner Managed D/B/B	Owner manages project, contracts out design to engineering consultants and construction to contractors	Maintains overall project control and transfers detailed engineering design/construction tasks and risks to contractors
	GEC	Owner retains a GEC to manage the design and design consultants	Owner transfers control of design and design management tasks and risks to GEC
	CM	Owner retains CM to manage construction contractors	Owner transfers control of construction and construction management tasks and risks to CM
	PMC	Owner retains a PMC to manage the project including consultants and contractors	Owner maintains control of project scope and transfers project management tasks and risks to PMC
CMAR Construction Manager at Risk	Owner may also retain a GEC and PMC	Owner retains a CMAR contractor in final design, who participates in design review, estimating, and value engineering and at some agreed point guarantees a fee to manage and carry out construction	Owner transfers a share of control of scope through design to the CMAR contractor and all of the control and risk of the management and execution of construction
D/B Design/Build	Owner may also retain a GEC and PMC	GEC completes design through preliminary engineering (approximately 30 percent). Owner retains a D/B contractor to complete design and construct the project	Owner maintains control of scope through concept design (30 percent) after which control and risk of design and construction is transferred to D/B contractor
D/B/O/M Design/Build/ Operate/Maintain	Design/Build/Operate or Design/Build/ Operate & Maintain	As for D/B plus contractor is responsible for the operations and maintenance of the facility for a specified period	Owner transfers control and risk of operations and maintenance to the contractor
Turnkey	Could be used for D/B or D/B/O/M	Owner prepares a performance specification that is bid on by turnkey contractor, who may also participate in financing the project	Owner controls scope of performance specification after which control and risk of conceptual/detail design and construction transfers to turnkey contractor, including operations and maintenance if D/B/O/M

Project Organization and Management Structure

With the delivery strategy selected, the project manager's attention turns to establishing the project organization structure needed to manage the project and carry out the project work done by the Agency's own forces. Only the largest projects justify the assignment of full-time project staff in every function. Small to mid-size projects call for some form of matrix organization. In a matrix organization, staff reports to the project manager through the project chain of command to receive direction on project work assignments (*what* work has to be done) and to their functional supervisor for direction on their technical performance (*how* the work is done).

The project manager for the example bus maintenance facility project requires Agency procurement staff to acquire GEC and CM consultants and construction contractors. The level of procurement effort to do this for the project is not full-time and the staff is assigned part-time to the project on a matrix-organization basis. The procurement staff takes project direction from the project manager on what procurements are needed and when, while the staff receives functional direction on how to undertake the procurements from the functional manager of the Agency's procurement department. When not assigned to the example project, the staff undertakes procurement activities for operations and/or other Agency projects.

Figure 3-4 – Sharing of Control and Risk Between Owner and Contractor for Alternative Delivery Strategies



Experience has shown that a project team works better within an integrated project office concept. This means that irrespective of the project staff's parent organization, the Agency's organization or those of the GEC and CM organizations, the staff's project reporting relationship with respect to project work assignments follows the project organization chain of command reporting to the project manager. When possible and in cases where staff is highly utilized, co-location of project staff within a single project office facility helps foster the integrated project office concept. Functional supervision remains the individual's usual functional supervisor within their parent organization.

Project Management Plan

The project manager has to provide the project team with a road map on how to get the project done. The PMP sets out *how* the project is to be managed, executed, monitored, controlled, and closed through the phases of its life cycle. Figure 3-5 sets out a typical PMP outline that would apply to a construction project such as the example bus maintenance facility project.

In the PMP, the project manager sets out the management approach for the project based on the decisions made with respect to the project delivery strategy, organization and management structure, assignment of responsibilities between the Agency and contractors, and delegation of management and financial authority through the project team.

The project's scope, budget, and schedule are refined to establish baselines for the project's scope of work, costs, and schedule that are documented in the PMP, (see Chapter 9 to learn about project control techniques used for establishing baselines). Scope, budget, and schedule baselines are yardsticks against which future project performance can be measured and assessed, and changes controlled. Depending on the project phase baselines are established for a project phase or the entire project baseline is established after completion of preliminary engineering. A baseline remains unchanged through the project or project phase unless a revision to the project's goals and objectives is authorized by the Agency's executive management responsible for the project authorization.

The PMP is a "living" document and is updated as the project progresses, usually as the project enters a new phase, such as moving from design into construction. Updating and revising the PMP requires the project manager to: add management detail on how a new phase is to be managed, note any changes to the project scope, and forecast project costs and schedule against the baselines. In Chapter 9 we explain some useful tools and techniques that support the project manager in the control of scope, cost, and schedule.

Figure 3-5 – Project Management Plan Outline

1. Project Overview
   - Background (Authorization/ PRD)
   - Scope/Budget/Schedule
   - Stakeholders
   - Delivery Strategy
2. Organization and Staffing
   - Position within Owner Organization
   - Project Organization
   - Key Personnel Job Functions
3. Project Management and Controls
   - Scope Control and Configuration Management
   - Budget and Cost Control
   - Schedule Control
   - Project Accounting
   - Project Reporting
   - Records Management
4. Planning / Conceptual Design Phase Management
   - Planning Studies
   - Site Investigations
   - Environmental Clearance
   - Permitting
   - Real Property Acquisition
5. Final Design Phase Management
   - Design Management
   - Design Standards
   - Design Reviews
   - Value Engineering
   - Constructability Reviews
6. Construction Phase Management
   - Construction Management
   - Field Inspection
   - Third Party Construction
   - Change Management
   - Construction Safety
   - Design Support
7. Closeout Phase Management
   - Test and Start-up
   - Operator Training
   - Contract Closeout
   - Administrative Closeout
8. Quality Management
   - Design QA/QC
   - Construction QA/QC
   - Final Acceptance and Approval
9. Risk Management
   - Risk Identification and Analysis
   - Risk Monitoring and Response
10. Procurement and Contract Administration
    - Procurement Plan
    - Contract Administration
      > Professional Services
      > Construction
      > Equipment Supply/Install
    - Third Party Agreements
11. Communications
    - Project Team
    - Community
    - Government
    - Media

A project's authorization may be limited to proceeding up to a certain milestone at which certain criteria must be met for the project to receive further authorization to continue. This staged authorization is known as staged-gate decision-making. In our example project scenario the agreement with the FTA authorized funding up to the conclusion of preliminary engineering. At this point continued FTA funding was conditional on the Agency preparing an acceptable PMP, demonstrating the capability and capacity to put in place the resources to manage and undertake design and construction, and securing financing for the Agency's share of the project costs.

Supporting Management Plans

Supporting management plans are added to a project as appropriate depending on the project's size and complexity. Larger and more complex projects may require adding one or more of the following supporting plans to the PMP at project initiation:

- Quality management plan
- Risk management plan
- Contract management plan.

The quality management plan describes how the project will comply with the Agency's quality policy in terms of the project procedures for quality assurance (QA), quality control (QC), and continuous process improvement. QA is the planned processes the project will follow to make certain that the quality policy is met through: QA audits to examine whether project activities are in compliance with project procedures, and process analysis to examine the effectiveness of project activities, learn from experience and problems encountered and thereby improve the process. QC is the monitoring of specific project results to determine whether they meet with predetermined quality standards and metrics. Continuous process improvement is the iterative application of process analysis over the length of the project and from project to project. Each consultant and construction contractor performing work on the project must have a QA plan that is acceptable to the Agency, so that the Agency can assess that the contractor's quality standards meet the Agency's quality management plan.

The risk management plan describes how the project is organized and the procedures used to manage the project risks, addressing in the plan:

- Roles and responsibilities of project staff in risk management
- Identification of project risks
- Categorization of risks in terms of probability of occurrence and impact on project cost, schedule, scope, and/or quality
- Risk handling should the risk event occur, through either
  - Assumption – Accepting the consequences of the risk.
  - Avoidance – Changing the project deliverable design or work methods that lead to the risk.
  - Control – Developing measures to reduce the risk's probability of occurrence, continually re-evaluating the risk, and having in place contingency plans to adopt that mitigate the impacts of the risk.
  - Transfer – Sharing or transferring the consequences of the risk with others, for example, through insurance or warranty provisions.

The contract management plan is discussed under Contract Management Planning in the section that follows.

3.3 CONTRACT MANAGEMENT PLANNING

The project manager's choice of project delivery strategy determines what products/services are to be delivered by the project team and those that will be contracted out. We now turn our attention to developing the project's contract management plan for the contracted out work. Depending on the size of the project, the contract management plan may be a section within the PMP or for larger projects a supporting planning document referenced in the PMP.

Important to Know

- A contract management plan defines:
  - What goods and services are to be acquired for the project and how they will be purchased or contracted.
  - How project purchase orders and contracts will be administered.

Contract Procurement Planning

Procurements for most projects are undertaken by the Agency's procurement department that has in place associated procurement procedures. The project manager's role is to make certain that the department's procurement activities on behalf of the project fit in with the project plan. The contract management plan sets out how this is to be achieved, by addressing:

- Types of contracts to be used. Choice of contract type depends on the nature of service/product purchased and choices on the division of risk between the owner and contractor; see Chapter 9.
- Who estimates the expected contract price.
- Who develops the scope of work statement for the contract.
- Use of standardized procurement documents and any special documents needed.
- Integration of procurement lead times into the project schedule.
- Incorporating contractual delivery dates into contracts that coordinate with the project schedule.
- Use of performance bonds and/or insurance contracts to meet the project's risk management objectives, including liability and insurance conditions and minimum limits to be met by the contractor.
- Establishing evaluation criteria to assess the selection of contractors; see Chapter 9.
- Definition of the procurement procedures for: preparation of procurement documents, advertising, bidder conferences, any bidder pre-qualification, receipt of proposals/bids, bidder interviews, selection, contract price negotiation, contract award and handling of protests. (In many instances the procedures used for project procurements will be those the Agency already has in place.)

Based on the delivery strategy the project manager selected for the example bus maintenance facility project, the contract management plan needs to include two professional service contracts, one for the GEC and one for CM, and various construction contractor and equipment supplier contracts. Identification of the number of construction and supplier contracts may not be possible until later in the design process, so as with the PMP, the contract management plan will require updating as the project progresses.

Contract Administration Planning

The contract management plan also addresses how awarded project contracts are to be administered. Due to a contract's legal nature it is important that the project team understands the legal implications of their actions relative to project contracts. The role of the contract

administrator is to make certain the contractor meets its contractual obligations, the Agency adheres to its contractual obligations, and the Agency's legal rights are protected.

It is important that the PMP and the contract management plan clearly identify the roles and procedures to be followed by the project staff responsible for managing the project (delivering the project scope on time and within budget) versus the project staff responsible for administering project contracts (making certain contract parties meet their contractual obligations and protecting the organization's legal rights). The contract management plan sets out how this is to be achieved, addressing:

- Who has the authority to direct and approve the contractor to perform work
- How the contractor's work is monitored and performance reported
- Process by which changes to the contractor's work are requested, approved, and the contract modified
- What inspections and audits are to be conducted of the contractor's work
- How the contractor requests payment and payment requests are reviewed and approved
- What financial audits are to be conducted on contractor payments
- How contract documents, correspondence, and other records are managed. (Chapter 9 provides additional information of what constitutes good project documentation for handling important contract administration activities such as contract changes and request for payment.)

CHAPTER 4. PLANNING, ENVIRONMENTAL CLEARANCE, REAL ESTATE ACQUISITION

IMPORTANT TO DO

- ASSIGN ONE LEAD WITH EXPERTISE IN GRANTS AND PLANNING AND AVAILABLE TIME TO WORK WITH THE FUNDING AGENCIES.
- ASSURE INVOLVEMENT OF ALL STAKEHOLDERS SUCH AS THE USERS, PLANNING AND GRANT, OPERATIONS, MAINTENANCE, ENGINEERING, AND PROCUREMENT STAFF.
- DEFINE AGENCY AND CONSULTANT ROLES AND HIRE THE NECESSARY CONSULTANT EXPERTISE EARLY IN THE PROCESS.
- PERFORM PLANNING STUDIES TO BETTER DEFINE AND REFINE PROJECT REQUIREMENTS.
- LOCATE ACCEPTABLE SITE(S) IN COORDINATION WITH OPERATIONS, PLANNING, AND ENGINEERING.
- GET RIGHT OF ENTRY TO ACCESS THE SITE(S) TO INVESTIGATE.
- CONDUCT GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATIONS.
- CONDUCT STUDIES TO EVALUATE POTENTIAL ENVIRONMENTAL IMPACTS AND MEET STATE REQUIREMENTS.
- IF FTA FUNDING IS CONTEMPLATED, OBTAIN NATIONAL ENVIRONMENTAL POLICY ACT ENVIRONMENTAL COMPLIANCE AND PERMITS.
- PURCHASE REAL ESTATE AFTER FTA DETERMINATION OF ENVIRONMENTAL COMPLIANCE.
- OBTAIN THE NECESSARY ENVIRONMENTAL PERMITS.

4.0 PURPOSE OF THIS CHAPTER

Introduction

In this chapter we show the project manager how to take the project through planning and environmental clearance activities. We address the steps that are necessary to purchase real estate for federally funded projects. This is a critical phase of the project; if it is not performed well it can result in major cost and schedule impacts later in design, construction, or operations. We review the project organization for the planning phase, the planning studies, site selection, and real estate acquisition. Next, we cover the importance of site investigation and environmental compliance before purchase of the property and the entitlement processes after acquisition.

Planning Phase

The project development process begins with the identification of transportation needs. Federally funded projects must be in the Metropolitan Planning Organization's (MPO) lists and the State Transportation Improvement Program (STIP).

The project level planning process begins after project initiation and continues through alternative analysis and should be significantly completed by the end of preliminary engineering. The major activities in the planning phase, which require early consideration and substantive completion, are functional analysis, alternative studies, site selection, hazardous material and geotechnical studies, utility and third party coordination, environmental compliance with the National Environmental Policy Act of 1969 (NEPA) and state agency if applicable, and compliance with Uniform Act of 1970 for real estate acquisitions. The planning phase activities can continue through final design and construction for assuring compliance with mitigation measures stated in the environmental compliance document and acquisition, relocation, and management of real estate.

Role of the Agency

The Agency's main role is to assure that the assigned project lead person for the planning phase has the right qualifications, responsibility, authority, and available time to steward this phase. This project lead may or may not be the assigned project manager and could be a consultant. Managers with current operational or planning assignments are often tasked with the work of planning a large capital project while managing many other issues. This may result in "reactive" project management rather than "proactive" project management since the lack of adequate time will result in problems getting ahead of management

decisions and driving the project, rather than the Agency proactively circumventing and solving them. This lead person will have to work closely with other functions in the organization such as service planning, operations, maintenance, and procurement. The Agency must set priorities such that adequate support is provided to the lead person. For the example bus maintenance facility project, the Agency will need to assign a qualified manager with prior maintenance facility project management experience dedicated to thinking through the project needs. This manager anticipates issues and develops plans, collaborates with all stakeholders, and brings on the necessary resources to carry the project forward to meet the budget, schedule, quality and safety requirements. If such a resource is not available or does not have the time necessary, the lead person will have to work with procurement to bring in consultants for this phase.

Important to Know

- Early role definition for project team members is necessary to balance the authority and responsibility.
- Consultants who take on the planning phase and take the project through environmental compliance are conflicted out of performing the final design.
- The Project Management Plan revision in this phase will highlight unique features related to the planning phase.

Role of Consultants/Contractors

Whether the planning phase leadership is through use of an in-house project manager or through project management provided by a consulting firm, the planning studies will have to be done by outside consultants for most major projects. This is the case especially when taken on by an Agency that does not have a large, on-going capital planning function with specialists in community planning, NEPA, and real estate acquisitions. Real estate consultants must have experience and a track record with the Uniform Act. The consultant team should have expertise in environmental compliance and NEPA, transportation planning, engineering, architecture, and community outreach. The planning consultant team will have design experts that will take the projects through completion of the preliminary engineering phase. There must be some separation between the engineering team in charge of analyzing impacts and providing mitigations, and the environmental team in charge of identifying impacts to assure no conflict of interest exists. It is recommended that the environmental team be a separate company from the engineering team. In any case, the planning team will take the project through planning, environmental compliance, and preliminary engineering. Since the team is involved in scoping of the final design phase, it is conflicted out of continuing to provide final design services for the same project unless it participates in a new competitive selection process. Once the team is selected the project manager must complete updating of the Project Management Plan (PMP) with input from the team.

4.1 PLANNING STUDIES

Functional Studies

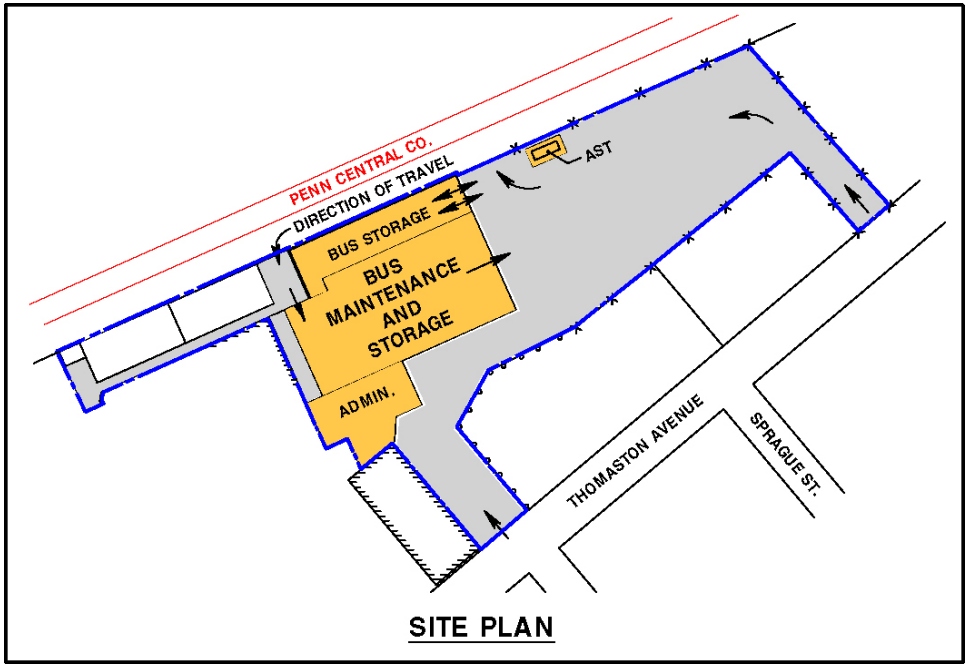
Functional studies are not site-specific. They are intended to define the needs of the users based on strategic goals regardless of site limitations or opportunities. In the case of a maintenance facility, the project manager will need to consider maintenance and operational needs including the size of fleet, number of shifts, outsourced functions, and labor mix to determine the space and equipment requirements. In the case of a bus stop, the functional study considerations could be limited to the loading capacity, type of shelter, shelter features, Americans with Disabilities Act (ADA) accessibility, lighting, advertising, and signage. In any case, the project manager must assign this work to a professional with extensive and prior experience with similar studies. The project manager must facilitate communication with internal and external stakeholders. Full coordination with the Agency's fleet management plans and short- and long-term transit plans is necessary. Once the users' needs have been identified, the project manager takes the report through the stakeholders for sign off.

Important to Know

- Functional studies are prepared to define and document the users' requirements.
- Alternative studies evaluate feasibility of potential solutions to meet users' needs.
- Site selection requires thorough consideration of transportation needs and impacts of operations on the environment.
- Technical investigations and studies are undertaken to prove technical merits and flaws of the recommended alternatives and selected sites.

Site Selection

To select a suitable site, the project manager will lead the team to determine a general area where the facilities may be constructed. The team considers a number of alternate sites within the general area. The project manager will lead the team to consider site features. Once all site constraints and opportunities have been identified, the team will undertake a more detailed study of the preferred site with respect to fit and function for the required functions. The team will develop a short list of selected sites to be studied further. The key elements of the study are the number of people and businesses that will be displaced, the estimated cost/time to acquire the real property for the project, the site geotechnical characteristics and environmental impact costs, the operational impact costs, and the estimated costs to relocate those eligible and/or to move personal property from the property. Once these factors are evaluated the sites will be ranked and listed in the environmental documents and an acquisition and relocation plan is developed.



Technical Studies

The project manager must have qualified technical professionals on the team to study the site and facilitate the technical evaluations early on and prior to completion of site selection and acquisition. Technical evaluation of the site includes geotechnical investigations, soil and water testing for contaminated material, traffic studies, zoning studies, and other technical assessment that may be applicable to the specific site. For example, the presence of hazardous material, waste, or other contaminants on the site, and potential of undesirable soil and geotechnical conditions can have severe cost and schedule implications and must be studied prior to completion of site selection and acquisition.

Utilities and Third Party Coordination

The project manager, with technical support as necessary, will play a significant role in communication and negotiation with utilities and impacted third parties. Utility relocation and third party coordination are critical parts of the construction of a project. Early and continuing coordination with the affected utilities and third parties is critical to keeping your project on schedule and budget. Utilities and third parties often need extensive lead time to reasonably schedule their work and obtain materials necessary for relocation of their facilities. The project manager should notify the affected utility company or third party as soon as a project is identified that may require utility relocation or third party cooperation. Once the parties are made aware (or notified) of the future need, the utility company will be able to provide information concerning the location of existing utilities and any proposed new utilities for a project site. Third party agreements are executed following letters of intent signed between the Agency and impacted third parties.

Environmental Studies

These studies may be necessary even if the project is categorically exempt from formal environmental review required by the federal or state governments. These studies could include traffic and noise studies to evaluate the impact on the neighboring homes and businesses. Federal law requires environmental compliance, in accordance with NEPA, prior to land acquisition. The project manager will depend heavily on the professional team with relevant experience for this work.

