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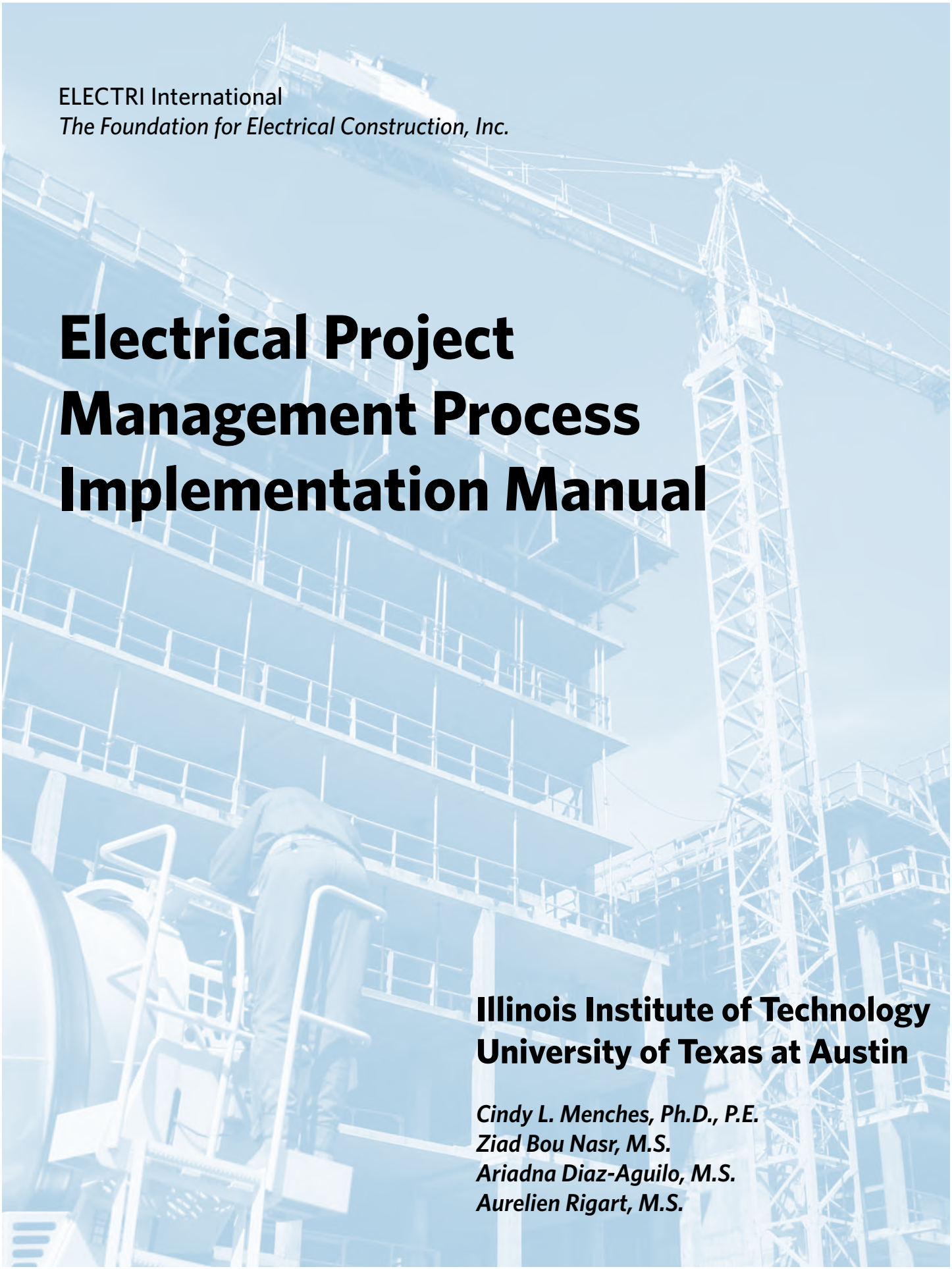
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Electrical Project Management Process Implementation Manual

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Executive Summary

In 2007, ELECTRI International – The Foundation for Electrical Construction, the research arm of the National Electrical Contractors Association (NECA), funded a research project to develop a model electrical project management process that could be used by NECA members to improve their management practices. The study critically evaluated the relationship between project management and project performance. As part of the research process, in-depth project-specific information was collected on the management effort and project outcome for several "successful" and "less-than-successful" projects. This data collection effort culminated in a detailed analysis of the project management practices of these two groups to identify clear differences between "successful" and "less-than-successful" projects. Ultimately, 25 randomly-selected companies from 12 states agreed to participate in an interview for the research project. Data was collected on 50 "successful" and "less-than-successful" projects.

The management activities that were performed on the successful projects were used to develop the model Electrical Project Management Process. The model process was fashioned after those projects that performed *good management* and achieved a *successful outcome*. As such, the model management process incorporated the best management practices in the electrical construction industry. The management processes of the successful and less-than-successful projects were compared to the model process, and, ultimately, it was discovered that those projects that implemented processes that more closely matched the model resulted in more successful performance.

Project Management Effectiveness and Outcomes

The results of the study revealed that projects that received more effective project management were also more likely to achieve successful outcomes. "Success" was defined by electrical construction contractors as:

1. The project was profitable
2. The customer was satisfied
3. The project resulted in repeat business
4. The project resulted in good working relationships between the electrical contractor, the general contractor, and the owner
5. The worksite was safe and there were no accidents
6. The project was completed on time
7. The workers took pride in the completed project

8. There was good communication and cooperation between the electrical contractor, the general contractor, and the owner
9. The quality of the work was excellent
10. The project achieved its budget goal

By examining several well-managed projects, 81 activities that occurred during the project management stage were identified. These 81 activities were further divided into fourteen categories of project management activities, including: (1) mobilization, (2) coordination, (3) documentation management, (4) communication, (5) scheduling, (6) scope & change control, (7) cost control & billing, (8) subcontractor management, (9) materials management, (10) tools management, (11) labor management, (12) safety management, (13) quality control, and (14) project closeout.