4.2 ENVIRONMENTAL COMPLIANCE

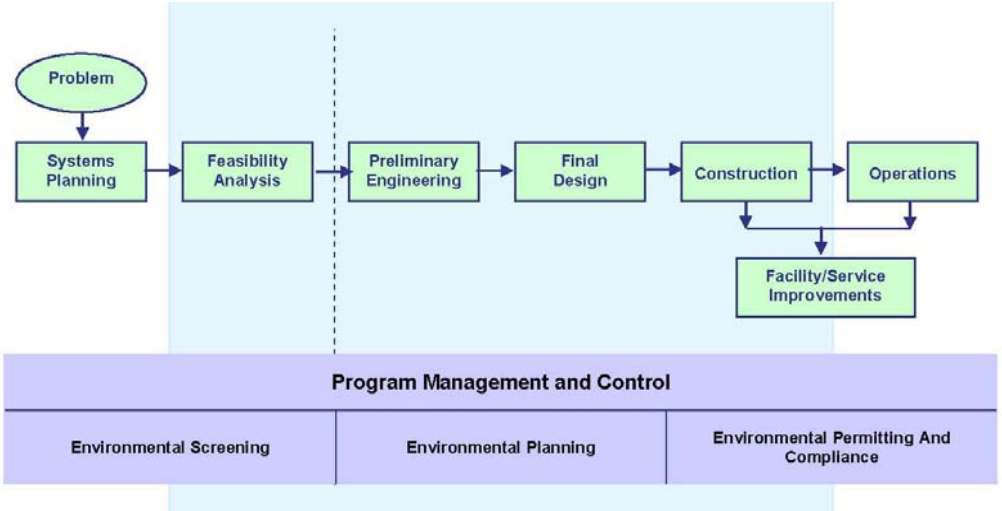
Federal Process

During the planning phase, when an Agency has programmed federal funds, the project manager must assure that the project clears the environmental impacts of the project, with acceptable mitigation measures, in accordance with the NEPA and receive clearance through an FTA action. NEPA provides an umbrella and "How to" guidelines for addressing many other federal and state requirements and laws governing environmental protection such as the Threatened Species Act (Section 7) regulated by the United States Fish and Wildlife Service. The regulations are described in detail in 23 CFR-Section 771. The FTA regional office can provide a checklist that will help evaluate the significance of potential impacts to determine if the project is exempt from further review or must perform more detailed environmental studies. Figure 4-1 shows an overview of the NEPA process.

Important to Know

- The National Environmental Policy Act establishes an umbrella process for coordinating compliance with many laws.
- The National Environmental Policy Act process requires the Agency to disclose, avoid, and minimize impacts to the extent possible during project development.
- FTA determines one of the following actions: Categorical Exclusion, Environmental Assessment, or Environmental Impact Statement.
- The Agency must comply with federal and state environmental requirements before proceeding to final design and real estate acquisition.

Figure 4-1 – The NEPA Process Overview



The project manager in consultation with the FTA and with help from an experienced staff or consultant will fill out the checklist and oversee performance of the necessary studies to address potential impacts such as traffic, noise, air quality, and biological resources. Once the checklist is submitted to the FTA, the FTA will review it and the supporting studies and make a determination. If it is determined that the proposed project would not result in significant adverse impacts, a Categorical Exclusion (CE) is prepared, and no further action, other than permitting, is necessary. A determination that a project is categorically excluded is based on past experience with similar projects that do not result in significant environmental impacts. It includes actions which do not induce significant impacts to planned growth or land use for the area; do not require the relocation of significant numbers of people; do not have a significant impact on any natural, social, cultural,

recreational, historic or other resource; do not involve significant air, noise, or water quality impacts; do not have significant impacts on travel patterns; or do not otherwise, either individually or cumulatively, have any significant environmental impacts. If it is determined that the action is categorically excluded and would not result in significant impacts, the CE may still require supporting documentation such as additional studies to address and clarify relatively minor impacts. Construction of new bus storage and maintenance facilities in areas used predominantly for industrial or transportation purposes, where such construction is consistent with existing zoning and located on or near a street with adequate capacity to handle anticipated bus and support vehicle traffic, is an example of an action that may be categorically excluded from further review. A typical abbreviated checklist is shown in Figure 4-2.

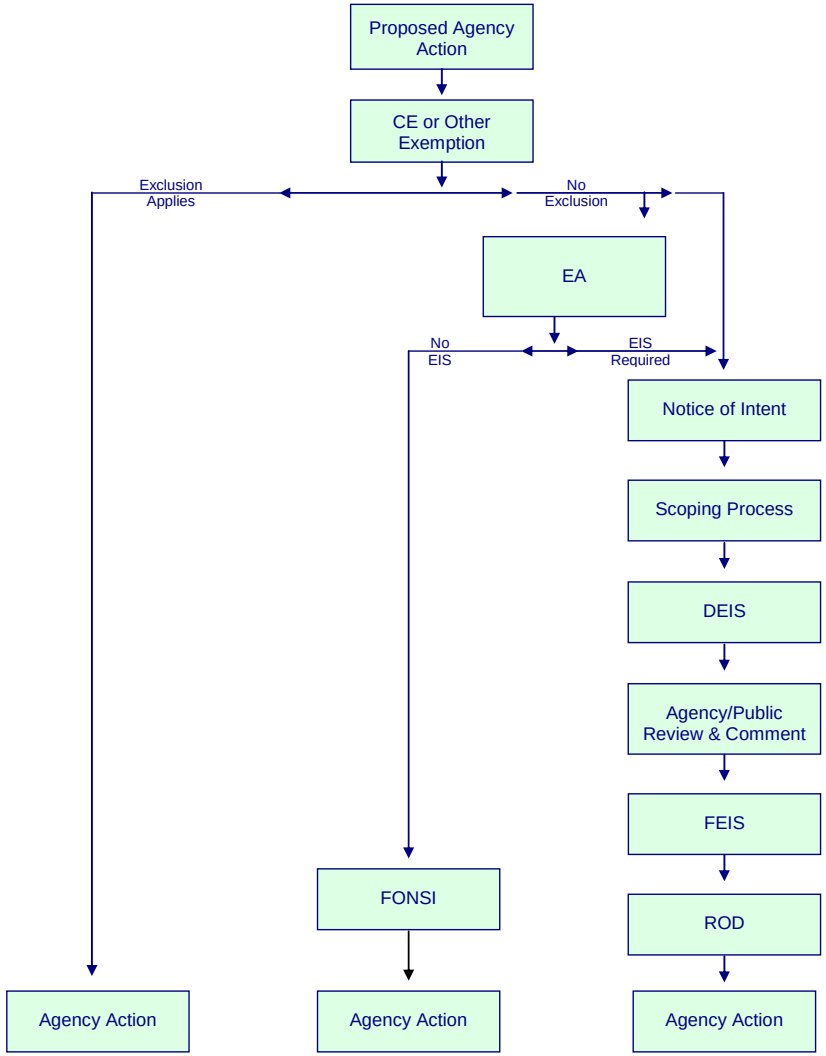
Figure 4-2 – Information Required for Probable Categorical Exclusion Projects (23 CFR Section 771.117(d))

- ✓ Detailed Project Description
- ✓ Location (Including Address)
- ✓ Metropolitan Planning and Air Quality Conformity
- ✓ Zoning
- ✓ Traffic Impacts
- ✓ Carbon Dioxide (CO) Hot Spots
- ✓ Historic Resources
- ✓ Noise
- ✓ Vibration
- ✓ Acquisitions & Relocations Required
- ✓ Hazardous Materials
- ✓ Community Disruption and Environmental Justice
- ✓ Use of Public Parkland and Recreation Areas
- ✓ Impacts on Wetlands
- ✓ Floodplain Impacts
- ✓ Impacts on Water Quality, Navigable Waterways, & Coastal Zones
- ✓ Impacts on Ecologically-Sensitive Areas and Endangered Species
- ✓ Impacts on Safety and Security
- ✓ Impacts Caused by Construction

In cases where the impacts or actions are not known, a more formal study called Environmental Assessment (EA) is performed. The purpose of an EA is to determine if certain aspects of the proposed project have the potential for significant adverse social, economic, or environmental impact and if present, create the foundation for preparation of an EIS. The significance of impacts is judged on a case-by-case basis and measured in terms of their context and intensity. The EA process may also facilitate identification of alternatives and measures which might mitigate adverse environmental impacts. At the conclusion of the EA study, the Agency may receive a Finding of No Significant Impacts (FONSI). It is possible that before an EA is completed, the Agency may be asked to expand the study to a full EIS.

If the impacts are significant, an EIS must be prepared. The EA and EIS include detailed environmental studies, related engineering studies, Agency coordination, and public involvement. However, final design activities, property acquisition, purchase of construction materials or rolling stock, or project construction, cannot proceed until FTA approval is received. There are a few exceptions for property acquisitions such as hardship and protective buying. Following the circulation and approval of a Draft Environmental Impact Statement (DEIS) and Final Environmental Impact Statement (FEIS), the FTA may issue a Record of Decision (ROD) documenting the work performed, decisions made, and mitigation commitments to be honored during the final design and construction. If the new information is found or conditions change, a reevaluation may be required. In some cases if the conditions change the project significantly, a supplemental EIS will be required. The flow chart in Figure 4-3 shows the project environmental compliance process.

Figure 4-3 – NEPA Environmental Review Process: An Overview



State Process

The environmental compliance process for states varies significantly from one state to another; several states have state-specific processes similar to the NEPA. Normally the lead Agency will process the planning applications for approval of land use, project design, and permitting. This process is very similar, and in some cases less stringent than the federal process. It is recommended that the Agency contact the State Department of Transportation (DOT) in the project state for details.

Permitting

Depending on the nature of the project, there are many permits that the project manager will have to be concerned with and acquire prior to construction. In this section, we cover the most commonly seen federal permits, which are required for waterway encroachments and obstructions in conjunction with the environmental review process. The applicable regulation is outlined in Section 404 of the Clean Water Act which requires a permit from the U.S. Army Corps of Engineers for the discharge of dredged or fill materials into Waters of the United States (Waters of the United States include wetlands). The Section 404 (b)(1) Guidelines provide guidance to the Corps of Engineers and applicants for issuance of permits. Impacts to Waters of the United States need to be avoided and minimized to the extent practicable. Compliance with the Guidelines is required for the issuance of a permit. The Guidelines require the selection of the Least Environmentally Damaging Practicable Alternative (LEDPA). Some states have similar legislation and permitting requirements for waters and wetlands.

Typically the NEPA process is completed for a project prior to applying for a permit under Section 404 of the Clean Water Act. The goal under NEPA is to identify and implement the environmentally preferable alternative that considers and balances impacts on natural, cultural, economic, and social resources. An EIS fully discloses all reasonable alternatives and their associated impacts as the basis for selecting an alternative; however, NEPA does not contain regulatory requirements that compel Agencies to select the LEDPA as required by the Clean Water Act. The project manager must be careful not to be misled by thinking that compliance with NEPA early in the transit project development process automatically translates to compliance with the Section of the Clean Water Act. To avoid potential need for reevaluation of alternatives, the project manager must assure that the Corps of Engineers' public interest review is integrated in the NEPA compliance process through early consultation with the Corps. Merging NEPA and Section 404 eliminates the potential conflicts with sequential NEPA and Section 404 processes. The Corps of Engineers encourages applicants to request pre-application conferences when projects are being planned that may require the discharge of dredged or fill materials into Waters of the United States.

4.3 REAL ESTATE ACQUISITION AND RELOCATION

Real Estate Acquisition

Acquisition of real estate for projects with federal funding must be carried out in accordance with provisions of federal law (Uniform Act, found at 42 U.S.C. 4601) and regulations (23 CFR and 49 CFR).

The transportation planning process in functional studies and due diligence, including environmental and geotechnical studies, were covered earlier. The following checklist provides for an itemization of the necessary steps to be taken before purchasing a property with federal funding:

- Procure a real estate specialist with Uniform Act knowledge and demonstrated experience.
- Research tax and plat records to identify possible owner of property.
- Select title company to work with and order title commitments to verify legal ownership of property and describe any title curative issues.
- Contact property owner and obtain a right of entry to get permission from property owner to enter property to perform due diligence.
- Have property surveyed.
- Begin environmental site analysis.
- Send property owner general information letter explaining project and possible need of property.

Important to Know

- Comply with Uniform Relocation and Acquisition Act for federally funded projects.
- Conduct comprehensive due diligence before you buy or lease.
- Examine the requirements of various funding agencies.

In addition, the completion of the environmental process, receipt of a determination by the FTA, and development of the right-of-way (ROW) plans, are required before the project is ready to enter the acquisition phase. The appraisal of real property needed for the project is the next step in the acquisition process. The appraisal report must be reviewed, corrected (or revised) if necessary, and ultimately approved by the Agency review appraiser. The approved appraisal then becomes the basis of the Agency's offer of just compensation to the property owner. The offer may not be less than the fair market value established by the approved appraisal.

The next step in the acquisition process is presenting the written offer to the property owner. The acquiring Agency presents a written offer of just compensation to the property owner. The Agency, acting principally through an acquisition agent or negotiator, should make every reasonable effort to reach an agreement expeditiously with the property owner. If an agreement is not reached, the Agency can initiate condemnation proceedings as prescribed by law using legal counsel. If there are occupants (including the property owner) or personal property on the parcel, relocation assistance will be required.

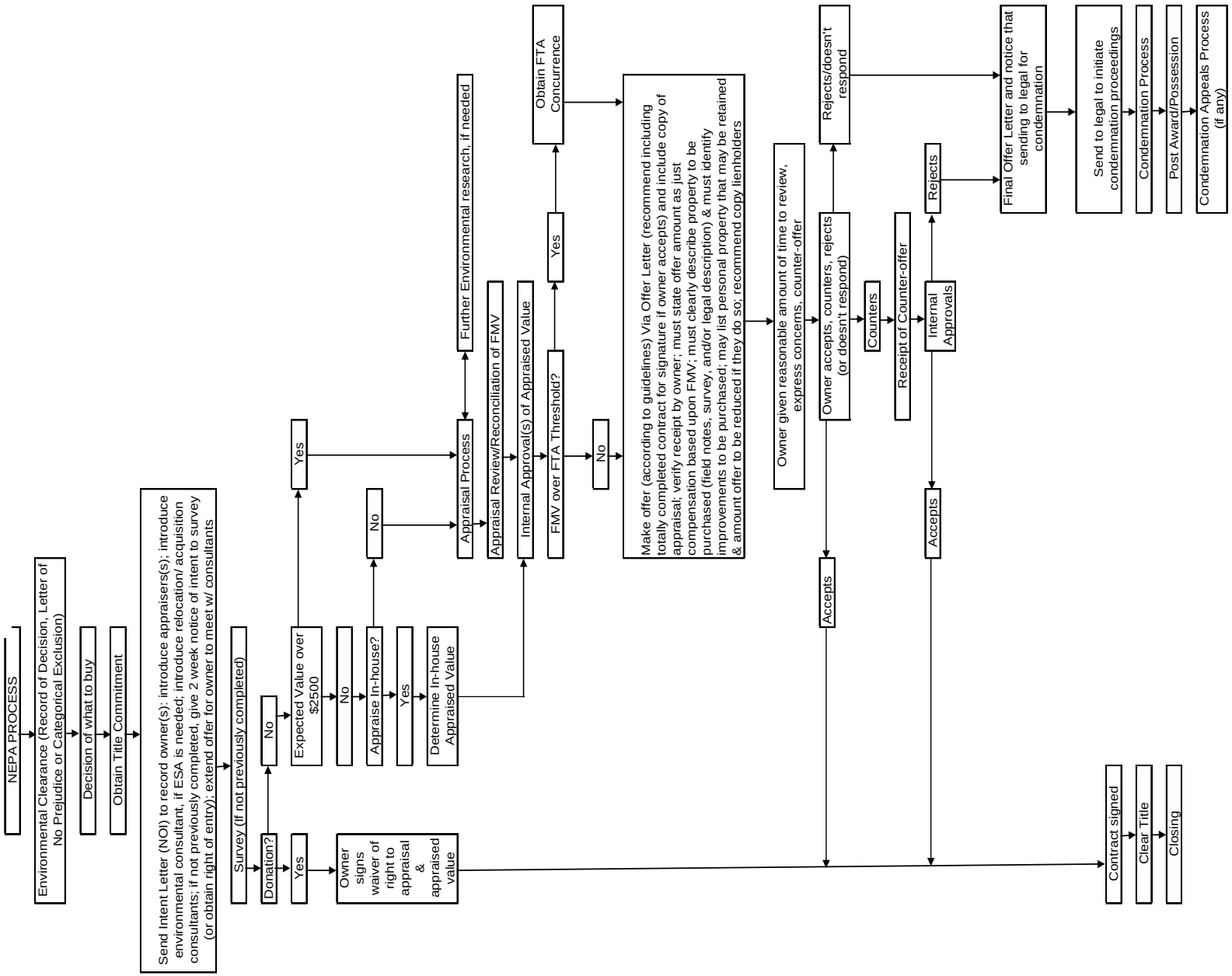
4.4 ENTITLEMENT

Many cities and counties will enforce state laws and regulate land development through zoning restrictions. The project manager will take the lead in communicating with the cities and counties having jurisdiction to ascertain what steps are needed to entitle the parcel for their intended use. There are numerous types of actions and varying procedures depending on the projects and the jurisdictions. In the case of the example maintenance facility project, the project manager must assure compatible zoning and file a design review application for the intended use. In most circumstances, the project will go through design review before the conceptual engineering is done. Many jurisdictions will not allow a final design review until after the project has gone through the environmental compliance process. If the zoning is not compatible with the intended use, a general plan amendment or a use permit may be necessary.

Important to Know

- Determine and reach agreement on the specific agency that has jurisdiction on the project.
- Agency with jurisdiction over the project can be a good resource.
- Approval of the project for intended use is provided by agency with jurisdiction.
- Agency with jurisdiction will review and approve conceptual design and construction drawings.

Figure 4-4 – Acquisition Process



CHAPTER 5. DESIGN

5.0 PURPOSE OF THIS CHAPTER

Introduction

This chapter will provide you with key concepts regarding the management of the design phase. During the design phase, you will oversee the translation of the project requirements into detail drawings and specifications that will be used for the construction contract documents. As part of this Chapter, the key points regarding the oversight of preliminary engineering and final design, managing the project schedule and performing constructability reviews, value engineering (VE), and peer reviews throughout development will be provided. Quality control (QC) and quality assurance (QA) for the design phase will also be discussed.

Design Phase

The design phase takes the project requirements through design criteria and conceptual design to the final design and construction documents for a contractor to bid on. As was discussed in Chapter 4 regarding the environmental clearance process – the design sub-phases, alternatives analysis, conceptual design, and preliminary engineering – are all interrelated with the environmental clearance and process. The design phase will involve interaction with the real property acquisition and third party coordination processes that were discussed in Chapter 4.

Role of the Agency in Design

Experience has shown that for the design phase to be a success, you as the project manager must be able to commit the time necessary, as well as, have an appropriate understanding of the project's scope. As part of this effort, you will need to manage the design consultant's scope of work and associated progress. This effort will include monitoring their cost and schedule performance against the agreed upon scope of work. This may require managing changes in the design contract as changes in design assumptions are identified. To aid in minimizing impacts to the design consultant's efforts, timely reviews and approvals should be given so as to not delay the project development process.

In addition, as construction capital cost estimates are developed during design, you will need to review the estimates, including the constraints of inflation and price uncertainties and balance the cost estimates within the budget. For larger projects, you may depend on a design manager. The design manager may come from either in-house staff or from a Program Management Consultant (PMC) contract, and would assist you in the timely review of key components delivered by the design consultant.

In general terms, your role as a project manager is to:

- Review and approve design concepts, preliminary engineering, and final engineering
- Provide and coordinate design review comments
- Participate in VE and risk assessment sessions
- Manage the design consultant's efforts
- Monitor design costs and schedule

DESIGN

IMPORTANT TO DO

- ❑ ORGANIZE DESIGN TEAM (IN-HOUSE OR DESIGN CONSULTANT).
- ❑ ESTABLISH QUALITY MANAGEMENT SYSTEM.
- ❑ LEAD DESIGN MANAGEMENT.
- ❑ ESTABLISH DESIGN CRITERIA.
- ❑ ASSESS AND ADDRESS PROJECT RISKS.
- ❑ PERFORM CONCEPTUAL DESIGN.
- ❑ PREPARE SHOP EQUIPMENT MANUAL.
- ❑ PERFORM PRELIMINARY ENGINEERING.
- ❑ ORGANIZE AND PARTICIPATE IN VALUE ENGINEERING.
- ❑ PERFORM FINAL DESIGN.
- ❑ OBTAIN APPROPRIATE PERMITS.
- ❑ ASSURE THIRD PARTY COORDINATION.
- ❑ CONDUCT DESIGN REVIEWS.
- ❑ ORGANIZE AND PARTICIPATE IN PEER REVIEWS.
- ❑ PERFORM QUALITY CONTROL.
- ❑ PERFORM QUALITY ASSURANCE.
- ❑ PERFORM CONSTRUCTABILITY REVIEWS.
- ❑ COMPLETE CONSTRUCTION BID DOCUMENTS.
- ❑ SUPPORT CONSTRUCTION AND COMMISSIONING ACTIVITIES.
- ❑ SUPPORT BID AND AWARD WITH PREPARATION OF ADDENDUMS.

- Oversee QA
- Approve baseline capital cost and schedule
- Approve the construction bid package.

Role of Design Consultants

The design consultant's role is to develop the design based on the approved project in the environment document, as was discussed in Chapter 4, and prepare the construction bid package. Their efforts will be identified in the scope of work for conceptual design, preliminary engineering, and final design. The scope of work must be consistent with the Project Management Plan (PMP), which should be updated prior to commencement of the design phase. In the PMP deliverables are defined and the roles for the project manager, the Agency, and the design staff and consultants are identified.

Typically, the design consultant's role for the design phase is to:

- Establish design criteria and assess and address project risks.
- Perform conceptual design and preliminary engineering in support of the environmental clearance documents.
- Perform technical studies, develop engineering criteria, and conduct VE and risk assessment.
- Estimate capital cost and construction schedule throughout the design process.
- Prepare final design drawings and specifications and coordinate design submissions and reviews.
- Develop and apply internal QA/QC criteria for the review of deliverables.
- Update capital cost estimates and construction schedule throughout the design process.
- Produce final design drawings and specifications for the construction bid package.

5.1 DESIGN PHASES

Project Scoping

The various design phases are intended to help develop and refine the project requirements. At the end of each phase, estimating and containing project costs is a key project management responsibility that begins at project scoping and continues throughout project development. One of the primary functions of project scoping is to develop an accurate preliminary cost estimate of project costs and compare it to the programmed cost. An effective way of containing project costs is to control the project scope during the initial scoping and then throughout project development at design reviews discussed in this Chapter. It is important that the scope of work developed during project scoping is achievable within the approved budget. The following costs should be considered and refined throughout the project development process:

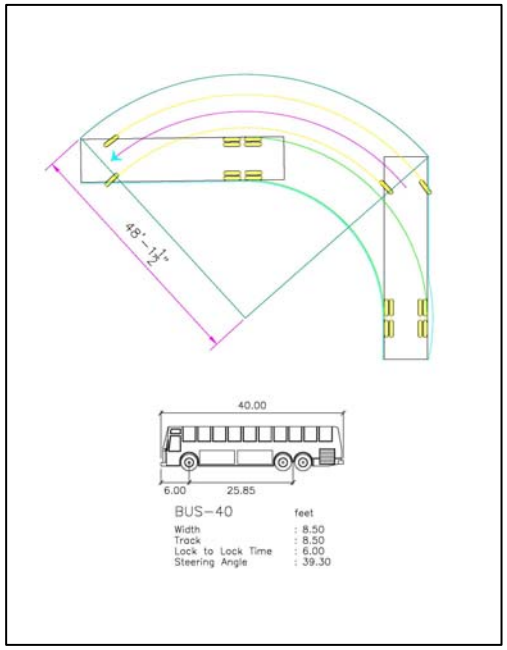
- Agency Project Administration
- Surveys – Topographical and Boundary
- Real Property and ROW Acquisition
- Geotechnical Investigation
- Engineering for Design and Construction Support
- Cost Estimation
- VE
- Peer Reviews
- Utility Services to Site
- Construction
- Construction Inspection/Management
- Owner Furnished Equipment.

Important to Know

- Alternative analysis is used to identify potential concepts for preliminary engineering analysis.
- Preliminary engineering is the development of enough design to support the approval of the environmental document.
- Final engineering develops preliminary engineering into the construction bid package containing the final drawings and specifications.

Conceptual Design and Preliminary Engineering

At the beginning of the design process, using the maintenance facility example, the project manager has to understand that the most important factor is the analysis of the existing bus fleet size and the potential for an expanded fleet size. Included in this thought process is the consideration of what future fleet mix may be, including articulated buses, alternatively fueled buses, and para-transit vehicles. This thought process and analysis establishes the basis for the design.



Basic elements for the example maintenance facility project to be included during the conceptual design process include assessing the spatial area requirements for general bus maintenance, fare removal, fueling, exterior washing, interior cleaning, and bus storage. Additional space will be required for administrative and operating staff offices, training rooms, lunch rooms, locker rooms, and associated toilet facilities. Space will also be needed for parts storage, body and paint shops, tire shops, and heavy repair areas.

On-site parking will be required for vehicles for employees and vendors who will park on the site. Accommodations should be provided for such items as landscaping, site security, stormwater management facilities, and potentially, water treatment facilities.

Upon completion of site selection and acquisition, the overall site layout considerations for daily operations at the bus maintenance facility in our example project need to include queuing space for buses during the mid-day and evening pull-in, bus circulation and storage space prior to maintenance and servicing, and circulation area for buses to move to and from storage on the site. Entrance and exit locations to and from the site to adjacent streets are also very important in the consideration of the overall site layout.

During the preliminary engineering sub-phase, the design team will finalize the concept for the facility and any associated equipment, and finalize the design criteria, and requirements for property/ROW and third party coordination work that will be used for the final design sub-phase. The preliminary engineering design should be developed to a point where the baseline capital cost and construction schedule can be developed.

Figure 5-1 – Design Criteria Document Outline

GENERAL PROJECT REQUIREMENTS
A. SITE WORK
- General Description of Site work
- Bus Operations Clearance Requirements
- Utility Service Hookups
- Paving
- Landscaping
- Site Utilities
- Best Management Practices

B. BUS MAINTENANCE AND STORAGE FACILITY
- Design Fleet
- Vehicle Characteristics
- General Description
- Facility Requirements

DISCIPLINE DESIGN CRITERIA
A. CIVIL/SITE/UTILITIES
- Codes and Standards (Typical)
- Design Criteria (Typical)
- Systems, Components, & Materials (Typical)

B. SITE LIGHTING
- Codes and Standards
- Design Criteria
- Luminaires

C. ARCHITECTURAL
D. STRUCTURAL
E. MECHANICAL – HVAC
F. MECHANICAL – PLUMBING
G. MECHANICAL – FIRE PROTECTION
H. MECHANICAL – FLUID DISPENSING
I. MECHANICAL – INDUSTRIAL WASTE
J. ELECTRICAL – AC POWER
K. ELECTRICAL – INTERIOR LIGHTING
L. ELECTRICAL – COMMUNICATIONS & SPECIAL SYSTEMS

Design Criteria – The design team will develop the design criteria for the project based on the scope of work provided. Engineering analysis will establish a range of acceptable criteria or standards for the project. An example of an outline for the design criteria document that may be used for a project is provided in Figure 5-1. The project manager will review the service characteristics and site constraints provided by the design team to make sure that they satisfy the needs of the Project Requirements Definition (PRD). The project manager will need to seek input from all stakeholders and based on their comments approve the design criteria in a timely manner. Once determined the design criteria must not change unless otherwise approved by both the project manager and the design team. A change of design criteria during either preliminary or final design may have significant implications on the design budget and schedule, as well as the construction budget and schedule.

Important to Know

Design Criteria

- Codes
- Design Standards
- Document Standards – Drawings, Specifications, Estimate, Schedule, and Calculations
- Project Requirements Definition
- Design Schedule
- Project Budget

Alternative Analysis – The design team will develop different concepts for the project within the identified design criteria. The design team will develop attributes regarding each alternative that will allow the Agency to perform the analysis and prioritization of the options. This identification of the preferred alternative will be moved forward into conceptual design by the design team.

DESIGN

Conceptual Design – The design consultant will develop graphic plans based on functional requirements and safety as identified for the preferred alternative. In addition, they will analyze the project site(s) to determine the initial "look and feel" of the project once completed. The result of the conceptual design is a set of architectural plans, elevations, landscaping plan, site boundary, and topographic surveys. Depending on the site complexity the design may include other drawings such as grading, utility, and drainage plans.

Important to Know

Conceptual Design

- Code Analysis
- Zoning Analysis
- Topographical Survey
- Boundary Survey
- Existing Utility Survey
- Geotechnical Survey
- Environmental Survey
- Space Programming
- Alternative Layouts
- Alternative Cost Analyses
- Community Outreach
- Traffic Impacts
- Noise Abatement

Important to Know

Preliminary Engineering

- Layout Refinement
- Available Utility Service Analysis
- Architectural and Engineering Systems Definition
- Preliminary Plans, Elevations, Sections, Schedules
- Discipline Coordination
- Outline Technical Specifications
- Preliminary Analyses and Calculations
- Preliminary Construction Schedule
- Preliminary Staging Plans
- Preliminary Cost Estimate
- Completion of Site Surveys and Right-of-Way Certificates
- Finalize Geotechnical Investigations
- Finalize Environmental Investigations

Preliminary Engineering – As part of this portion of the project, the design team will take the project from the conceptual design to a level of design that defines all significant elements that will enable a more accurate estimate of the construction project costs and impacts. The developed technical and cost information will serve as the basis for subsequent funding and implementation decisions. A major objective of preliminary engineering is for the project manager to oversee that the design team investigates the merits of all sound configurations and designs. These investigations require in-depth analysis of all components, their interrelationships, and their costs. In addition, environmental review requirements are completed. Once the design team completes the preliminary engineering portion of the total design effort, the project can move through final design with a minimum of design changes, disruptions, or delays. In addition, any environmental-related permits not yet obtained should be pursued shortly after this phase and by the end of final design.

Final Design

Federal law requires that final design cannot begin prior to NEPA completion as denoted by an FTA Record of Decision (ROD), Finding of No Significant Impact (FONSI), or a Categorical Exclusion (CE) determination. The final design team will develop the construction bid package that contains the final drawings and specifications for the project required to solicit and obtain construction contract bids. The final drawings and specifications will also detail the property or ROW needed to accommodate the project, include the appropriate permits and associated conditions from other agencies, and any coordination of work with or by third parties (e.g., utility companies) that was discussed in Chapter 4. The project manager will oversee the final design efforts of the design team through reviews of design drawings and specification submissions at the 60 percent, 90 percent, and 100 percent complete stages of design. In addition, value engineering (VE) will either be performed at the end of preliminary engineering or early in final design. Using the various reviews as checkpoints, you will be able to maintain an accurate assessment of the final capital cost and construction schedule for the construction phase. In addition, the design team must develop clear statements of testing requirements, operations and maintenance (O&M) manuals, and acceptance criteria for the safety and functionality of all subsystems, the implementation of which we discuss in Chapter 7. The completed construction bid package will be used by the Agency to procure a contractor, and monitor the construction efforts of the contractor, as we will describe in Chapter 6.

Important to Know

Final Design

- Final Plans, Elevations, Sections, Schedules
- Detail Development
- Final Technical Specifications
- Discipline Coordination
- Summary of Work Preparation
- Temporary Facilities and Controls Defined
- Federal, State, and Local Legal Requirements – Bid Forms, Bonds, Prevailing Wages, Etc.
- Final Design Calculations
- Final Construction Schedule
- Final Construction Staging Plans
- Construction Cost Estimate Update
- Environmental permits

Important to Know

Construction Drawings, Specifications and Legal Requirements

- Final Document Checking and Coordination
- Summary of Work Finalization
- Signing and Sealing of Construction Documents
- Finalize Legal Requirements – Bid Forms, Bonds, Prevailing Wages
- Plan Checks and Building Permits
- Final Cost Estimate Preparation

5.2 DESIGN MANAGEMENT

Important to Know

- Design management is the oversight of the design efforts phase activities.

As the Agency's project manager, you are responsible for overseeing the entire design development process as defined by both the PRD and associated PMP, as were discussed in Chapter 3. As part of your initial assessment of the Agency's current capacity and capabilities and the scope of the project, the determination will need to be made as to whether the design management will be performed by either you, an independent in-house individual, or by a program management consultant (PMC) that is procured for the task of design management. You will need to oversee the efforts of the PMC. The designer of record can take on project management of the design phase on less complex projects. However, the Agency's project manager will still be very involved and will most likely have to take the lead role of interfacing the third parties who may be reluctant to deal with a design consultant without authority to commit the Agency.

Regardless of who performs the design management, it is a key role in guiding the project to a successful conclusion. Typical duties and responsibilities of the design phase project manager are to:

- Finalize project scope of work and budget.
- Make certain that the design team is performing the work and services required by the scope.
- Provide assistance and guidance to the design consultant.
- Prepare and monitor the project schedule.
- Monitor project cost including cost of design, ROW acquisition, utility relocations, construction, etc., to keep costs within budget.
- Review and coordinate reviews of all design submissions, preliminary and final real property and ROW plans, design drawings, special provisions, specifications, and estimates.
- Accept and evaluate the quality of deliverable. Verify adherence of the design consultant to the QA/QC plan.
- Coordinate and oversee design review meetings, constructability reviews, and plan checks.
- Coordinate between the Agency and involved third parties (e.g., environmental agencies, municipal officials, municipal authorities, utility companies).

5.3 DESIGN REVIEWS

For a design/bid/build project, the project manager coordinates and oversees reviews at the design criteria, conceptual, preliminary engineering, 30 percent, 60 percent, 90 percent, 100 percent, and bid documents stages. The percent refers to the approximate ratio of design budget spent over total design budget. Reviews at these points in design are key control points to the design management process. A design review is a detailed, analytical, and unbiased approach used to verify that the appropriate deliverables (e.g., studies, final drawings, technical specifications, and construction bid documents) are being prepared and that the design consultant is maintaining pace with the budget and project schedule. In addition, during each review, a current construction cost estimate should be reviewed and compared against the anticipated cost.

Important to Know

- Design reviews involve a formalized, structured approach to assure interdisciplinary coordination and compliance with design criteria and environmental, site, and operational constraints.
- Design reviews are conducted to assure quality of products in development.
- Design reviews generally occur at the following points in the design process: design criteria, conceptual, preliminary engineering, or 30 percent, 60 percent, 90 percent, 100 percent, and bid documents.

For each design review, you make certain that the design manager will ensure the following key objectives are accomplished, as applicable to the particular review:

- Adherence to design criteria, environmental documents
- Quality of the design
- Identification of errors and omissions
- Building codes compliance
- Operational and functional objectives are met
- Coordination between engineering disciplines
- Adherence of cost estimates to the budget
- Designers' feedback before progressing further
- Design is biddable, constructible, and cost-effective
- Interface compatibility: adjacent project elements and the existing transit system
- Final construction contract documents comply with the design criteria, environmental document, codes, and regulations.

Figure 5-2 – Design Review Comments Register

REVIEW COMMENT REGISTER

PROJECT: _____ DATE: _____

REVIEWER: _____ DISCIPLINE: _____

DOCUMENT: ☐ DWGS. ☐ SPEC. ☐ ESTIMATE ☐ OTHER _____

REVIEW: ☐ PRELIM. ☐ INTER. ☐ PREFINAL ☐ FINAL ☐ OTHER _____

PURPOSE: ☐ GENERAL ☐ TECHNICAL

☐ COORDINATION ☐ QUALITY ASSURANCE ☐ OTHER _____

ITEM NUMBER	DWG/SECT/ PAGE NO.	COMMENT	ACTION BY	RESPONSE

To help with the reviews, Figure 5-2 shows a typical Review Comment Register that the project manager and the other reviewers can use to facilitate the review during the various design reviews.

The following two submittals/reviews should be accomplished during the preliminary engineering sub-phase of the project:

- *In-Progress Preliminary Submittal* - This preliminary submittal is intended to facilitate the review of the recommended approach, including evaluation of the rejected alternatives with the design team. As such, the recommendation approach must be addressed in the plans and/or design report. It is recommended that VE be conducted at this point.

- *Preliminary Engineering Submittal (30-Percent Review)* - This submittal marks the division between preliminary and final design and is the project manager's and/or design manager's last review in the preliminary engineering phase. The review is meant to demonstrate that the selected approach to all major design concepts and VE recommendations and other design features have been resolved and that final design can proceed without delay. Therefore, the review should:
  - Define the impact of construction on all affected parties including utilities, railroads, governmental agencies, commercial properties, and residential areas.
  - Define the scope of work for detailed design of the project.
  - Provide a satisfactory basis for a realistic estimate of the cost of construction, which will serve as a budget.
  - Establish the project scope, or limits, with respect to real property and ROW.
  - It is recommended that a risk assessment study be done prior to completion of preliminary engineering phase.

Three major reviews occur during the final design phase. These reviews are typically referred to as 60-percent review, 90-percent review, and 100-percent review, although the exact percent complete could vary depending on the nature of the project. The construction bid document verification and delivery review follows the 90-percent review. The scope of these reviews is:

- *60-Percent Review* – The project manager and/or design manager will make certain that all major features of design are progressing in accordance with prior direction, major engineering and VE decisions; and most drawings, specifications, and other documents are well advanced. Usually a constructability review is conducted at this point or at the latest before the 90 percent submittal.

- *90-Percent Review* – The drawings and specifications provided by the design team are to be nearly completed and checked. Therefore, the project manager and the design manager will need to perform an extensive review since at this point in the design development cycle, this will be the last major design review. In addition, you and the design manager will verify that comments from the 60-percent review have been addressed. When applicable these drawings should be sent to the permitting agency for a plan check. The construction cost estimate should also be verified against the budget established for the project.

- *100-Percent Review* – The drawings and specifications are to be finished by the design team and checked. In addition, the project manager and/or design manager will verify that comments from the 90-percent review have been addressed. Only incorporation of comments arising from this review, plus sign-off and approval should be required to complete the construction bid documents.

- *Bid Document Verification* – After delivery of all completed, signed, and sealed original drawings by the design consultant, you and the design manager are to verify that comments from the 100-percent review have been satisfactorily resolved, construction cost estimates are in line with budgets, and appropriate Agency or individual approvals can be given. Further comments that do not pertain to the 100-percent review should not be considered unless the design is in error because of an unsafe condition, non-constructability of work as shown, or new work that was not previously shown. At this point the Agency procurement staff will add the necessary contractual provisions to the packages.

5.4 THIRD PARTY COORDINATION

As indicated in Chapter 4, third party coordination as early as possible during the project development cycle is imperative. During the design phase, the design consultant may find it necessary to relocate or rearrange existing facilities prior to or during the construction phase. Third party work involves the relocation or rearrangement of existing facilities that impact project construction, including:

- Operational interference
- Utilities (electric power, gas, telephone, cable etc.)
- Public infrastructure (highways, roads, bridges, streets, drainage, sewer, water, etc.)
- Railroads
- Easements and ROW acquisitions.

Important to Know

- Third party agreements should be in place as early as possible but no later than completion of preliminary engineering, which will help to make certain that the project will not encounter any delays or cost growth during the design or construction phases.

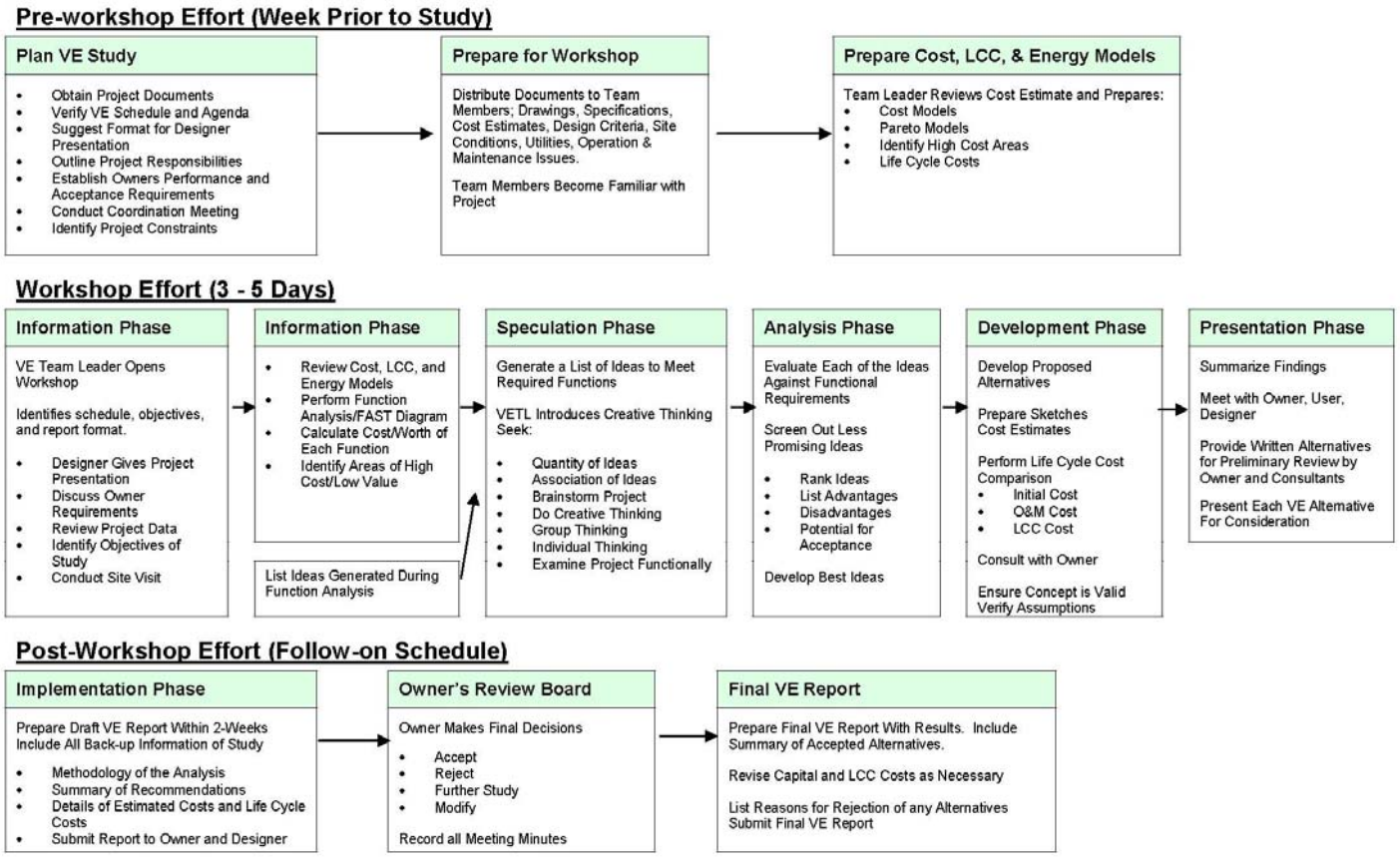
The timing and duration of third party work requires careful planning, negotiation, and execution. This is due to the fact that third parties typically need significant lead time to perform the necessary design and perform the relocation, or determine the interfaces of the third party that can be incorporated into the contract provisions. Due to the limited influence that an Agency has with respect to controlling the work of a third party, the chance for a schedule impact on the project is likely. These risks will be identified as part of the risk assessment described in Section 5.8. Therefore, the earlier that a third party agreement can be negotiated, the better understanding the project manager and the design consultant will have of the overall schedule impact. A discussion on developing third party agreements is provided in Chapter 9.

DESIGN

5.5 VALUE ENGINEERING

Agencies are encouraged to apply VE techniques to all projects including bus maintenance and storage facilities whose construction costs are estimated to exceed $2 million. The objective of VE is to satisfy the required functions of the project at the lowest initial total cost and cost over the life of the project. Figure 5-3 provides an overview of the VE process.

Figure 5-3 – Value Engineering Study Task Flow Diagram



When to Perform Value Engineering

VE for a project should be performed early in the design process before major decisions have been completely incorporated into the design, including civil, systems, and architectural areas. Ideally, the project manager or the design manager will see that the VE is accomplished at or prior to the end of preliminary design or before 30 percent of design.

How to Perform Value Engineering

As the Agency's project manager, you will coordinate the VE session that will consist of a multi-disciplined team of professionals, who preferably are not part of the design team. VE personnel can include electrical, mechanical, civil/structural, and construction engineers, as well as specialists in architecture, cost estimation, construction management, and transit O&M. The designer of record will provide support to the VE team. The VE team leader could be a certified value specialist (CVS). For additional information on this certification visit the Society of American Value Engineers (SAVE) at www.value-eng.org.

Implementation of Value Engineering Recommendations

Upon the project manager's review of the VE recommendations, the design team will determine whether to adopt and/or reject the various proposals and then finalize the VE response report. The final report shall include a summary of accepted VE proposals with revised capital and implementation costs, as well as a list of rejected proposals and the reasons for their rejection.

Based on the VE proposals that will be adopted, you should consider providing the design team with additional funds that are needed to implement the design enhancements that were identified as part of the VE.

Important to Know

- Value Engineering is a systematic, multi-disciplined approach designed to optimize the value of each dollar spent. To accomplish this goal, an independent team of architects/engineers identifies, analyzes, and establishes a value for a function of an item or system.
- Value Engineering is to satisfy the required function at the lowest total cost (capital, operating, and maintenance) over the life of a project consistent with the requirements of performance, reliability, maintainability, safety, and esthetics.
- Value Engineering on a project should be performed early in the design process before major decisions have been completely incorporated into the design, at or near the end of preliminary design, or at 30 percent of design.
- Value Engineering review could add function and cost that have not been thought through previously.

5.6 PEER REVIEWS

Peer review should be an early step in the design process that can add an external perspective to enhance the functionality of design, construction, and operation. Used in addition to a VE study, that is usually later in the design process, peer review is based on the question "can we do this better?" and can be used to provide an independent critique of the design phase.

Whether you or the team does or does not have previous experience with the overall design process, the team is encouraged to contact other transit operations and maintenance experts, or PMCs in order to bring in and benefit from their experience with similar design efforts.

Although Agencies are encouraged to conduct a peer review for all capital projects, FTA requires the peer review process for projects funded under the Section 5309 discretionary program. These reviews are to make certain that bus facilities are effectively designed to enhance bus operations. A review of plans at the completion of preliminary design will be conducted using the expertise of transit operator peers who provide service under similar circumstances. The FTA requires that peer reviews be coordinated with the FTA's regional engineer.

Important to Know

- Peer review can be applied to any problem or situation where a second opinion can be useful.
- Peer reviews are intended to take advantage of the lessons learned by other agencies having done similar work in the past.

5.7 CONSTRUCTABILITY REVIEWS

Later in the design process, the design team will need to perform constructability reviews as part of the design process. Participants for constructability reviews can come from within your Agency, the design team, or assistance can be obtained from other transit agencies, code officials, independent consultants, or contractors. The constructability reviews should be prior to completion of 90 percent and preferably shortly after 60 percent of the design. The purpose of constructability review is to:

Important to Know

- Constructability reviews are necessary prior to completion of final design and preferred at 60 percent design to make certain what is depicted on the final drawings, technical specifications, and construction bid documents can be built.

- Eliminate construction requirements that are impossible or impractical to build.
- Maximize constructability, recognizing the availability and suitability of materials, the capability of labor resources, and the standards of practice of the construction resources.
- Verify accurate depictions of site conditions with regard to access, utilities, and general configuration.
- Make sure of the adaptation of designed structures and features to the project site conditions and constraints.
- Determine adequacy of work and storage space including contractor access to the site.
- Determine appropriate construction durations and milestones.
- Verify requirements for QA/QC during construction.
- Clearly define procedures for scheduling outages and the feasibility of utility interruptions.
- Determine requirements for Agency-provided materials, equipment, services, and utility connections.
- Make certain that designs can be constructed using methods, materials, and equipment common to the construction industry.
- Pay attention to the requirements of the public including adjacent land use functions, existing transit patrons, and persons with disabilities.
- Make sure coordination is included with all operating elements of the existing transit system.
- Make certain adequate provisions are provided for access, staging, and storage of waste and supplies; parking for worker and construction vehicles; and mitigation of environmental impacts during construction.

DESIGN

5.8 RISK ASSESSMENT

During the design phase and preferably prior to completion of preliminary engineering, the project manager must facilitate performance of a risk assessment to determine whether there are events or circumstances that can occur that will have a direct impact on the project's schedule and associated cost. As the design of the project gets more refined and nears completion of the drawings and specifications, the more costly the impact of an unexpected event will have in terms of money and schedule. Therefore, team's risk assessment should be updated periodically through the design phase of the project, with the final update occurring prior to construction. This risk assessment will be completed through the use of a risk register process. An example of a risk register is provided in Figure 5-4.

Figure 5-4 – Example of a Risk Register

RISK REGISTER							
Project Component	Risk ID	Risk/Opportunity	Description of Issue and Potential Management Action	Affected Project Activities[1]	Probability of Occurrence	Change in Cost ($000)	Change in Duration/ Schedule (months)
1. Right-of-Way							
	R1	Right-of-Way costs and/or schedule greater than anticipated; includes: • uncertainty in amount of ROW • unit prices • excessive condemnation • relocation, demolition • business mitigation	Row-of-way cost and quantity estimates are out of date and not based upon the latest design drawings; additional takes affect businesses in Line Section 3. Risks affect project cost estimate and start of construction in certain line sections.	All construction line sections; components, 01-10	.5 (.5)	$2,000.0 ($0)	6 (0)
2. Utilities							
	U1	City waterline project not completed as planned	Delay causes project delay and increased overhead costs for project	Components 02-05	.25 .25	*TBD*	6 12
	U2	City sewer project not completed as planned	Delay causes project delay and increased overhead costs for project	Components 02-05	.25 .25	*TBD*	6 12
	U3	City vaults not completed as planned	Delay causes project delay and increased overhead costs for project	Components 02-05	.9	*TBD*	4
	U4	Private utility relocations not completed as planned (utility company fails to move on time)	Delay causes project delay and increased overhead costs for project	All construction line sections, components 01-10	T=.1 T=.5 T=.9	*TBD* *TBD* *TBD*	2 4 6
	U5	Delay in obtaining agreement between grantee and private utilities	Delays FFGA/grant award and potentially start of construction	Components 01-10	.8 .2	*TBD* *TBD*	2 3
	U6	Project's adjustment budget for private utilities is too low	Cost increase to grantee for payment of additional relocation costs	Components 01-10	.5 .1	$2,000.0 $3,000.0	0 0
	U7	Encounter unexpected utilities during construction	Change order claim by contractor results; cost and schedule impacts	Components 01-10	.5	$500.0	1
3. Environmental, Permitting, and Agreements							
	E1	Delay in gaining signoff on programmatic agreements	Delay in issuing bid documents and subsequent construction delayed	Components 05, 06	.5 .25	*TBD* *TBD*	1 2
ETC.							

Important to Know

- Project risk is an unexpected event or circumstance that has a chance of occurring and that may prevent a project from meeting its schedule and cost estimate/budget.
- Project risks can be divided into two main categories: design/construction risks and financial risks.
  - Design/construction risks include weather conditions, contractors' inability to carry out the project, unforeseen site conditions, permitting delays, and so forth.
  - Financial risks include revenue shortfalls, changes in the project cash demands, and changes in interest rates, among other things.
- Risk is defined in terms of an event (what may occur to the detriment of the project), its probability (how likely it is to occur), and the amount involved (dollars of maximum possible loss or number of losses that could occur).

A risk register will help the project team capture the risks associated with the project and quantify the potential impacts to the project. To develop the risk register, you should coordinate with the other key stakeholders via a meeting or workshop to identify:

- Each project risk
- Description of the risk
- Impacted project activities
- Probability of occurrence
- Potential cost impact
- Potential schedule impact.

The following are a few examples of risks that may impact the development of a project:

- Budget Risks - Risk that budget elements will deviate from the estimate (e.g., deviations in unit prices, deviations in quantities).
- Event Risks - Risk of internal or external events that force the project team to work beyond the estimate just to meet the project scope and scope of work (SOW) (e.g., extreme weather, contractor non-performance).
- Scope Risks - Risk of significant changes to project scope due to external pressures (e.g., community pressures for changes in bus shelter location or increase in maintenance facility size).

Examples of risks that the Agency project manager and the design consultant should consider for the project include:

- **Real Estate**
  - Property acquisition
  - Relocation
  - Condemn
  - Eminent Domain
- **Public Utilities**
  - Analysis and coordination
  - Agreements
  - Relocation
- **Financial**
- **Politics**
  - Internal/external
- **Environmental**
  - Environmental impact studies
- **Historical Significance**
  - Protected Lands
  - Archaeological
  - Structures
- **Contract phasing and packaging**
  - Scope of work
  - Bid process / Labor
  - Integrating Construction Packages
- **Community impacts and public perception**
- **Public hearing**
  - Marketing/Communication
  - Safety and security
- **Material, Equipment and Construction Techniques**

Once the risks for the project have been identified, they should be ranked according to the probability of their occurring and an associated cost implication. Then the project manager can prepare the risk management plan that will establish and prioritize mitigation measures, allocate the risks to the appropriate party (i.e., Agency, design consultant, contractor, third parties), and assign mitigation and management responsibilities.

During the design phase, the project's risks can be monitored through peer reviews, VE studies, and constructability reviews in an effort to design the project within budget and schedule given the inevitability of unknowns.

5.9 QUALITY ASSURANCE AND QUALITY CONTROL

Agency Oversight

As the project manager, you are responsible to assure that FTA capital funds are spent wisely. As part of the PMP discussed in Chapter 3, the quality requirements for the project must be addressed in the Quality Management Plan portion. The difficulty is that not every Agency will be able to justify a special QA/QC staff for a one-time project or even justify having a QA/QC staff for smaller projects such as the development of bus storage and maintenance facilities. In such cases use of consultants is appropriate.

Once the PMP is accepted, the QA/QC plan is set in place for the design portion of the project. The plan should answer the questions of who is responsible and when in time actions should occur. More important, the quality plan needs to be maintained throughout the design phase so that as a new phase is initiated, it will reflect the appropriate quality requirements. Since the primary product of the design phase is construction contract documents for construction contractors, decisions about quality requirements for construction and manufacturing need to be planned and included in the contract documents. Therefore, during the design phase of the project, you follow the design control portion of the quality management system that was put in place as part of the PMP for the entire project.

Quality Control in Design

QC during the design phase of projects is a very important part of a project-related quality program. The design team is responsible for their own QC. The design team shall provide a quality management plan prior to initiating design activities that identifies how they will achieve QC for the project. The quality management plan describes the procedures that are to be followed for design changes, including sign-off and documentation. In addition, any contract quality requirements for design reviews and sign-off from other departments within the Agency, such as construction and operations, and other relevant Agencies must be stated. A procedure for the control of project documents should also be specified.

Important to Know

- Quality Control – the act of taking measurements, testing, and inspecting a process or product to make sure that it meets specification. It also includes actions by those performing the work to control the quality of the work. Products may be design drawings or specifications, manufactured equipment, or constructed items. Quality Control also refers to the process of witnessing or attesting to, and documenting such actions.
- Quality Assurance – making certain the project requirements are developed to meet the needs of all relevant internal and external agencies, planning the processes needed to assure quality of the project, making sure that equipment and staffing is capable of performing tasks related to project quality, making sure that contractors are capable of meeting and do carry out quality requirements, and documenting the quality efforts.

- Calculations, drawings, and specifications are checked by qualified personnel not normally associated with their preparation.
- Verify the design against the scope.
- Constructability reviews make sure that the project includes the application of sound construction principles consistent with operating and maintenance requirements and accepted engineering practices for safe, efficient, and economic construction.
- VE design reviews assure cost effectiveness.
- Design validations make certain that the project conforms to the requirements of its intended use.

Quality Assurance in Design

The design manager is responsible for overseeing the design QA system. The design team can accomplish this by setting up an in-house QA system for the project and having the design manager perform the QA by overseeing the design consultant's QC efforts. As the project manager you will need to maintain an oversight role to acquire confidence that the quality management system for design is achieving the project quality objectives.

CHAPTER 6. CONSTRUCTION

6.0 PURPOSE OF THIS CHAPTER

Introduction

This chapter discusses how to manage project construction by contractors, third parties, and the Agency's own forces. Emphasis is placed on schedule, cost, and change controls; configuration management and document control; and partnering and value engineering (VE) incentives. Other important topics covered are construction Quality Assurance (QA) and Safety Management. The chapter discusses construction using design/bid/build (D/B/B) which is the most frequently selected project delivery method.

Construction Phase

In the construction phase contractors, procured by the Agency, combined with the Agency's own forces, construct the project's facilities, and fabricate and install equipment. The work is done in accordance with the plans and specifications developed during the design phase. Following construction the facilities and equipment are integrated and tested in the commissioning phase.

The project's highest levels of activity, in terms of numbers of personnel and costs incurred per day, occur during construction. The construction phase also has the most opportunities for cost overruns due to changes and delays, disputes with contractors, and the resulting contract changes and claims.

Role of the Agency in Construction

The best way for you, the Agency's project manager, to assure good performance during construction is to make timely and decisive decisions. Your project organization and management approach, defined by the project management plan (PMP), should have clear lines of communication and delegated authority. In addition the Agency should free you, and other Agency staff assigned to the project, of operational responsibilities that could detract from your project duties.

In our example maintenance facility project, a delay during design – due to the Agency not finalizing scope in a timely manner, such as deciding the number of service bays – has a relatively moderate cost impact. The design consultants' work is put on hold and there may be additional costs for redesign. Agency indecision during construction is significantly more costly. Delaying a contractor can result in substantial claims for compensation for extended overhead. Changes in scope can result in expensive re-work such as tearing out and replacing construction. Delaying one contractor may delay other contractors resulting in further claims.

Role of the Consultant Construction Manager

For all but the simplest project, you will need project staff with expertise and experience in construction management beyond the capability and capacity of the Agency's regular employees, for which the Agency will need to retain a construction manager (CM) consultant. The CM acts as the Agency's representative with the contractors, oversees what work the contractors perform pursuant to the contract drawings and specifications, inspects the work as acceptable, and recommends payment of contractor invoices. The key CM staff is the resident engineer

(RE) who is principal point of contact with the contractor and is stationed at the site for larger projects and for smaller projects visits the construction site one or more days a week.

IMPORTANT TO DO

- ❑ MAKE TIMELY AND DECISIVE DECISIONS.
- ❑ ACQUIRE PROJECT STAFF WITH EXPERTISE/EXPERIENCE IN CONSTRUCTION MANAGEMENT.
- ❑ RETAIN A CONSTRUCTION MANAGER CONSULTANT IF AGENCY DOES NOT HAVE QUALIFIED STAFF.
- ❑ DELEGATE LEVELS OF AUTHORITY THROUGH THE PROJECT TEAM TO HANDLE CONSTRUCTION ISSUES SUCH AS CONTRACTOR CHANGE REQUESTS.
- ❑ CONTINUE THE SERVICES OF THE DESIGNER OF RECORD TO RESPOND TO CONTRACTOR REQUESTS FOR INFORMATION AND REVIEW CHANGE REQUESTS THAT IMPACT DESIGN.
- ❑ COMPLETE THIRD PARTY WORK EARLY IN THE PROJECT SO AS TO AVOID DELAYING FOLLOW ON CONTRACTORS.
- ❑ FOCUS QUALITY MANAGEMENT ON QUALITY ASSURANCE AND AUDIT CONTRACTOR QUALITY ASSURANCE/QUALITY CONTROL COMPLIANCE.
- ❑ FOCUS SAFETY MANAGEMENT ON SAFETY ASSURANCE AND AUDIT CONTRACTOR SAFETY ENFORCEMENT, EDUCATION, AND INCENTIVE ACTIONS.

Role of the Design Consultant(s) in Construction

Design consultant(s) who produced the contract drawings and specifications and "sealed" them with their professional engineering seal, are referred to as the designer(s) of record; and will continue to provide the following design services during construction:

- Receive and respond to construction contractor Requests for Information (RFI), communicated from the contractor to the designer through the CM. An RFI is a request by the contractor for clarification of the design intent of the drawings and specifications.
- Review and recommend acceptance of contractor submittals called for in the drawings and specifications with respect to the construction deliverables.
- Review change requests and estimate costs for change orders.
- Make periodic visits to the site to assure design compliance and provide certification efforts as required by the permitting agency.

Role of the Contractor in Construction

The role of the construction contractor is to:

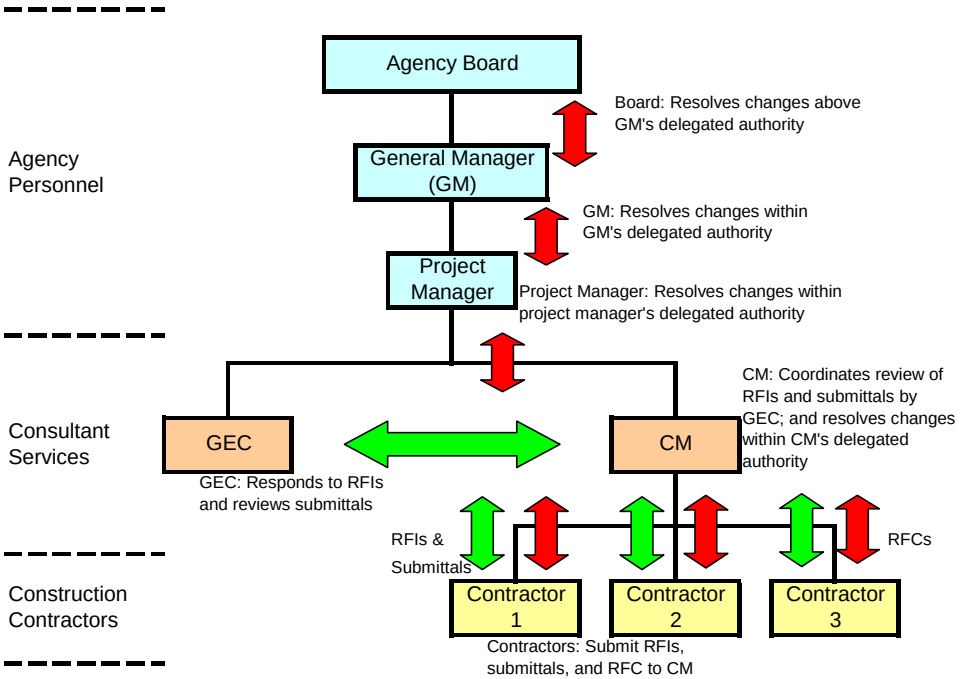
- Perform construction work defined by the contract drawings and specifications using means and methods that are the contractor's responsibility.
- Obtain the permits related to the work for which the contractor is responsible.
- Develop and implement a quality control (QC) plan for inspection and testing of the work.
- Develop and implement a safety plan to ensure a safe work site.
- Deliver submittals defined by the contract drawings and specifications, such as
  - Shop drawings, manufacturer's drawings, calculations and data, and product information.
  - Contract schedule updated monthly noting progress and looking ahead to upcoming work.
  - Requests for payment supported by reports as called for in the contract.
  - Record drawings of the as-built work.
  - O&M manuals and training of Agency staff called for in the contract specifications.
- Submit RFIs to the CM to obtain clarification of the design intent.
- Submit Requests for Change (RFC).

6.1 CONSTRUCTION MANAGEMENT

Project Organization for Construction

Figure 6-1 illustrates a project organization structure for construction for a project with three construction contracts (yellow boxes), where the Agency (blue boxes) has retained the services of a CM and a general engineering consultant (GEC) who is the designer of record (tan boxes). Delegation of authority for RFCs is illustrated by the "red arrows" and lines of communication for RFIs by "green arrows".

Figure 6-1 - Project Organization, Assigned Authorities, and Lines of Communication for Construction



Important to Know

- Partnering builds positive working relationships with contractors and helps avoid disputes.
- Opportunities still exist in construction for contractors to raise Value Engineering proposals.
- Construction schedule control should focus on the high-level management of interfaces between contractors, third parties, and other construction activities.
- Construction cost control should focus on the management of contractor changes.
- Configuration management and document control are needed to support change management.

Division of Management Responsibilities between the Agency and Construction Manager

As project manager, you are the Agency's senior decision maker on the project and should be delegated that commensurate decision making authority. Where the Agency's governance policy requires actions to be approved by the Agency's board, the PMP and Agency administrative procedures should not unduly delay the construction schedule.

Similarly, your project procedures should delegate authority to the CM staff for activities contracted out to the CM. You should base the division of duties between the Agency and CM on who is best suited to the function. Typically the Agency deals with project's stakeholders and the CM with the technical matters concerning contractor work. The table below, Figure 6-2, identifies generally accepted divisions of functions between the Agency, CM, and GEC during construction.

Figure 6-2 – Agency and Construction Manager Functions During Construction

Function	Performed by
Pre-contract award reviews	
General provisions	Agency
Special conditions	Agency and CM
Contract milestones fit project master schedule	Agency and CM
Special construction conditions and staging	CM
Constructability	CM
Contractor Integration and Coordination	CM
Designer Interface	CM
QA	Agency and CM
Construction Safety	Agency and CM
Project Schedule and Cost Control	CM
Design Services (GEC – Designer of Record)	
Respond to contractor RFIs	GEC
Review contractor submittals	GEC
Resident Engineer	
Construction supervision and inspection	CM
Acceptance of work and direction of re-work	CM
Receipt of:	
	CM
RFIs	CM
Field memos	CM
Change order requests	CM
Submittals	
Contract compliance with:	
Drawings and specifications	CM
Construction warranties	Agency and CM
Contract documentation and as-built records	CM

CONSTRUCTION

Function	Performed by
Utilities interface	CM
Review of contractor pay requests for work performed	Agency and CM
Contract Administrator Administration of contractual and commercial terms	Agency
Coordination with Existing Agency Operations	Agency
Community Relations	Agency and CM
Public Information	Agency
Media Relations	Agency
Governmental Liaison	Agency
Third Party and Agency Agreements	Agency
Property Acquisition and Right-of-Way	Agency
Assessment of Environmental Impacts	Agency
Payment of Contractor Invoices	Agency
Contract Closeout (See Chapter 8)	Agency and CM

Contract Management and Administration

The RE, who is typically a member of the CM staff, oversees the contractor with respect to what work is to be done pursuant to the contract specifications. The RE is the Agency's primary field representative and the contractor's single point of contact. The RE receives/processes contractor RFIs and submittals, has the authority to accept or reject contractor work based on compliance with the contract specifications, receives/processes RFCs, and resolves those changes within the RE's delegated authority. All changes that affect the design must be approved by the designer of record.

Working in partnership with the RE is a contract administrator (CA), who is typically a member of the Agency's staff. The CA ensures that the contractor is fulfilling their contractual obligations and protects the Agency's rights, expectations, and obligations with respect to managing the contractor. This role is particularly critical when the contractor has submitted RFCs and/or when disputes arise for which the contractor may submit a claim. The CA supports the CM in the prevailing wages, labor, and civil rights provisions of the contract.

The RE and CA meet with the contractor on a regular basis to assess the contractor's progress. At these meetings the contractor reports on progress, issues that arise in the field are addressed, and any disputes resolved. If disputes cannot be resolved between the RE and contractor they are passed up the project management chain of command as delineated in the PMP.

Partnering

As project manager you can use partnering to demonstrate leadership, build positive working relationships between project parties, and help avoid and resolve disputes.

Partnering is incorporated into the contract provisions and begins with a half-day to two-day workshop held at the start of the contract facilitated by an independent partnering consultant. Workshop participants are the contract stakeholders including representatives from the Agency, CM, contractor, sub contractors, suppliers, government agencies and third parties, design consultants, special interest groups such as community and local business leaders, and local fire/life safety officers. The workshop sets contract goals, identifies stakeholder expectations, establishes lines of communication, and anticipates potential issues and the means for their resolution.

Partnering provides an informal disputes resolution process, up through the Agency/CM and contractor chains of command, to address potentially contentious issues that ultimately can use mediation or arbitration as alternatives to expensive and time-consuming litigation.

Permitting

While the Agency is responsible for obtaining project clearances, environmental permits, and plan checks by the construction permitting agencies (see Chapters 4 and 5), the contractor is responsible for obtaining permits related to the contractor's work. The cost and time involved are the contractor's responsibility and should be included in the contract price and schedule.

Value Engineering Changes

The project manager's responsibility to find VE opportunities – to deliver a better and/or lower cost project without compromising quality – does not end with design. Even though VE's main use is in the design phase, the project manager can organize a "design scrub" workshop with the designer and contractor before the start of construction, where the contractor can bring questions, comments, and ideas. At a minimum this meeting will save time during construction in processing RFIs and at best result in VE ideas to save time and/or money.

As part of partnering, the project manager should encourage contractors to raise VE ideas and the Agency to include incentives in construction contracts for contractors to propose VE changes to the work called for in the drawings and specifications. If the proposed changes are acceptable to the Agency the cost savings could be shared between the Agency and the contractor.

Schedule Control

Construction contractors control their contracts' detailed schedule progress. As project manager your focus is the big picture, the master schedule, to manage interfaces between contractor, third party, and Agency construction activities. Your approach to master schedule control depends on the project's size and complexity:

- For larger and more complex projects you will require the CM to provide a scheduler to monitor construction progress using scheduling software to maintain a master schedule of construction activities.
- For smaller projects the use of hand drawn bar charts worked out directly with the RE(s) should be adequate to serve as a master schedule for you to oversee construction progress.

Large or small, to control the project schedule as project manager you should:

- Create a high-level master schedule and limit detail to what is necessary to control interfaces.
- Focus management on the critical path activities that determine the overall schedule duration.
- Require each contractor, through the contract terms and conditions, to submit:
  - A baseline contract schedule following award, for your review and approval
  - Monthly updates of progress against the approved baseline schedule
  - A revised baseline schedule for Agency approved contract changes.
- Use contractor submissions to update the master schedule and focus management effort on:
  - Changes to the critical path through construction
  - Contractor activities forecast to be late that impact the critical path
  - Interface activities forecast to be late that impact a contractor's progress
  - Validation of progress on activities that control contract milestone payments.
- Incorporate into contract conditions schedule milestones for work critical to project completion and/or interfaces with other contractors, including liquidated damages for late performance.

Cost and Change Control

Cost control's objective in construction is to complete the contracts within budget. Most construction contracts awarded for projects like the example maintenance facility are a lump sum fixed price. After award the contractor is responsible for completing the work at the fixed price bid, unless a change to the contract is agreed that alters the contract price. Consequently once the fixed price construction contracts are awarded, cost control comes down to managing changes to the contracts so that the original award amounts plus agreed changes are within the construction budget.

The most effective approach to controlling the cost of changes is a management culture that resolves contractor RFCs in a timely, decisive, and equitable manner. Experience shows that it is costly for project managers to allow a backlog of unresolved changes to grow. A backlog creates contention and diverts management attention to the backlog and away from productive project activities.

Figure 6-3 below describes the types of changes that occur during construction and indicates whether the contractor is entitled to receive additional compensation for the change.

Figure 6-3 – Changes During Construction/Contractor Compensation

Type of Change	Description	Contractor Compensation
Agency Action	-Changing the plans and specifications -Altering the time to complete the work -Changing the contractors' means and methods -Regulatory changes -Third party delays where the Agency is responsible for coordinating the third party work	Contractor is compensated. If another contractor's non-performance causes the change, the other contractor should be backcharged.

Type of Change	Description	Contractor Compensation
Differing Site Conditions	-Subsurface conditions differ from those represented by the Agency -Unusual conditions occur that could not reasonably be anticipated	Contractor is compensated.
Errors or Omissions	-Errors or omissions in the design plans and specifications	Contractor is compensated. The designer should be backcharged.
VE	-Contractor proposes a change that will reduce the project costs	Agency and contractor share the cost savings.
Contractor Action	-Contractor changes means and methods and/or delays project due to their own non-performance -Third party delays where the contractor is responsible for coordinating the third party work	Contractor is not compensated but may be given additional time for third party delays.

Management techniques to help you make timely, decisive, and equitable decisions on RFCs include:

- Delegate through the project chain of command responsibility and financial authority to make decisions on contract changes, as illustrated by the "red arrows" in Figure 6-1.
- Use a change control board made up of senior project staff to make decisions on large, complex, and/or contentious contract changes.
- Include within the construction budget a reserve to cover construction risks assumed by the Agency that could result in contract changes.
- Establish up-front through the partnering process an understanding with the contractor of the process for resolving RFCs, including a disputes resolution process.
- Support change control with configuration management procedures as discussed below.

Configuration Management

The project manager should put in place procedures to provide for the configuration management of (i) Contractor RFCs, "red arrows" in Figure 6-1, to:

- Document the different types of change that occur during construction, describe the change's nature and justification, and indicate whether the contractor merits additional compensation. Documentation includes the RFC, change notice, change orders, supporting correspondence, cost/schedule/scope impacts, meeting minutes, and negotiation records.
- Track and expedite the change resolution process beginning with raising the RFC forms and tracking the RFC's progress through the review/approval process. Configuration management tracks the party responsible for the next action in the resolution process, such as who is responsible when additional information needs to be prepared and/or analyzed.
- Update project documents to reflect a contract change, including amendments to contracts, drawings and specifications, schedules and budgets, and design documents.

The project manager should put in place procedures to provide for the configuration management of (ii) Contractor RFIs and submittals, "green arrows" in Figure 6-1, to:

- Document the CM's receipt of RFIs from the contractor, track and expedite the CM's response, and coordinate information from the designer of record where design issues are involved.
- Document the timely receipt of contractor submittals called for in the contract specifications and track their review/acceptance. Submittals include: contractor's schedule, safety plan, quality plan, shop drawings, progress reports, invoices, record drawings and documents, and operations and maintenance manuals.

Document Control

Document control is the management of records generated during construction. In addition to the records associated with changes, RFIs, and submittals discussed above, document control procedures are needed to handle reporting of construction progress including:

- Site records that include a daily log of site activities, occurrences, weather, equipment, personnel, and communications.
- Inspection Report of contractor's work and practices observed by the CM's construction inspectors covering construction work performed, instructions given or received, unsatisfactory conditions, delays encountered, manpower and equipment, or other problems.
- RE's weekly Construction Report of all items of importance, conferences with the contractor or other parties, agreements made, special notes regarding equipment or organization, labor conditions, weather or other causes of possible delays, and other matters that have a bearing on the history of the job.
- Safety management and accident reports.
- QA/QC reports.

Progress Payments

Management of progress payments begins with the contract specifications clearly stating how the contractor's work progress is to be measured, how payments are determined based on the measured progress, and what documents and reports are required to be submitted by the contractor to justify the payment request. The project manager should authorize payment only when the contractor's progress payment request is in full compliance with the contract requirements and the progress claimed has been independently verified by the CM.

Force Account Management

Force account management is the management of construction carried out by the Agency's own labor forces or the contractor for out of scope work executed on a time and material basis. The project manager should use internal work orders to authorize force account work. The work should be managed so that its completion does not interfere with the major construction contractors. It is also prudent for the project manager to confirm that non-project related force account

costs are not allowed to be charged against the project. The CM should observe the activities and keep accurate accounts of time and material used.

Communications Management and Community Outreach

A communications plan is important for projects that impact the local community or businesses, are of potential interest to the media, and where there are political stakeholders. Figure 6-4 sets out basic guidelines for managing communications in each of these areas.

Figure 6-4 – Guidelines for Managing Communications

Audience	Communications Guidelines
Local Community and Business Groups	▪ Identify project impacts of concern to local community and business groups. ▪ Communicate frequently and timely on the status of the project and associated impacts (community meetings, informational newssheets). ▪ Demonstrate sincere empathy and understanding on adverse impacts. ▪ Mitigate adverse impacts (limit construction at nights/weekends, provide temporary signage where access to business is impacted during construction).
Media	▪ Limit media contact to designated Agency personnel. ▪ Require contractors to refer all media comment to the Agency. ▪ Establish the Agency's position and message on project issues. ▪ Address media questions so as to communicate the Agency's message. ▪ Cultivate the media to present positive news on project events.
Political Stakeholders	▪ Above all else make certain a political stakeholder is not taken by surprise by a project event, good or bad. ▪ Regularly brief political stakeholders on project events and issues. ▪ Discuss project issues with political stakeholders before they have to comment or decide on them in public such as at a board meeting or media interview. ▪ Include political stakeholders in project milestone events so that their support and contributions can be recognized.

Although communications management is usually thought of as managing damage control when bad things happen, communications management also manages good news on the project such as:

- Announcing the project to promote its benefits.
- Holding milestone events to celebrate progress such as:
  - Unveiling the design of a new facility
  - A groundbreaking to mark the start of construction
  - Inaugurating the start-up of a completed facility.
- Publicizing any awards or industry recognition achieved by the project or the project team.

6.2 THIRD PARTY COORDINATION

Third Party Work

Third party work involves the relocation or rearrangement of existing facilities that impact project construction including:

- Utilities (electric power, gas, telephone, cable, etc.)
- Public infrastructure (highways, bridges, streets, sewer, water, etc.)
- Railroads.

The timing and duration of third party work requires careful negotiation with third parties due to the significant time required for the work and the limited influence an Agency has with respect to controlling the work of a third party. Work by third parties needs to be accomplished early in the project because any delays impact the follow-on contractors with the risk of delaying the overall project and incurring additional costs due to contractor delay claims.

Important to Know

- Third party work needs to be completed early to give clear access to contractors.
- Agencies have limited influence on the performance of work by third parties.
- Delays in third party work can have costly impacts on the follow on contractors.
- Costs for betterments should be paid for by the third party.

Third Party Agreements

It is imperative that the project manager negotiates and has in place agreements with third parties early in design so the project manager can assess their impact on the overall schedule, the utilities have time to plan and carry out any design required, and the project manager identifies interfaces with other contractors and incorporates them into the contract provisions.

The project manager's negotiations with third parties should address betterment work that the third party intends to carry out. Betterments are where the third party takes advantage of the relocation to upgrade the relocated facility. The project manager should agree to reimburse the third party only for the cost of relocating the equivalent facility and any additional costs for upgrades should be borne by the third party.

Managing Third Party Construction

The project manager should make certain there is no ambiguity as to who is responsible for the oversight of the construction work of a third party by explicitly delegating the oversight either to the CM or to the contractor as part of the contract requirements.

Where the CM is responsible for overseeing third party work on behalf of the Agency, the CM needs to carefully coordinate third party work using the master schedule to monitor the interfaces with other contractors. Due to the limited

influence an Agency has over a third party it is important that the project manager maintains a close and good relationship with third parties and gains an understanding of what motivates a particular third party to expedite their work. Motivation may include a subtle combination of negotiation trade-offs with respect to betterments and applying pressure through the political jurisdiction under which the third party operates.

Where responsibility for certain third party work is given to a contractor it is important that the contract provisions are clear on who is responsible for the relocation of a third party facility. During construction the CM should oversee that the contractor is aggressively managing the interfaces and that responsibility for any delays and their cost impact lie with the contractor.

6.3 QUALITY MANAGEMENT

Scope of Quality Management During Construction

Quality management during the construction phase covers:

- Review of contract documents to verify that quality aspects have been considered
- Surveillance of construction for adherence to quality requirements
- In process and receiving point quality inspections
- Audits of consultant, contractor, and supplier quality programs for adequacy and compliance.

Important to Know

- Quality is achieved by the contractors performing quality work.
- Contractors should have a Quality Assurance/Quality Control plan.
- The Agency should audit contractor compliance with their Quality Assurance/Quality Control plan.

Role of the Agency in Quality Management During Construction

The focus of the Agency is quality management and assurance. The PMP should document the project approach to quality management and larger projects may require a subsidiary quality management plan.

The Agency performs scheduled audits and periodic oversight reviews to ensure contractors comply with their quality plans and overall Agency QA policies. To avoid conflicts of interest between project progress and quality management the Agency's quality manager should report outside of the project manager's chain of command. The project manager should set a tone for the project that emphasizes quality management and supports the Agency's independent quality manager.

Role of the Contractor in Quality Management During Construction

Quality is achieved by the contractors performing work in accordance to an approved quality control plan. Construction contractors and suppliers should be required to submit a quality plan appropriate for their scope of work to the Agency for approval.

The contractor controls the quality of deliverables by monitoring and verification against the quality criteria specified in the design documents. The quality control activities include construction site activity, installation, inspection, test, and documentation. Results of inspections and tests are retained by the contractor as objective evidence of acceptability. The contractor turns over the records to the Agency as required by the contract documents. In particular, where quality problems are revealed, these are documented in non-conformance reports (NCRs).

Action on Non-Conforming Work

The contractor is responsible for determining the cause of non-conformance reports (NCRs) and taking appropriate corrective action. If the quality problem continues, the CM should raise the corrective action request to the contractor's senior management using the partnering concepts agreed to at the project outset. Further actions the CM can take include recommending to the Agency non-payment for the non-conforming work and ultimately that the Agency issue a stop work order until the contractor implements proper disposition of the quality problem.

Audits

The Agency's quality management plan should include a comprehensive program of periodic audits. The audits are to verify that the CM and contractors have effectively implemented and are in compliance with, applicable elements of the quality management plan. Follow-up audits, including re-audit of deficient areas will be conducted to assure that effective corrective action has been taken.

6.4 SAFETY MANAGEMENT DURING CONSTRUCTION

Scope of Safety Management

Safety management during construction phase covers:

- Planning of work to avoid personal injury and property damage
- Monitoring of work to provide early detection and correction of unsafe practices and conditions
- Protecting adjacent public and private properties to provide for the safety of the public
- Providing safety education and incentive programs
- Complying with federal and state Occupational Health and Safety Acts (OSHA).

Important to Know

- Safety is a top priority.
- Safety management depends on contractor enforcement, education, and incentives.
- The Agency should audit the contractor's safety, compliance, and performance.

Roles of the Agency in Safety Management

The Agency's role is to establish awareness that the prevention of accidents and protection of employees, the public, and property is a top priority. The Agency should have a safety management plan which can be a sub section of the PMP or on larger projects a separate subsidiary planning document. The requirements of the safety management plan should be incorporated as part of the contract documents.

The Agency through their CM monitors individual contractor safety performance for compliance with the above contractual safety requirements and conducts regular contractor safety audits and loss control surveys. When a violation of job safety is observed the CM will advise the Agency to notify the contractor in writing to correct the violation.

Roles of the Contractor in Safety Management

Contractors are responsible for having a safety management plan in place and for assuring safety on site, the safe and healthful performance of their work, preventing accidents or damage to adjacent public and private property, and safety training of their employees. When a contractor is advised by the Agency of a safety violation, the contractor should respond in writing and immediately take corrective action as set out in their safety management plan.

Enforcement

Contractors enforce safety by developing a Job Hazard Analysis for the work to be undertaken and discussing actions needed to provide safety at jobsite planning meetings. Supervisors draw on their safety experience to direct the actions of those under their direction. Contractor staff should include a safety professional who undertakes surveillance of operations to eliminate sources of potential accidents.

Education

Contractors give newly employed, promoted, and/or transferred personnel comprehensive safety indoctrination on topics such as: workplace hazards, required protective equipment, procedures for reporting unsafe job conditions, procedures for reporting accidents, contractor job rules, location of first-aid and medical facilities, and tool box safety meeting requirements. Safety should be a standing item at site meetings.

Foremen or shift supervisors should also hold regular crew training (toolbox) meetings to cover specific safety procedures pertinent to the crew's on-going activity.

Incentives

Contractors should display signs and posters at the job site to reinforce safety training and as an incentive to maintain interest in job safety with the changing work assignments and jobsite conditions. The Agency should encourage contractors to introduce employee incentive programs that reward safe work performance through personal recognition and prizes such as belt buckles, pins, or lunch boxes.

Audits

The Agency through the CM monitors and conducts regular audits of contractor safety performance and notifies the contractor in writing of unsafe practices observed. Should a contractor fail to correct an unsafe condition or practice, the CM may recommend that the Agency issue a stop work order until the condition is corrected.

Accident Investigation and Record Keeping

Accidents should be investigated without delay by the contractor and the investigation should generate recommendations for corrective actions to prevent recurrence of similar accidents. The contractor's accident report, project records, progress reports, and daily time reports may become important evidential material in any ensuing legal action. The contractor prepares monthly accident summary reports for submission to the CM. These reports will allow the CM to assess contractor safety performance as measured by recordable and lost time accident frequency rates and the type and cause of accidents. The federal and state regulations mandate reporting of certain injury accidents to the authorities.

CHAPTER 7. COMMISSIONING

IMPORTANT TO DO

- ❑ IDENTIFY A CHAMPION TO LEAD COMMISSIONING STARTING AS EARLY AS PROJECT INITIATION.
- ❑ INITIATE A COMMISSIONING PLAN AS A PART OF, OR A COMPLEMENTARY DOCUMENT TO, THE PROJECT MANAGEMENT PLAN.
- ❑ CONSIDER LEAD TIMES IN PROCUREMENT OF OWNER FURNISHED EQUIPMENT IN THE SCHEDULE.
- ❑ ASSURE SYSTEM COORDINATION THROUGH INTEGRATION TESTING.
- ❑ DEVELOP AND IMPLEMENT A SAFETY AND SECURITY CERTIFICATION PLAN AND PROVIDE CONTINGENCY FOR EMERGENCIES IN CLOSE COORDINATION WITH EMERGENCY RESPONDERS IN YOUR AREA.
- ❑ REQUIRE THE OPERATIONS AND MAINTENANCE MANUALS WELL IN ADVANCE OF CONSTRUCTION COMPLETION.
- ❑ ALLOW ADEQUATE TIME TO TRAIN STAFF WITH THE NEW EQUIPMENT.
- ❑ DOCUMENT THE AS-BUILT CONDITIONS AND BECOME FAMILIAR WITH THEM.
- ❑ ACCEPT EQUIPMENT AFTER IT IS IN OPERATION TO ASSURE A FULL WARRANTY PERIOD.

7.0 PURPOSE OF THIS CHAPTER

Introduction

We often hear people say that the last ten percent of the job took ninety percent of the resources. Advance planning of the commissioning process can help you reduce the risks of prolonging the project in its last strides. Whether you are rolling buses into a new park-and-ride station, moving people into a new maintenance building, or flipping the switch at your new compressed natural gas station, you will need to follow certain key steps to minimize commissioning issues. This chapter discusses the commissioning phase of a project, which consists of the roles and responsibilities, commissioning plan, owner furnished equipment (OFE), integrated testing, safety and security and emergency preparedness, operations and maintenance (O&M) manuals, training, as-built drawings, and warranty administration.

Commissioning Phase

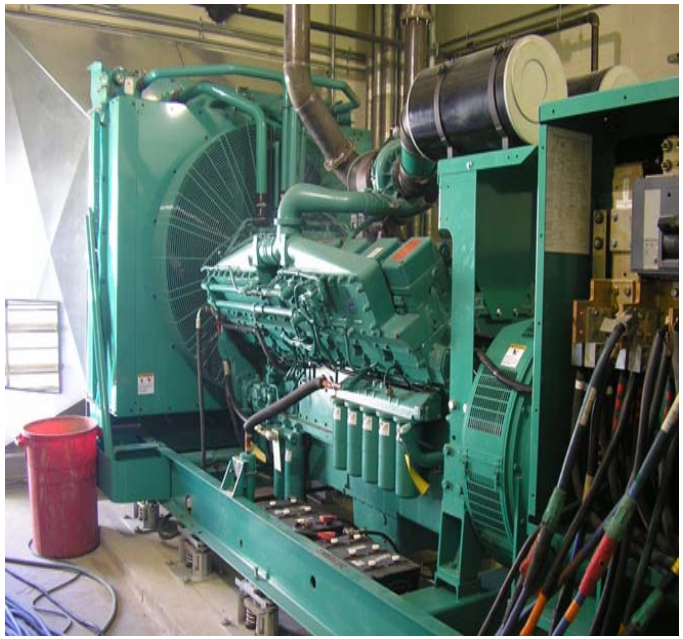
Commissioning is a process for validation of building equipment and systems in coordination with operations personnel and third parties. When the project manager allows adequate time and resources in the commissioning phase, the Agency minimizes the risk of delays, cost overruns, and underperforming heating, air conditioning and ventilation systems; electrical power systems failure and faults; and unreliable support equipment.

In the maintenance facility example, the commissioning process will help validate performance of such equipment as fare collection, fueling, bus washer, and lifts. The overall impact of life cycle costs is not only associated with direct operations costs, but also can be attributed to employee productivity associated with indoor environmental conditions.

Understanding of the commissioning phase before you embark on a new project will help you identify and address issues before they could take additional time and cost more dollars. The project manager should begin the project with the end in mind through a well thought-out commissioning phase early during project initiation.

Important to Know

- Commissioning is a process for validation of building equipment and systems in coordination with operations personnel and third parties.
- In the commissioning phase the project manager assigns responsibility and authority to the team that will incorporate checks and balances to ensure that the documentation, manufacturing requirements, and systems, equipment, and operations are integrated, validated, and accepted.



In the commissioning phase the project manager assigns responsibility and authority to the commissioning team that will incorporate checks and balances to ensure that the documentation, manufacturing requirements, and systems, equipment, and operations are integrated, validated, and accepted. The United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED®) 2.2 Energy and Atmosphere (Prerequisite 1) mandates that fundamental building commissioning be incorporated for LEED® certified construction projects. The emphasis for building commissioning has taken a whole new dimension as a result of LEED®. Commissioning is recognized as an effective way to ensure that the energy design requirements are being met.

This commissioning phase should be described in detail in the PMP and followed by development of the Commissioning Plan.

Role of Agency

Early in the planning and design process the project manager should assign a champion for the facility commissioning. In our maintenance facility example, this champion could be staff from operations or engineering with prior relevant experience. This champion would be partially or fully relieved of his or her normal duties to focus on the commissioning work. Alternatively, a commissioning consultant could be hired. Under the general supervision of the project manager, the Agency will need to support the commissioning manager with assignment of personnel from safety, security, operations, engineering, maintenance, procurement and warranty administration, customer service, public relations, and other functions as may be necessary.

Important to Know

- The assignment of a commissioning team during the design phase will help begin the project with the end in mind and facilitate preparation of a well thought commissioning plan.
- The project manager must assign a commission manager with prior relevant experience to work with all internal and external stakeholders throughout the project implementation.
- The commissioning manager may be an experienced staff member who is relieved of normal duties or a consultant.

Role of Consultants and Contractors

The project manager may feel that the Agency is already paying for commissioning through project management, the construction contract, and construction management services and may wonder why they should expend additional dollars to perform tasks that the construction manager and general contractor should be providing. While the many aspects of commissioning are included in the scope of the above parties, there will always be gaps in requirements due to interfaces that are out of the control and/or capacity and capability of one party or another. The level of effort by the commissioning manager and the team varies from one project to another, but the assignment of responsibility and authority to a single point of responsibility who can take ownership for this phase is a necessity. For example, a maintenance facility project is a complex undertaking and will require a high-level of capacity and capability for commissioning to assure the project is completed within the schedule and budget and realizes life cycle cost savings.

Figure 7-1 below is a typical responsibility matrix that shows the lead personnel commissioning tasks including testing.

Figure 7-1 – Typical Responsibility Matrix for Commissioning Tasks (Design-Bid-Build Delivery)

Team Members	Prepare plans and specifications	Submittals: Equipment, O&M Manuals, and Warranties	Proof of design, construction and manufacturing tests	Prepare integrated test procedures	Perform integrated tests	Training	Safety Certification	As-built drawings	Warranty Administration	Team Management
Designer of record	Lead		Support					Support		Support
Construction Manager			Support							Support
Construction Contractor		Lead	Lead			Lead		Lead		Support
Project Manager										Lead
Commissioning Team				Lead	Lead					Support
Operations					Support	Support	Support		Support	Support
Safety and Security Department							Lead			Support
Procurement Department									Lead	Support
Agency top management										Support

7.1 THE COMMISSIONING PLAN

The commissioning plan is a living document and a supporting document to the PMP. The plan should be started early in the design phase and further refined with additional details as information becomes available at the completion of design and well in advance of construction completion. Under the general direction of the project manager, the commissioning manager will prepare the commissioning plan. The plan provides guidance and details the key elements of the commissioning process including roles and responsibilities, critical equipment list, OFE, integrated testing, safety and security and emergency preparedness, O&M manuals, training, as-built drawings, and the warranty administration. The commissioning plan is prepared with significant input from all internal and external stakeholders in close coordination with the design and construction teams. Prepared properly and used as a living document the plan will assure all requirements are properly incorporated in the design and construction bid documents and executed during construction and commissioning.

Important to Know

- The commissioning plan is a living document and a supporting document to the Project Management Plan.
- The plan should be prepared as early as possible in the design phase.
- A formal commissioning process is required by LEED® for certain equipment.

Figure 7-2 shows a typical commissioning list for equipment used in a maintenance facility project. There may be many other items that will have to be added to this list for your project. Items checked are assumed to be required for LEED® certification.

Figure 7-2 – Typical Equipment Commissioning List

LEED®	ITEM	HVAC System (and all integral equipment controls):
X	1.	Pumps (chilled water) if required
X	2.	Chillers if required
X	3.	Piping, cleaning, and purging
X	4.	Chemical treatment
X	5.	Ductwork
X	6.	Air handling units
X	7.	Heating/A.C (including controls, piping, pumps, compressors) recovery & ventilating units
X	8.	Split systems
X	9.	Air terminal units
X	10.	Testing, adjusting, and balancing work (TAB)
X	11.	Unit heaters (area, cabinet)
X	12.	Building automation system (controlled devices, control loops, and system integration)
X	13.	Fans & ventilation systems including fume and exhaust evacuation systems
X	14.	Variable frequency drives
X	15.	Humidifiers

LEED®	ITEM	Mechanical Systems: (As related to facilities and processes including primary control systems)
X	16.	Building envelope
	17.	Overhead roll-up doors and grilles
X	18.	Boilers
	19.	Bus wash and reclamation system
	20.	Elevators (freight and passenger)
	21.	Bulk fluid storage and distribution systems including but not limited to diesel fuel, fuel oil, motor oil, antifreeze, chassis grease, automatic transmission fluid, gear oil, windshield washer fluid, and waste fluids
	22.	Oil/water separator systems
	23.	Paint spray booths
	24.	Compressed air system
	25.	Domestic water system (plumbing, fixtures etc.)
	26.	Piping
	27.	Monorail systems and traveling cranes
LEED®	**ITEM**	**Electrical Systems:**
X	28.	Sweep and scheduled lighting controls (i.e. photocells, occupancy sensors)
	29.	Fire alarm system
	30.	Emergency power system and transfer switch
X	31.	UPS
	32.	Wiring devices
	33.	Transient voltage suppression
	34.	Secondary unit substations
	35.	Enclosed switches and circuit breakers
	36.	Enclosed controllers
	37.	Panel boards
	38.	Dry-type transformers
	39.	Grounding
	40.	Battery charging system
	41.	Level gauging and leak detection systems for bulk fluid systems and tanks
	42.	Fuel management system
	43.	Bus traffic control system and pedestrian protection system
	44.	Data communications system
	45.	Integrated telephone and paging systems
	46.	Security system
	47.	Closed-circuit television (CCTV) system
	48.	Time clock system
LEED®	**ITEM**	**Life Safety Systems:**
	49.	Emergency lights and signs
	50.	Emergency eye wash
	51.	Fire protection (including but not limited to fire pump, standpipe, and sprinkler systems)
	52.	Gas detection

7.2 OWNER FURNISHED EQUIPMENT

Almost every job will have some level of owner furnished equipment (OFE), either due to long lead procurement cycles of equipment or the high-level of specialty involved, or when equipment requirements are not known during the design phase. The OFE can be any equipment that is not furnished and installed by the construction contractors but will require installation facilities by the contractor or is required by the project to be fully operational. The OFE could be furniture, office equipment, telephones, audio-visual equipment, operational signage, fare collection equipment, etc. As the project manager you are responsible to fully integrate and account for the OFE with the rest of the construction project work. Lack of OFE coordination with the design and construction is often the main source of schedule delays and technical difficulties.

Important to Know

- Almost every job will have some level of owner furnished equipment due to long lead time, specialty equipment, or unknown requirements at the time of bidding.
- The project manager is responsible to fully integrate and account for the owner furnished equipment with the rest of the construction project work.
- The commissioning manager will be focused on installation and testing.
- The assignment of the commissioning manager early on may help catch an omission in integration of owner furnished equipment early in design or during construction and provide an opportunity for the parties to close any gaps. Procure furniture and/or amenities early.

In the example maintenance facility project, the Agency may decide to furnish its own telephone system and furniture. The project manager should assure that the equipment is ordered and delivered in time for installation and that the construction contractor has the necessary facilities ready for operation of the OFE. The fare collection supplier may furnish a perfectly factory tested fare collection system. However, if the contractor does not provide adequate power and signal conduits, it may not have the power and communication cables to be operational when it arrives on site. The commissioning manager will be focused on installation and testing. However, assignment of the commissioning manager early on may help catch an omission in integration of OFE early in design or during construction and provide an opportunity for the parties to close any gaps. Another example is signage. The architect may have specified all building code related signage. However, in every project there will be some operational signages that will need to be defined and ordered under direction of the project manager and installed under supervision of the commissioning manager.

7.3 INTEGRATED TESTING AND START-UP

The objectives of integrated testing are: verification of the proof of design and construction tests done by the contractor and observed by the construction manager. Usually this information is available through the construction manager or the contractor: assurance of compliance with performance requirements for the system as a whole; coordination and compliance with third party requirements such as fire, police, etc.; and documentation of integrated testing results for safety and security certification.

The project manager fulfills the above objectives, by overseeing the commissioning manager, identifying roles and responsibilities of the testing organization, establishing testing plans and procedures, and performing and documenting test results.

Test types include: proof of construction tests including contractual material tests, factory/plant tests, installation checkout tests, inspections, and acceptance tests to provide verification of functional performance and contract compliance. Integrated tests are generally non-contractual because they usually involve more than one responsible party. These tests will provide verification, validation, and documentation of system performance and its operational characteristics. Finally, the Agency may want simulated operations tests to provide an opportunity for development of operating procedures, training and familiarization exercises for the O&M staff.

Important to Know

- Integrated testing verifies proof of design and construction tests, assures compliance with performance requirements, coordinates compliance with third parties, and documents results for safety and security certification.
- Integrated tests are generally non-contractual because they usually involve more than one responsible party beyond the control of the construction contractor.
- The project manager oversees integrated testing led by the commissioning team.

7.4 SAFETY AND SECURITY CERTIFICATION

The word "safety" is used to deal with hazards (due to unintentional acts) and "security" to deal with vulnerabilities (due to intentional acts). The projects that are the subject of this Handbook fall mainly under bus transit mode. The standards that apply include: American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE); Institute of Electrical and Electronics Engineers; and federal, city, and state building codes. In addition, for bus operations the project manager should consider regulations by the Federal Motor Carrier Safety Administration (FMCSA), Occupational Safety and Health Administration (OSHA), FTA Drug and Alcohol, and the applicable State's Department of Motor Vehicle regulations.

The project manager, with support from the commissioning manager and led by the safety and security personnel, should consider self-certification of the project for satisfactory compliance with a formal list of hazards and applicable safety and security requirements. The self-certification will document all actions taken, identify and close gaps, and assure the stakeholders of the Agency's commitment to safety and security. The responsible parties self-certify by signing off on this document.

In addition, the Agency should establish strong ties with emergency response agencies and resources to provide mutual assistance in an event of major emergencies on or near the project. Emergency preparedness requires working with local emergency management groups to develop procedures and contingency plans specific to the location and the nature of the project, and perform specific drills to simulate emergencies.

Important to Know

- "Safety" is used for hazards due to unintentional acts, and "security" is to deal with vulnerabilities due to intentional acts.
- The project manager identifies safety and security requirements with support from the design and commissioning team and in coordination with the safety and security personnel.
- Hazard and risk analysis are the basis for identification and development of a safety and security plan.
- Emergency preparedness requires working with local emergency management groups to develop procedures and contingency plans.

7.5 OPERATIONAL AND MAINTENANCE MANUALS

The project manager must assure that the technical requirements for O&M manuals are addressed by the designers of record and specify schedule requirements for submittal of the O&M manuals well in advance of construction completion. The contractor prepares and submits the O&M manuals in accordance with specification requirements. The specifications should address the systems and subsystems for which manuals are required. It should outline the media (hard copy, CDROM, etc.), the quantities, formatting, and schedule for delivery. You should consider liquidated damages to be specified and assessed to the contractor if the O&M manuals and follow-on training are not provided within the specified time frame well in advance of the operations. The O&M manuals typically contain items listed in Figure 7-3.

Important to Know

- Operations and maintenance manuals are specified during design.
- Operations and maintenance manuals and the necessary training must occur well in advance of project completion.

Figure 7-3 – Typical O&M Manual Content

- Equipment Ratings & Specifications Including Specific Product Data Sheet
- Standards/Code Compliance
- Training and Safe Practices
- Receiving and Handling
- Inspection and Installation
- Description and Operation
- Factory Specified Tests
- Control Descriptions
- Environmental Considerations
- Inspection Maintenance & Troubleshooting
- Required Forms to Document Maintenance
- Authorized Factory Representative Contact Information for Technical Support and Replacement Parts
- Warranty
- Renewal Parts Listing and Views
- Figures/Drawings

7.6 TRAINING AND TRANSITION TO OPERATIONS

Under general direction of the project manager and through supervision of the commissioning manager, training is conducted by the contractor or its subcontractors or suppliers and takes place after the acceptance of equipment and O&M manuals, and before operations begin. The project manager will work closely with the commissioning manager to schedule personnel in training classes. When a large number of personnel are involved, the project may choose to have several experienced personnel with ability to teach, take part in train-the-trainer sessions (if available) and begin training others. The contractor must submit a detailed outline of the training program with the O&M manuals. The commissioning manager will review the material for compliance with construction specifications and get input from the specific group being trained. The commissioning manager with assistance from the contractor and the group being trained will ensure that all training requirements are met and the training material is turned over to the Agency.

Important to Know

- To assure a smooth start in operations, the personnel must be trained well in advance of the project completion.
- When a large number of personnel are involved the project manager can consider training Agency personnel as trainers to train their groups.

7.7 AS-BUILT DOCUMENTATION

The project manager should assure the construction contract calls for the contractor to mark up the changes on the drawings and specifications as they occur during construction and turn in a set of marked up drawings and specifications. Under general direction of the project manager, the construction manager verifies the construction contractor is keeping the drawings up to date. The project manager should provide in the agreement with the designer of record scope for the designer to review, approve, and produce the final as-built drawings.

The commissioning manager will use the as-built documentation as necessary to commission the project. As-built drawings will save significant life cycle costs and avoid potential safety hazards during operations and life of the facilities. The commissioning manager will review the final as-built drawings and assure they are a part of the final commissioning report.

Important to Know

- The construction contractor should mark up the drawing as changes occur.
- The designer of the record reviews, approves, and documents the changes into final as-built drawings and conformed specifications.

7.8 WARRANTY ADMINISTRATION

Warranty is an assurance by the manufacturer in writing to the Agency that assumes stipulated responsibility for the performance of the equipment supplied for a specified period after acceptance. Warranty lengths typically vary in length from six months to five years. The project manager should be careful not to accept a piece of equipment before it is ready for overall operations. The project manager should consider provisions for extended warranty when equipment must arrive and must be accepted well in advance of total operations. Under general direction of the project manager, the commissioning manager will work closely with the procurement department personnel who will check the equipment warranties against contractual requirements.

Important to Know

- The project manager should be careful not to accept a piece of equipment before it is ready for overall operations.

CHAPTER 8. PROJECT CLOSEOUT

IMPORTANT TO DO

- ❑ PREPARE A PUNCH LIST OF INCOMPLETE CONTRACTOR ITEMS.
- ❑ LEAD A FINAL WALK THROUGH INSPECTION OF CONSTRUCTED FACILITY.
- ❑ RESOLVE OUTSTANDING CHANGES/CLAIMS.
- ❑ DEVELOP A PLAN TO DEMOBILIZE AGENCY AND CONSULTANT STAFF.
- ❑ KEEP PROJECT TEAM'S ATTENTION FOCUSED ON CLOSEOUT ACTIVITIES.
- ❑ ASSESS AND DOCUMENT LESSONS LEARNED ON PROJECT.
- ❑ OBTAIN PROJECT ACCEPTANCE FROM PRINCIPAL STAKEHOLDERS.
- ❑ CELEBRATE PROJECT COMPLETION.

8.0 PURPOSE OF THIS CHAPTER

Introduction

Completing a project requires procedures to closeout project contractual and administrative activities.

Role of the Agency in Project Completion

Closing contractual activities requires the Agency's project manager to oversee final settlement of project contracts, acceptance of contract deliverables, collection of contract documents and records (such as as-built drawings, operation and maintenance manuals, and warranties, etc.), and approval of final payments. The project manager's responsibilities for administrative closeout relate to demobilizing the project team and completing activities with other stakeholders, arranging the disposition of project records, closing of funding and financing agreements, and performing an evaluation of project success and lessons learned.

8.1 CONTRACTUAL CLOSEOUT

Construction Contracts

The project manager, commissioning manager, construction manager/resident engineer, and contract administrator, should follow the procedures and actions specified in each contract's terms and conditions to settle and close the project's construction contract agreements.

For a typical construction contract you will need to confirm the completion and acceptability of the following activities:

Manuals and Training – The contractor delivers the operations and maintenance (O&M) manuals for the facilities constructed and equipment installed and provides any associated training of Agency staff in their use.

Beneficial Occupancy – A contract is substantially complete when the permitting authority issues a Certificate of Beneficial Occupancy to the Agency and then the Agency can occupy and begin use of the facility and equipment. It is important on taking beneficial occupancy that you ensure the construction manager/resident engineer prepares a punch list of open items for the contractor to complete.

Guaranties and Warranties – With beneficial occupancy confirm that the contractor has initiated the guaranties and warranties associated with the facility and equipment.

Record or As-built Drawings – The construction manager/resident engineer confirms that the contractor has submitted the record drawings that show the as-built condition of the constructed facility and installed equipment.

Important to Know

- A contract's terms and conditions specify the actions needed for final settlement and closure.
- A contract is substantially complete when the permitting authority issues Certificate of Beneficial Occupancy.
- A contract audit is needed to verify appropriateness of costs invoiced on cost plus type contracts.
- A contract audit examines direct labor, other direct cost, and indirect overhead charges.

Final Inspection – Lead a final walk through inspection of the facility to confirm that the contractor has completed the open punch list items and all work is completed correctly and satisfactorily.

Resolve Outstanding Change/Claim Disputes – You should make every effort to resolve any outstanding contract disputes so that they do not drag on past contract and project completion.

Final Payment – With the above activities satisfactorily completed you can approve the final payment to the contractor and the Agency can close the contract.

Commissioning – Assure that all other commissioning activities have been completed in a satisfactory manner.

Professional Service Contracts

Although closing a professional service contract, for such as design or management services, does not involve as many milestones and activities as a construction contract, you still need to follow the completion procedures dictated by the terms of the professional service contract.

Typical closeout activities for a professional service contract include:

Verification of Scope Completion – Confirm that the professional service contractor has satisfactorily delivered the services called for in the contract scope of work.

Contract Audit – Where contract payments are on a cost plus fee basis, the contract provisions should give the Agency the right to audit the contractor's costs. The audit should verify items such as direct labor rates, support for time charges, support for other direct costs, and justification for overhead rates.

Final Payment and Release of Retention – With scope completed satisfactorily and audit completed, you can approve the final payment and release of any retention held back from prior contract payments pending satisfactory completion of services and audit of costs.

8.2 ADMINISTRATIVE CLOSEOUT

Project Demobilization

Managing the demobilization of the project can often test the project manager's administrative and interpersonal skills in order to address the following end of project issues:

- Key project staff that see the end of the project coming and acquire positions elsewhere in the Agency before their project role and duties are complete.
- Or the opposite, Agency project staff whose duties are complete and are difficult to relocate off the project because there is no immediate position for them to move to.
- Professional service consultants, whose role is concluding, prematurely transfer key staff to newer long term assignments and/or endeavor to stretch out their services to maintain revenue.

To manage demobilization as project manager, you should develop a staffing plan for the final phase of the project that plans the reduction in the Agency's own forces and those of the professional service consultants. You should work with the Agency's human resources to help manage the transition of staff off the project, ease their anxieties surrounding what their next role is, and provide incentives for key staff to remain on the project and defer moving on. Similarly you should meet with the principals of the professional service firms to reach agreement on a timetable for winding down their services as the project concludes.

The project manager's final challenge once the demobilization plans are in place is to keep the project team's attention focused on the tasks needed to complete the project as opposed to what they will be doing once the project is over.

Closure of Project Financing and Funding

The project manager will need to work with the Agency's finance staff to closeout the funding to the project. Where a project receives FTA funds, Circular 5010.1C Grant Management Guidelines sets out the activities required of an Agency to satisfy the FTA that all the Agency's project responsibilities and work are completed and the associated financial records closed.

Important to Know

- The original Project Authorization and Project Requirements Definition set out what the project needs to fulfill before it is closed out.
- Important administrative closeout items include the:
  - Demobilization of project team.
  - Closure of project funding and financing.
  - Securing the disposition of project records.
  - Conducting a lessons learned project evaluation.
  - Achieving closure with stakeholders.
  - Celebrating project success.

Disposition of Project Records

The project manager has to arrange for project records to be transferred to the Agency's document control function. Project records required to be maintained will be determined by a combination of the Agency's own records retention policy, retention requirements imposed by parties funding the project such as the FTA, and any special requirements due to contract provisions. Should there be an unresolved change/claim dispute, it is important that all records pertaining to the contract and dispute also be retained.

Project Evaluation

Before the project is over and key project staff has dispersed, it is desirable for the project manager to hold a lessons learned session. The lessons learned should focus on identifying project strengths and weaknesses with recommendations on how to improve future performance on projects. To be most effective the project manager should encourage the project team to identify and document lessons learned through the project life cycle so that a database of lessons learned experience is built up for consideration at the final lessons learned session. Lessons learned can consider technical, managerial, and process aspects of the project.

Stakeholder Closure

Perhaps the most important aspect of completing the project is to achieve acceptance and closure of the project by the project's principal stakeholders, those who sponsored the project, and those that are to use the facilities and equipment delivered by the project. The Project Authorization and PRD documents formally set out the expectations for the project. The project manager should now receive formal confirmation that with the hand over of the project deliverables from the project team to the operational users, the project sponsors and users have officially accepted the project deliverables.

This formal acceptance is also the opportunity to celebrate project success with some ceremony to mark the opening of the new facility and equipment into operations.

CHAPTER 9. PROJECT SUPPORT

IMPORTANT TO DO

- ❑ INCLUDE FUNDS WITHIN THE PROJECT BUDGET TO PROVIDE FOR PROJECT SUPPORT FUNCTIONS.
- ❑ ESTABLISH CONTROL BASELINES AGAINST WHICH TO COMPARE ACTUAL PERFORMANCE.
- ❑ FOCUS CONTROL ACTIVITIES ON CORRECTING THE SIGNIFICANT VARIANCES.
- ❑ ALLOW ENOUGH TIME IN THE PROJECT SCHEDULE FOR THE PROCUREMENT PROCESS.
- ❑ USE PROACTIVE COMMUNICATION AND AVOID STAKEHOLDERS BEING SURPRISED BY PROJECT EVENTS.

9.0 PURPOSE OF THIS CHAPTER

Introduction

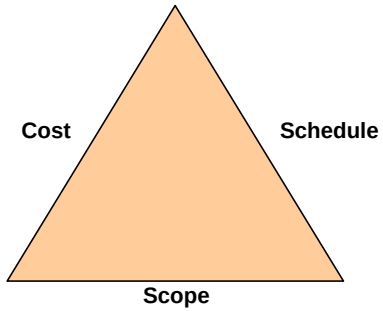
Project support functions are administrative in nature and typically take place throughout all phases of the project cycle in order to support the management and control of project activities. Topics discussed in this chapter include: project control, project accounting, grant management and clerical/administrative support; procurement and contract administration of professional services, construction, equipment and supplies, and third party agreements; project communications; and records management.

9.1 PROJECT CONTROL

Project Control Process

Project control provides the systems and procedures to track and control the project's scope, cost, and schedule to support project management's objective of delivering a scope that meets project requirements, within the budget and on schedule. Scope, cost, and schedule are interdependent on a project, see Figure 9-1. For example, a change that increases the project scope typically is associated with an increase to the project cost or schedule or both.

Figure 9-1 – Project Control Triangle



Illustrating scope, cost, and schedule as three sides of a triangle underlines their interdependency. A change to one (side) impacts one or both of the other (sides).

The fundamental principles of the control processes are the same for controlling scope, cost, or schedule. They are to:

- Establish a control baseline
- Track project performance against the baseline
- Continually forecast performance at completion and compare to the baseline
- Identify changes to the project and assess their impact on performance against the baseline
- Take management action to correct adverse forecast and/or change variances.

The role of the Agency and its project manager is to establish the management approach to project control and ensure that it is followed during the execution of each phase of the project. You should

Important to Know

- Project control compares actual performance with plan (baseline), identifies variances, and corrects adverse variances.
- A Work Breakdown Structure is a hierarchical breakdown of project scope into its component parts and their elements of work.
- Scope control (configuration management) defines the project deliverables of the Work Breakdown Structure, controls changes to deliverables and tracks the impact of changes.
- Schedule control defines the dates for performing project activities of the Work Breakdown Structure elements of work, identifies the relationship between activities, identifies activities that determine the project total duration (critical path), and tracks and controls changes to the schedule.
- Cost control defines the budget for the Work Breakdown Structure components, tracks actual costs, estimates the costs at completion, and controls changes to costs and variances of forecast costs from budget.

document the approach to project control in the Project Management Plan (PMP). For larger projects you may need to retain the services of a program management or project controls consultant to provide staff with specialist expertise in scope, cost, and schedule controls.

Scope Control

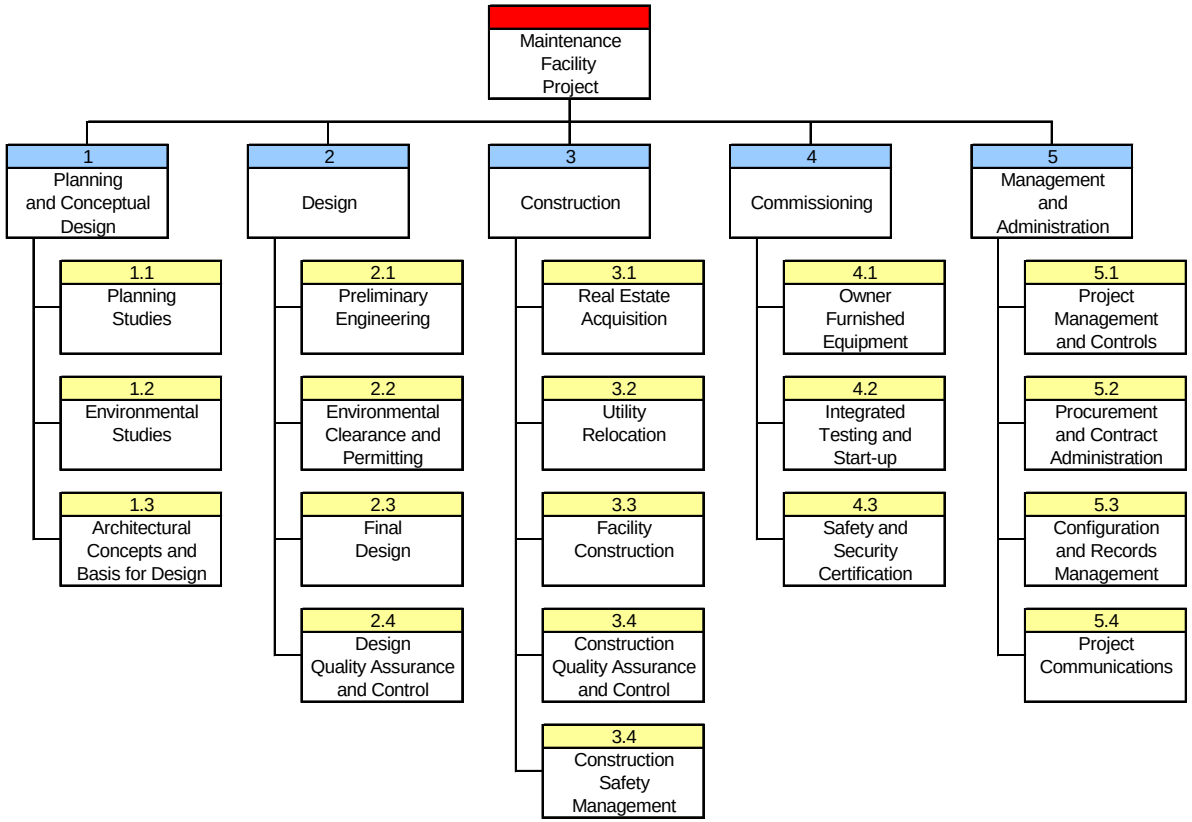
The project requirements, as set out in the Project Requirements Document discussed in Chapter 2, determine the project scope described in terms of the project deliverables. The project scope is alternatively referred to as the project configuration. Configuration management is the project control process for scope control.

For engineering/construction projects, such as our example bus maintenance facility project, project scope is defined and quantified by the drawings and specifications. In successive phases of the project, the design drawing and specifications develop from the design concepts and technical studies of conceptual design/preliminary engineering, through final design packages, and the as-built drawings at the end of construction.

In conceptual design/preliminary engineering you analyze alternative design concepts and select the preferred design configuration for the required project deliverables. It is at the conclusion of preliminary engineering prior to beginning final design that you should establish the scope baseline, sometimes called the technical baseline, for the project. Configuration management provides the project control process to identify, assess, and track the impact on the scope baseline of changes to the project requirements. Changes in project requirements may be due to changes in owner requirements, unforeseen project conditions, changes in governing regulations, value engineering proposals, etc.

An important project control tool in configuration management and the other project control processes for cost and schedule control is the Work Breakdown Structure (WBS). The WBS is a hierarchical structure that breaks down the scope of the project deliverables into their component and subcomponent parts and then further down into the subcomponents' design and construction work package elements. Figure 9-2 is a simplified WBS for our example maintenance facility project.

Figure 9-2 – Work Breakdown Structure, Maintenance Facility Project



In a complete WBS the above work elements would be broken down into more detailed work packages. For example: WBS 1.1 Planing Studies could be broken down further into 1.1.1 Functional Studies, 1.1.2 Site Selection, and 1.1.3 Technical Studies; and WBS 2.3 Final Design broken down further by design package into 2.3.1 Utility Relocations, 2.3.2 Facility Structure, and 2.3.3 Major Equipment Procurement and Installation.

The work package elements are assigned to the design consultants, contractors, third parties, and the Agency's own forces. In addition to using the WBS to define scope, budgets and cost estimates are developed for each WBS work package element and the activities of the WBS work packages are scheduled to define and control the project's cost and schedule as discussed below.

Prior to preliminary engineering phase completion, the project manager will budget and baseline each task. However, at the conclusion of preliminary engineering the control baseline for the scope should be established and supported by the technical studies, conceptual designs, and preliminary engineering drawings and specifications. As the final design and construction phases progress, configuration management requires that any changes to project requirements are identified, their impact on the project scope assessed, and the configuration of the

affected drawings and specifications amended. It is important that you make certain that project changes do not result in compromising the intended project deliverables in terms of required performance and/or quality and take the necessary management action to ensure the current configuration delivers the required standard of performance and quality as defined by the control scope baseline.

Often the scope changes also result in changes to the scopes of work of the design consultant and/or construction contracts, in which case the project's change control processes should be used to process the associated contract changes. Additionally, the impact on the project's cost and schedule needs to be assessed with corresponding updates to cost and schedule as discussed below.

The final phase of configuration management is to document the as-built scope of the project deliverables, through receiving the as-built drawings from the construction contractors.

Cost Control

Cost control is based on continually refining the project's cost estimate at completion as the project progresses and taking management action to address adverse variances in the cost estimate compared to the baseline budget. As with the scope baseline, the cost baseline is developed at the conclusion of preliminary engineering. You should manage the preliminary engineering so that the baseline cost estimate for the selected scope configuration is in an acceptable range of the estimated project cost at the time the project was authorized and the project requirements definition prepared.

The baseline cost estimate must include allocated and overall unallocated contingency funds that are established based on deterministic or probablistic risk assessment.

It is important to understand the reliability of the cost estimate. To accomplish this you should require your cost estimators to provide an estimating range in addition to the single point estimate, so for our example maintenance facility the cost baseline project budget estimate is expressed as $40 million with a 90 percent confidence that the cost will be in the range of $35 to $50 million. As the design and construction phases progress the range should become narrower for the same level of confidence. The ranges can be used to establish the levels of cost contingency to include in the project budget. Risk assessment techniques are helpful in both identifying cost impact of project risks and the resulting estimating range for a given level of confidence.

You should track the project's cost performance against the baseline budget as design and construction progresses and contracts are awarded, costs incurred, project changes identified, and cost trends forecasted based on expected future scope and/or contract changes. The project's cost at completion should be continually reforecast and management action taken to address adverse cost variances.

The WBS is again the key control tool. The baseline budget and cost estimates are developed for the WBS work package elements. The assignment of the elements to design and construction work packages provide the means to track the costs as they develop by the same categories as the work is performed. In addition, as the scope control is also by the same work package elements, the WBS provides for consistency in assessing changes in scope and assessing the corresponding impact on costs for the affected WBS work package elements. Figure 9-3 provides an example format for a WBS cost control report for the bus maintenance facility project.

Figure 9-3 – Cost Control Report, Maintenance Facility Project

WBS Element/Package	Baseline Budget (a)	Committed (b)	Incurred (c)	Estimate to Complete (d)	Estimate at Completion (e =c + d)	Variance (f = a - e)
1 Planning and Conceptual Design						
1.1 Planning Studies						
1.1.1 Functional Studies						
1.1.2 Site Selection						
1.1.3 Technical Studies						
1.2 Environmental Studies						
⋮						
2 Design						
⋮						
3 Construction						
⋮						
4 Commissioning						
⋮						
5 Management & Administration						
⋮						
9 Contingency						
Total Project						

Notes:

(a) Baseline Budget: Control budget against which project cost performance is measured and controlled
(b) Committed: Value of project contractual commitments to contractors and/or internal work orders to Agency's own forces
(c) Incurred: Project costs to date incurred by contractors and/or Agency's own forces
(d) Estimate to Complete: Forecast of estimated costs to go in order to finish the remaining work on the WBS element/package: for construction in design - the forecast is based on the current capital cost estimate for the construction package; for contract work in progress - the forecast is based on the outstanding commitment (b - c) plus the forecast value of any pending and/or expected contract changes; for Agency own forces work - the forecast is based on the expected cost of the remaining work.
(e) Estimate at Completion: Forecast of the final cost of the work element/package (c + d)
(f) Variance: Comparison of the Estimate at Completion to the Baseline Budget (a - e): positive variance indicate forecast project costs better than budget; negative variances are forecast to be worse than budget and indicate to the project manager where action needs to be taken to address forecast adverse project cost performance.

You should include formal cost reviews at the following project milestones and major events:

- Construction package design reviews (conceptual, 30 percent, 60 percent, 90 percent, and 100 percent)
- Construction contract award
- Major contract changes.

Each construction package design review should include an updated estimate of the package's capital cost. The review process should include a consideration of the capital cost in relationship to the baseline budget and the technical scope. Any adverse variances should be addressed and the level of design contingency assessed based on the level of confidence of the estimate. Following award of the construction contract the costs should be examined to take account of differences between the contract amount and the 100 percent design estimate and the level of contingency necessary to cover for risks during construction that remain with the Agency and could result in contract changes. Where major contract changes have occurred, are pending, or forecast, the expected final contract cost should be updated. At each of these types of review, management action should be taken to address adverse cost trends so that the final cost of the project can be maintained within the cost baseline.

You should have in place cost control procedures to provide for transfers in budget between WBS elements as the project evolves so that, for example, cost savings in one area can be used to offset overruns elsewhere, or scope is transferred along with budget from one area of the project to another. The procedures should provide for the appropriate levels of management approval to transfer budget and the maintenance of an audit trail of budget transfers so the current budget can be tied back to the original baseline.

Unforeseen events may result in the need to make hard trade-off decisions between scope, budget, and schedule. For example a part of the project's scope may have to be reduced in order to keep costs within budget following an unforeseen change that exceeds the outstanding contingency. Alternatively, an increase in the project's final cost may be agreed to in order to keep the project on schedule following delays in progress due to unforeseen construction conditions. Project procedures should require that significant changes in scope, schedule, or budget from the baseline receive the approval of the project's sponsors, which in our example maintenance facility project would be the Agency's board.

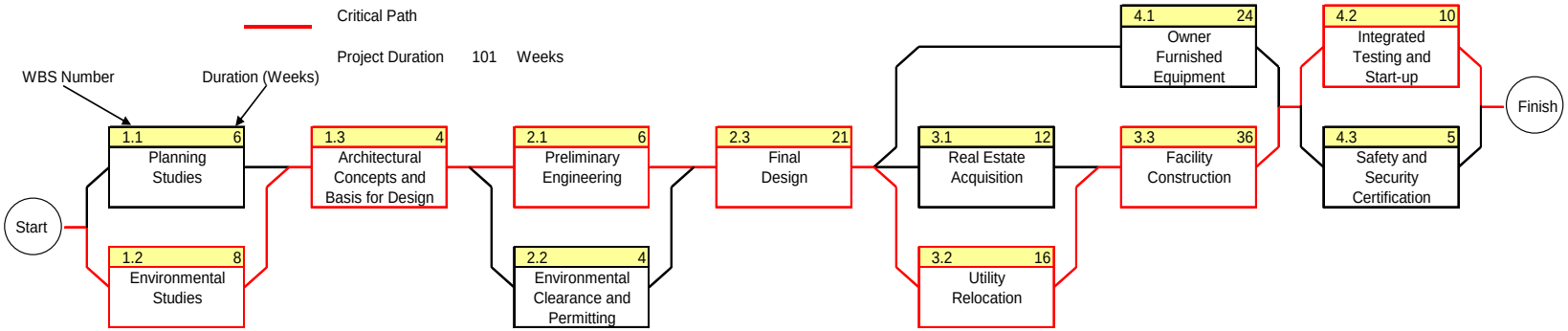
Good cost control also requires regular reporting of project costs on a monthly basis. Cost reports, see Figure 9-3, should present the baseline budget compared to contract commitment, incurred costs, approved and pending changes, forecast cost trends, estimated costs at completion, and variance between the cost at completion and budget. You should use the WBS as the means to prepare reports at various levels of summary and detail.

Schedule Control

The WBS is again the starting point for schedule control. Work activities are identified for each of the WBS work package elements and form the building blocks of the project schedule. For relatively simple projects you can represent the activities using a bar chart schedule and the time from the beginning of the first bar (start) and the end of the last bar (finish) is the duration of the project. More complex projects, such as our example maintenance facility project require a critical path method (CPM) schedule.

To develop a CPM schedule the activities are arranged into a precedence diagram network that shows the logical start and finish relationships between each activity along with the estimated duration of each activity. The logic of the precedence diagram and activity durations is then input into a CPM software scheduling program that calculates the project's critical path. The critical path is the path through the network that has the longest duration and therefore determines the duration of the project. The sums of the durations along all other paths through the network are shorter than the critical path. Figure 9-4 shows a simplified precedence and critical path for the maintenance facility project.

Figure 9-4 – Precedence Diagram and Critical Path, Maintenance Facility Project



The critical path is important because it focuses management's attention on the activities that contribute to the longest path through the schedule. If the critical activities are completed on time then the project will finish on schedule. In practice it is prudent to focus schedule control on critical and near critical activities on other paths. A near critical activity is identified by the size of its float. The float is the number of days the activity can be delayed before it becomes critical. Activities with little float are near critical (and by definition activities on the critical path have zero float).

As with the scope and cost baseline, the schedule baseline should be developed at the close of conceptual design/preliminary engineering. As the project progresses through final design and construction the schedule performance is monitored, the outstanding durations of incomplete activities estimated, the critical path updated and compared to baseline. You should then take management action to address schedule slippages of critical and near critical activities.

When changes to the project occur it is important to assess their impact on the schedule along with their scope and cost impact. If a change results in a delay to a contractor, where the change is not due to the contractor's own non-performance, then in addition to compensating the contractor for the cost impact of the change, the contractor should also be allowed the additional time to complete the work brought about by the delay. Consequently, it is important that you understand and manage the schedule relationships between contractors in addition to overseeing the schedule performance of each specific contract.

9.2 PROJECT ADMINISTRATION

Project Accounting

The Agency's accounting department performs accounting functions for the project including:

- Developing the fiscal year budgets for the project
- Recording and reporting expenditures in the Agency's accounts
- Review and payment of contractor invoices
- Management of project cash flow.

The total project budget typically spans multiple project years. Agency accounting works with project staff to develop the fiscal year budgets as part of the Agency's annual budget. In addition to being by fiscal year, the accounting project budget is broken down by the Agency's chart of accounts as opposed to the WBS breakdown used for project control. For these reasons an Agency that relies only on accounting information to manage project costs (that is fiscal year and chart of account based) and does not create a project cost control system (that is project-to-date and WBS based) finds that cost data appropriate for accounting controls is not helpful from a project cost management point of view.

Similarly, accounting records project expenditures by the Agency's chart of accounts and report the results against the fiscal year budgets. In setting up procedures to process project transactions you should give careful consideration to ensuring that costs are coded by both their WBS and accounting codes so that they can be processed through both the cost control and accounting systems.

The project team is responsible for reviewing consultant and contractor invoices to confirm that the services or work invoiced has been acceptably completed. Accounting's role is to review the invoices to confirm that they are computed accurately, that the charges billed are contractually eligible, and that the charge rates and/or prices are consistent with the contract terms. Following review, accounting is responsible for paying the invoice having made adjustments for retainage and any disallowed charges.

Accounting, through its treasury function, manages the cash flow for the project. Accounting works with the project team to project both the near and long term cash flow requirements for the project so that funds are made available for project expenditures without tying up the Agency's cash. Accounting invests funds raised for the project that are not immediately required in a mix of short and long term investments based on the cash flow projections.

Important to Know

- Project accounting reports project expenditures in compliance with generally accepted accounting practice, administers the project's accounts payables, and manages the project cash flow.
- Grants management applies for project funding from federal, state, and local agencies, draws down funds to meet project expenditures, and reports project status to funding agencies.
- Administrative support provides for the project office facilities and clerical and administrative staff.

Grant Management

Grant management involves:

- Application for grant funding from the FTA and/or state and local funding agencies
- Reporting of project progress
- Drawing down and management of grant funds during project implementation.

An Agency submits grant applications to the FTA through its Transportation Electronic Award and Management (TEAM) system. The grantee's primary point of contact with the FTA during the grant application process is the FTA community planner. The FTA regional engineer is available to provide active monitoring and technical assistance through the application process.

Once a grant has been approved the regional engineer will monitor project milestones and progress reports that the grantee submits through the TEAM system. After a grant has been awarded the Agency will draw down funds for reimbursement of project expenses using the FTA Electronic Clearing House Operation (ECHO) system.

FTA Circular C 5010 1.C Grant Management Guidelines provides detailed guidance on FTA's grant management requirements.

Administrative Support

Administrative support involves providing the project office facilities and clerical/administrative staff. Wherever possible a project team works most effectively when the team members, including both Agency staff and their consultants, can be co-located in the same project office. Large projects can justify the cost of setting up a special project office for this purpose. An effective compromise for mid size and smaller projects, such as our example maintenance facility project, is to set aside workspace in the Agency's office and require the project's principal consultants to use this space when working on the project.

As the demands of a project change as the project moves through its phases, it is desirable to select administrative support staff who thrive on variety and are flexible to take on a range of administrative tasks where the workloads can vary from day to day.

9.3 PROCUREMENT AND CONTRACT ADMINISTRATION

The methods of solicitation and selection allowed within the federal contractual sphere are listed in § 9 of FTA Circular 4220.1E. You may choose:

- Micro-purchases only for contract amounts less than $2,500.
- Small purchase procedures only for contract amounts less than the simplified acquisition threshold (currently $100,000).
- Sealed bids where
  - You have a complete, adequate, and realistic specification or purchase description.
  - Two or more responsible bidders are willing and able to compete.
  - The procurement lends itself to a firm fixed price contract and the selection can be made primarily on the basis of price.
  - No discussion with bidders is needed after receipt of offers.
- Competitive proposals.
- Noncompetitive proposals (sole source) procurement only if you can justify not soliciting additional competition in the manner explicitly defined in FTA Circular 4420.1E § 9.h.

State law usually restricts the method of procurement more tightly than these federal requirements.

Professional Services

Contract Types

To contract for professional services, you have two main methods:

a. Procurement by Competitive Proposal/Request for Proposals (RFP). The competitive proposal method of procurement is normally conducted with more than one offerer (e.g., design consultant, design manager). This method of procurement is generally used when conditions are not appropriate for the use of sealed bids.

b. Procurement of Architectural and Engineering Services (A&E). When contracting for A&E services, you will need to use competitive proposal procedures based on the Brooks Act as defined in 40 U.S.C. Section 541. Other types of services considered A&E services include program management, construction management, feasibility studies, preliminary engineering, design, surveying, mapping, and services which require performance by a registered or licensed architect or engineer. This "qualifications based procurement method" can only be used for the procurement of A&E services. These requirements apply except to the extent any state adopts or has adopted by statute a formal procedure for the procurement of A&E services. The Brooks Act requires a *qualifications based procurement method* for the selection of A&E firms. Price is excluded as an evaluation factor, and negotiations are conducted with the most qualified firm only.

For further details regarding each selection method, you should refer to FTA Circular 4220.1E, Section 9, Procurement Methods.

Contract Provisions

When procuring for professional services, you will need to coordinate with your Agency's contracting officer. When developing the contract provisions you and the contracting officer should review the 54 mandatory procurement standards listed in Appendix B.19 of FTA Circular 4220.1E and determine the provisions that apply to the particular procurement. In addition, to receive federal funds, you will need to determine which of the 31 federal statutes and regulations presented in Appendix A.1 of the FTA Best Practices Procurement Manual (BPPM) applies to the project. Finally, you will also need to make sure your Agency's required terms and conditions (clauses, etc.) are included in the advertisement. This will allow the A&E firm to address these terms and conditions as part of the proposal. Any exceptions taken by the A&E firm to terms and conditions should be included in the price proposal only, as this recognizes that contract terms involve risk allocation and therefore cost.

Procurement Process

The procurement process for professional services is a multi-step process. The following are the key steps that occur in the process. For additional information, refer to Chapter 6.5 of the BPPM.

- Name selection committee with specific expertise needed for performing the contract.
- Announce project in accordance with state law. The announcement should describe the project's requirements, criteria to be used in the evaluation, and when and in what form the qualification statements are to be submitted.
- Determine short-list of qualified firms based on the submitted qualification statements. The short-list should be appropriate in size for adequate competition and should consist of those firms that have a reasonable chance of getting the award. You should check your state laws to determine if a minimum number of firms are required to be short-listed.
- Request technical proposals. If you determine to require detailed technical proposals after the short-list has been determined, you will need to establish the evaluation criteria to be used in selecting the successful contractor and to advise the firms of the criteria in your RFP. Criteria would normally involve past performance, technical criteria, and key personnel.
- Evaluate the technical proposals. The selection committee will review the submitted technical proposals within the criteria that were set forth in the RFP.
- Oral presentations by A&E firms. If the selection committee feels that oral presentations are needed, they should be scheduled with the short-listed firms. It is important that the actual project managers are being proposed by the short-listed firms assigned to the project.
- Final rank of firms. After the technical evaluation and oral presentations (if held), the selection committee will finalize the ranking of the firms.
- Once an agreement is reached on the highest qualified firm, that firm is then requested to submit a cost proposal for negotiation of a contract.
- Contract Negotiations - The Brooks Act requires a *qualifications based procurement method* for the selection of A&E firms. Price is excluded as an evaluation factor, and negotiations are conducted with the most qualified firm only.

Construction Contracts

The traditional approach has been to have a detailed design completed for the entire project prior to soliciting bids from construction contractors. This is known as design/bid/build (D/B/B). This D/B/B approach requires that a detailed design package of the entire project be complete before bids are solicited from construction contractors. For the procurement of contractors, the most common method of procurement is Procurement by Sealed Bids/Invitation for Bid. Bids are publicly solicited and a firm-fixed-price contract (lump sum or unit

price) is awarded to the responsible bidder whose bid, conforming to all the material terms and conditions of the bids, is the lowest in price. These services must be procured in a manner that conforms to applicable state and local law, the requirements of FTA Circular 4220.1E relative to the method of procurement used, and all other applicable federal requirements.

Contract Provisions

Construction contracts require certain provisions which are unique to that activity. These provisions are discussed in detail Chapter 6 of the BPPM. Following is a summary of the special provisions and the BPPM sections where they are discussed.

- **Labor** – The three wage and hour laws governing federally assisted construction are the Davis-Bacon Act, the Contract Work-Hours and Safety Standards Act, and the Copeland Anti-Kickback Act.
- **Bonding** – Construction contracts require contractors to furnish three types of bonds-bid bonds, payment bonds, and performance bonds.
- **Liquidated damages** – Section 8.2.3 *Liquidated Damages* contains guidance on the use of liquidated damages clauses.
- **Differing Site Conditions** – Section 9.2.3.1 contains guidance on administering the *Differing Site Conditions* clause.
- **Specifications for Construction** – Section 3.4 *Specifications for Construction* discusses requirements within FTA Circular 4220.1E and the Master Agreement which may affect your construction specifications.
- **Insurance** – Section 6.6 *Insurance* discusses an approach to insuring construction project contractors known as *Owner Controlled Insurance Programs,* which has proven to be an effective method of insuring the contractor teams involved in construction projects.
- **Warranties** – Obtaining acceptable warranty documents in a timely manner from contractors has been historically difficult. No contractual incentive has existed to motivate contractors to supply the required warranties. Grantees may wish to consider making the submission of an acceptable warranty form a condition of product or system acceptance in order to motivate contractors to furnish the required form. Grantees might also include the warranty forms as a fixed-price line item in the contract for payment purposes, thus giving the contractors a strong motivation to supply the required forms.
- **Contract Closeout** – Closeout of construction contracts will require certain documentation unique to these contracts, such as lien waivers, as-built drawings, etc. These requirements are discussed in Chapter 10, *Closeout*.

When developing the contract provisions for sealed bid procurement, you along with the Agency's contracting officer should review the 54 mandatory procurement standards listed in Appendix B.19 of FTA Circular 4220.1E and determine the provisions that apply to the particular procurement. In addition, to receive federal funds, you will need to determine which of the 31 federal statutes and regulations presented in Appendix A.1 of the FTA BPPM applies to the sealed bid document.

Procurement Process

The procurement process for construction is a multi-step process. The following are the key steps that occur in the process. For additional information, refer to Chapter 6.5 of the BPPM.

- Prepare Notice – Describe the project's requirements completely, clearly, accurately, and unambiguously. The notice must also include all documents (whether actually attached or incorporated by reference) furnished to all prospective bidders for the purpose of bidding.
- Publicize Notice – The notice must be publicly advertised and distributed to prospective bidders. The amount of time after publication and distribution of the notice to prepare and submit their bids and prior to the time and date set for opening of bids is important.

- Submission of bids – Sealed bids are submitted to you by bidders by the time and place stated in the invitation. Bids are publicly opened at the time and place described in the invitation.
- Contract Award – A fixed price contract will be awarded to the responsible bidder whose bid, conforming to the terms and conditions of the notice is the lowest in price.

Equipment and Supplies

Contract Types
For the procurement of equipment, you will need to perform a lease versus purchase analysis to determine the most economical approach. The analysis should be appropriate to the size and complexity of the procurement. While it is usually more economical to purchase equipment than to lease it, this is not always true, however, especially when highly complex equipment is involved and there are issues of maintaining the equipment or having trained personnel who are competent to operate the equipment. The factors that must be considered when performing a lease versus purchase analysis are discussed in detail in Chapter 6.2 of the BPPM.

Contract Provisions
When developing procurements for equipment and supplies, you along with the contracting officer must be aware of local or state labor laws, as well as federal laws if construction is involved (e.g., Davis-Bacon Act), when developing the solicitation document and contract. In addition, the contract officer should carefully coordinate the insurance provisions with their insurance department or legal specialists. Requirements might include coverage for commercial general liability, auto vehicle insurance, workers compensation, and perhaps, a special railway protective policy. The Agency's insurance specialists should determine specific coverage requirements and amounts.

Third Party (Utility) Agreements

The development of a project typically requires you to perform coordination with utility companies regarding the relocation of utilities and associated reimbursement to the utility. Utilities are defined in 23 CFR, Part 645, Subpart B, Section 645.207 as a "privately, publicly, or cooperatively owned line, facility, or system for producing, transmitting, or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, stormwater not connected with highway drainage, or any other similar commodity, including any fire or police signal system or street lighting system, which directly or indirectly serves the public."

Once the preliminary initial utility alignments have been identified, you should initiate discussions with the utility regarding the development of the utility agreement. The scope of the utility relocation must be determined as well as the responsibility for costs of the relocation. As part of this discussion, determine:

- The utility's policy for relocating its own utilities or if it wants the relocation performed under the relocation activities of the project.
- Who is responsible for the relocation costs. Only actual allowable, allocable, and reasonable costs are reimbursable. If costs are to be covered by the Agency, determine what these costs are up front, and begin negotiations. The costs of the relocation are not always borne by the Agency. Cost sharing must always be considered as a feasible alternative.
- If a utility elects to improve, change, rearrange, or otherwise enhance its facilities beyond that which currently exists, you should obtain separate estimates to identify the cost difference between the improved adjustment and the adjustment that is comparable to the existing facility.

The ideal situation is to have signed agreements and all utilities relocated prior to the general contractor receiving a notice-to-proceed on the main project. If this is not possible, all affected utility facilities need to be shown in the project documents and relocation will be made concurrent with the construction activities. Coordinating the availability of the project site with the project's general contractor and the utility will be very important. Once the utility agreement is in place, you will need to oversee or perform the following as part of administering the utility agreement:

- Conduct a utility pre-construction meeting.
- Monitor the relocation work.
- Provide oversight of progress. Any slip in the schedule of the utility relocation will have an effect on main construction project's schedule.
- Inspect the utility relocations to ensure that all work is performed according to the Agency's expectations.

DBE Requirements

Any third party contract that you award, funded in whole or in part with Federal Department of Transportation (DOT) funds, is subject to the DBE regulations in 49 CFR Part 26. It does not matter whether the federal funds are for planning, capital, or operating assistance, the DBE rules apply. This does not mean, however, that every procurement or contract must be reviewed for DBE participation. The rules give you the flexibility regarding how and when they establish individual contract goals. Certain types of procurements (e.g., off-the-shelf commodities) may not have subcontracting opportunities or be appropriate for DBE goal setting.

While the U.S. DOT has a national goal of 10 percent, this goal does not apply to individual Agencies or their contractors. Therefore, Agencies are not required to set their overall or contract goals at 10 percent or any other particular level. Agencies are to set goals based on what will achieve a level playing field for DBEs in their own programs, without regard to the national DOT goal.

It should also be noted that a contract that is funded entirely with local funds, without any federal funds, is not subject to the DBE requirements under this rule.

Important to Know

- A Disadvantaged Business Enterprise or DBE means a for-profit small business concern that is at least 51 percent owned by one or more individuals who are both socially and economically disadvantaged, or, in the case of a corporation, 51 percent of the stock of which is owned by one or more such individuals; and whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it.

9.4 PROJECT COMMUNICATIONS

In accordance to the Project Management Plan, the project manager or delegated personnel should prepare a communication plan for the project that addresses the following:

Important to Know

- Most transit projects impact the community and therefore need informing.
- Every media contact is an opportunity to communicate your "project message".
- Good communications with government stakeholders means "no surprises".
- Regular project team communications maintain morale.

Community Relations

Most transit-related projects have an impact on the community. The project manager should inform the general public, business groups, and civic associations as to the goals, facts, and progress of the project. The Agency through the project manager should encourage community input and comments during the project design and adhere to any local, state, or federal comment period regulations that apply to the project.

You should pay special attention to making certain that the residents, businesses, and general public in the vicinity of project construction are kept informed of the status of construction and its possible impact on the community. To assist in this effort on larger projects it is beneficial to open a local store front office conveniently accessible to the community, hold community meetings, and visit local schools.

Public Agencies have the policy and obligation to ensure that DBEs have the opportunity to compete for contracts and perform work on Agency projects. The project manager should communicate with the DBE community to make certain that they are informed on project contracting opportunities. You should refer to Agency records of DBE firms interested in performing project work as subcontractors and make this available to principal professional service and contracting firms competing for project contracts.

Media Communications

Project managers should be accessible and responsive to media requests for information and comment. However, communication with the media needs to be coordinated by and channeled through the Agency's media communications personnel. The project manager should make certain that project staff, consultants, and contractors do not contact or respond to the media unless requested to do so by the Agency's communications personnel. Contacts by the media to project personnel, consultants, or contractors should be immediately referred to the Agency communications personnel.

All contacts with the media should be viewed as opportunities to get the Agency's message out on the status of the project through briefings and press releases covering project facts, events, and progress of interest to the media. Special events are a particularly good time for messages to the media, e.g., ceremonies to mark groundbreaking, significant project achievements, dedication ceremonies upon the completion of project facilities, tours of the project, and local community events.

Government Relations

The most important principle the project manager needs to remember with respect to government relations is "no surprises". Whatever developments take place on the project, good or bad, it is critical that you make certain that the government stakeholders are kept informed and do not learn of events from other sources, particularly the media. You should make full use of your Agency's government relations staff to

help you keep government stakeholders fully informed. To do this you need to keep the government relations staff informed on project issues and status, and give priority to responding to requests from government relations staff on project issues.

Project Team Communications

Internal project team communications are essential to project team building and maintaining effective ongoing working relationships. The project manager should hold regular general team meetings to discuss the project status as well as focused technical meetings on design, construction, and project control issues. Although it is unreasonable for everyone to be kept informed about everything, you should take care to avoid unnecessarily limiting access to project information amongst the team as this can create mistrust and distracting speculation.

9.5 RECORDS MANAGEMENT

Document Control

Document control supports the configuration management of scope control discussed earlier. Document control makes certain that project design and baseline documentation, including contract drawings, specifications, budget, and schedule, are maintained and revised throughout the design, bid, procurement, construction, and closeout phases of the project with the required standard of security, integrity, quality, and currency. Document control tracks actions to ensure that changes to the baseline documents are evaluated and approved and that the integrity of the baseline documentation is maintained as changes are executed.

The project manager should make certain that the project's document control process identifies who on the project management team has the authority and accountability for ensuring that each of the baseline documents is kept current in compliance with the project's configuration management and document control procedures. Figure 9-5 shows the types of baseline documents for a typical engineering/construction project such as our example maintenance facility project.

Important to Know

- Document control is needed to support scope control (configuration management).
- Records management provides for the distribution, storage, and retrieval of hard copy and electronic records.

Figure 9-5 – Typical Baseline Documents

Function	Document
Management and Control	Project Management Plan Project Budget Project Master Schedule Project Financial Plan (Funding & Cash Flow) Project Policies and Procedures
Quality	Quality Assurance/Quality Control Program Plan
Safety and Security	Management Plan
Design	Functional Analysis Design Standards and Criteria Technical Reports Contract Unit Descriptions
Contracts	Instructions to Bidders and Bid Forms Master Contract General Conditions Contract Drawings Contract Specifications Contract Terms and Conditions
Construction	Resident Engineer's Manual
Operations and Maintenance	Facility Operating Plan Project Management Plan
Communications	Community Awareness Plan
Administration	Project Status Reporting Configuration and Records Management Plan

Records Distribution, Storage, and Retrieval

Records management controls the distribution, storage, and retrieval of project records in both hard copy and electronic form.

The project manager should ensure that incoming and outgoing correspondence and documents are transmitted through the project's records management specialist, who can use records database software to computer index the records. Working copies of records can be retrieved by records management for use by project staff. Records management should securely store original copies and ultimately dispose of the records according to the Agency's and the project's records retention schedule.

The project manager should not allow project staff to keep their own files of original project documents or correspondence. Records management should maintain the project's active and historical records and files in order to provide efficient access and complete audit trails of the current status and record of revisions to the project design and baseline documentation and associated correspondence.

Records management's correspondence control system should provide convenient access to records and make certain the records are secure and the appropriate level of confidentiality maintained. The system should be set up to comply with the Agency's administrative, legal, and historical record requirements and provide an audit trail and documentation of project activities.

Records management can also be used to establish an accessible project library of technical documents, standards, baseline documents, industry codes and standards, studies, and other general information pertaining to the project.

Records management should develop a records storage program that identifies and protects project documentation critical to project completion and the ongoing operation of the completed project. The vital records storage program needs a procedure for archiving critical documents and their disaster protection.

HANDBOOK REFERENCES

Where to Find Additional Help and Resources

FTA Office Locations:

FTA Headquarters
Federal Transit Administration
400 7th Street, SW
Washington, DC 20590
Office of Communications and
Congressional Affairs (202) 366-4043
Fax: (202) 366-3472

REGION 1
Transportation Systems Center
Kendall Square
55 Broadway, Suite 920
Cambridge, MA 02142-1093
Telephone: (617) 494-2055
Fax: (617) 494-2865
Areas served: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut

REGION 2
One Bowling Green
Room 429
New York, NY 10004-1415
Telephone: (212) 668-2170
Fax: (212) 668-2136
Areas served: New York, New Jersey, and U.S. Virgin Islands

REGION 3
1760 Market Street
Suite 500
Philadelphia, PA 19103-4124
Telephone: (215) 656-7100
Fax: (215) 656-7260
Areas served: Pennsylvania, Virginia, West Virginia, Delaware, Maryland, and District of Columbia

REGION 4
Atlanta Federal Center
Suite 17T50
61 Forsyth Street, SW
Atlanta, GA 30303
Telephone: (404) 562-3500
Fax: (404) 562-3505
Areas served: North Carolina, Kentucky, Tennessee, South Carolina, Alabama, Georgia, Florida, Mississippi, and Puerto Rico

REGION 5
200 West Adams Street
Suite 2410
Chicago, IL 60606
Telephone: (312) 353-2789
Fax: (312) 886-0351
Areas served: Illinois, Ohio, Minnesota, Wisconsin, Indiana, and Michigan

REGION 6
819 Taylor Street
Room 8A36
Fort Worth, TX 76102
Telephone: (817) 978-0550
Fax: (817) 978-0575
Areas served: Texas, Oklahoma, Arkansas, Louisiana, and New Mexico

REGION 7
901 Locust Street
Suite 404
Kansas City, MO 64106
Telephone: (816) 329-3920
Fax: (816) 329-3921
Areas served: Iowa, Kansas, Nebraska, and Missouri

REGION 8
12300 West Dakota Ave., Suite 310
Lakewood, CO 80228-2583
Telephone: (720) 963-3300
Fax: (720) 963-3333
Areas served: Colorado, Utah, Montana, Wyoming, South Dakota, and North Dakota

REGION 9
201 Mission Street, Room 2210
San Francisco, CA 94105-1926
Telephone: (415) 744-3133
Fax: (415) 744-2726
Areas served: California, Arizona, Nevada, Hawaii, Guam, American Samoa, and the Northern Mariana Islands

REGION 10
Jackson Federal Building
915 Second Avenue, Suite 3142
Seattle, WA 98174-1002
Telephone: (206) 220-7954
Fax: (206) 220-7959
Areas served: Washington, Oregon, Idaho, and Alaska

Metropolitan Offices/Lower Manhattan Recovery Office

New York Metropolitan Office
One Bowling Green, Room 428
New York, NY 10004-1415
Telephone: (212) 668-2201
Fax: (212) 668-2136
Area served: New York Metropolitan Area

Lower Manhattan Recovery Office
One Bowling Green, Room 436
New York, NY 10004-1415
Telephone: (212) 668-1770
Fax: (212) 668-2505
Area served: Lower Manhattan Recovery Area

Philadelphia Metropolitan Office
1760 Market Street, Suite 510
Philadelphia, PA 19103-4124
Telephone: (215) 656-7070
Fax: (215) 656-7269
Area served: Philadelphia Metropolitan Area

Chicago Metropolitan Office
200 West Adams Street
Suite 2410 (24th floor)
Chicago, IL 60606
Telephone: (312) 886-1616
Fax: (312) 886-0351
Area served: Chicago Metropolitan Area

Los Angeles Metropolitan Office
888 S. Figueroa, Suite 1850
Los Angeles, CA 90012
Telephone: (213) 202-3950
Fax: (213) 202-3961
Area served: Los Angeles Metropolitan Area

Washington, D.C. Metropolitan Office
1990 K Street, NW
Suite 510
Washington, DC 20006
Telephone: (202) 219-3562/219-3565
Fax: (202) 219-3545
Area served: Washington, D.C. Metropolitan Area

CHAPTER 1

Federal Transit Administration: www.fta.dot.gov
National Transit Institute: www.ntionline.com
American Public Transportation Association: www.apta.com
Transportation Research Board: www.trb.org
International Association of Public Transport: www.uitp.com

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HEADQUARTERS
Federal Transit Administration
400 7th Street, SW
Washington, DC 20590
Office of Communications and
Congressional Affairs
Telephone: (202) 366-4043
Fax: (202) 366-3472

REGION I
Transportation Systems Center
Kendall Square
55 Broadway, Suite 920
Cambridge, MA 02142-1093
Telephone: (617) 494-2055
Fax: (617) 494-2865

REGION II
One Bowling Green
Room 429
New York, NY 10004-1415
Telephone: (212) 668-2170
Fax: (212) 668-2136

REGION III
1760 Market Street
Suite 500
Philadelphia, PA 19103-4124
Telephone: (215) 656-7100
Fax: (215) 656-7260

REGION IV
Atlanta Federal Center
Suite 17T50
61 Forsyth Street, SW
Atlanta, GA 30303
Telephone: (404) 562-3500
Fax: (404) 562-3505

REGION V
200 West Adams Street
Suite 320
Chicago, IL 60606
Telephone: (312) 353-2789
Fax: (312) 886-0351

REGION VI
819 Taylor Street
Room 8A36
Fort Worth, TX 76102
Telephone: (817) 978-0550
Fax: (817) 978-0575

REGION VII
901 Locust Street
Suite 404
Kansas City, MO 64106
Telephone: (816) 329-3920
Fax: (816) 329-3921

REGION VIII
12300 West Dakota Avenue
Suite 310
Lakewood, CO 80228-2583
Telephone: (720) 963-3300
Fax: (720) 963-3333

REGION IX
201 Mission Street
Room 2210
San Francisco, CA 94105-1839
Telephone: (415) 744-3133
Fax: (415) 744-2726

REGION X
Jackson Federal Building
915 Second Avenue
Suite 3142
Seattle, WA 98174-1002
Telephone: (206) 220-7954
Fax: (206) 220-7959

New York Metropolitan Office
One Bowling Green
Room 428
New York, NY 10004-1415
Telephone: (212) 668-2201
Fax: (212) 668-2136

Lower Manhattan Recovery Office
One Bowling Green
Room 436
New York, NY 10004-1415
Telephone: (212) 668-1770
Fax: (212) 668-2505

Philadelphia Metropolitan Office
1760 Market Street
Suite 510
Philadelphia, PA 19103-4124
Telephone: (215) 656-7070
Fax: (215) 656-7269

Chicago Metropolitan Office
200 West Adams Street
Suite 2410 (24th floor)
Chicago, IL 60606
Telephone: (312) 886-1616
Fax: (312) 886-0351

Los Angeles Metropolitan Office
888 S. Figueroa
Suite 1850
Los Angeles, CA 90012
Telephone: (213) 202-3950
Fax: (213) 202-3961

Washington, DC Metropolitan Office
1990 K Street, NW
Suite 510
Washington, DC 20006
Telephone: (202) 219-3562/219-3565
Fax: (202) 219-3545