Practical Application

The research resulted in the creation of the model electrical project management process that is designed to complement the model electrical pre-construction planning process. Both processes were modeled after several of the most successful electrical construction projects in the industry. Contractors should implement both processes so that during pre-construction planning, the systems are set up to manage the project once it has been executed. After execution, the model electrical project management process serves as a constant reminder of the tasks that need to be performed to increase the likelihood of achieving a successful project outcome. A significant number of checklists and examples have been provided in this implementation guide so that users can refer to the checklists frequently to ensure all tasks are being completed.

A list of factors that impacted the success and relative lack of success on several projects has been provided to serve as a reminder of the other influences that can be a benefit or barrier to successful project performance. Hence, in addition to implementing standardized planning and management processes, contractors should become aware of other factors that can positively or negatively influence performance.

1. Introduction

Electrical construction contractors continue to be faced with the challenge of improving productivity in order to remain successful in an increasingly competitive industry. As a result, many contractors are searching for new ways to increase their productivity and decrease their costs in order to gain or maintain market share.

While there may not be a single measure of productivity, it is generally acknowledged that increased project and company efficiency are key components of enhanced profitability. Indeed, the competitive nature of the construction industry has motivated many contractors to search for ways to improve efficiency by increasing their quality and decreasing their costs in order to strengthen their market share. As a result, contractors are turning to "better planning" and "better project management" as a method for improving their efficiency and, consequently, increasing their profitability. In fact, a consensus exists in the construction industry that more formalized pre-construction planning and project management is necessary to remain successful in an increasingly competitive industry.

1.1 How the Project Management Process was Developed

In 2003, The Foundation for Electrical Construction (ELECTRI International), the research arm of the National Electrical Contractors Association (NECA), funded a research project to develop a model pre-construction planning process that could be used by NECA members to improve their planning practices. The study critically evaluated the relationship between pre-construction planning and project performance. In 2007, a follow-on study was conducted to develop a model project management process that would complement the model pre-construction planning process to produce a comprehensive project success strategy that pairs planning with management to achieve significantly better performance.

As part of the research process, in-depth project-specific information was collected on the planning and management effort and project outcome for several "successful" and "less-than-successful" projects. This data collection effort culminated in a detailed analysis of the planning and project management practices of these two groups to identify clear differences between "successful" and "less-than-successful" projects. Ultimately, 25 randomly-selected companies from 12 states agreed to participate in an interview for the research project. Data was collected on 50 "successful" and "less-than-successful" projects.

The management activities that were performed on the successful projects were used to develop the model Electrical Project Management Process. The model process was fashioned after those projects that performed *good management* and achieved a *successful outcome*. As such, the model management process incorporated the best management practices in the electrical construction industry.

The management processes of the successful and less-than-successful projects were compared to the model process, and, ultimately, it was discovered that those projects that implemented management processes that more closely matched the model resulted in more successful performance (see Figure 3.2 at the end of Chapter 3).

1.2 Purpose of this Implementation Manual

This implementation manual presents the Electrical Project Management Process and provides guidance on:

- *which* management activities have been effective at improving project performance
- *who* should be involved at each stage of project management
- *how* to successfully implement a project management process
- *what are* the expected benefits of proper project management
- *how* can project planning and project management be aligned to achieved overall better performance

The Electrical Project Management Process along with the Electrical Pre-Construction Process can, and should, be used on all projects regardless of size or type of construction. However, both processes should be tailored to the unique characteristics of each project, including complexity, duration, and sheer volume of work.

2. User's Guide to the Implementation Manual

The purpose of this implementation manual is to present the Electrical Project Management Process and its associated management activities. The process is presented in a graphical flow-chart format to illustrate the interrelationship between management activities.

The process organizes 81 project management activities into a framework that represent key management stages, such as documentation management, scheduling, and safety management, to name a few. Each management stage will be presented and discussed in this manual, and each activity will have a set of implementation guidelines to assist with performing the activity. The process can be implemented fully or partially to accommodate each company's unique project planning situation.

2.1 How to Use the Project Management Process

The Electrical Project Management Process targets three primary audiences:

1. Companies that do not currently have a formal project management process and who want to adopt the model process
2. Companies that have a semiformal project management process and who want to modify their process to be aligned with the model process
3. Companies that already have a formal project management process and who want to verify and adjust their process based on the information provided in this manual

The project management process is presented in a flow chart that identifies an *approximate* sequence of activities. However, several activities may occur concurrently unless completion of one activity is dependent on the completion of a preceding activity. The flow chart is supported by a set of implementation guidelines and checklists that guide the Project Manager through the project management process.

2.1.1 Development of a Project Management Binder

It is strongly recommended that the Project Manager develop a Project Management Binder that will contain all of the products that will be needed for the management process. This binder can then be referenced throughout the execution processes. The binder should be divided into the fifteen categories of management, as described in Chapter 3, and nearly every category of management will have one or more products that can be added to the binder. If a Pre-Construction Planning (PCP) Binder has been developed, then many of the products from the PCP Binder can be inserted into the Project Management Binder. For example, a team member contact sheet,

written standard request for information (RFI) process, schedule of values (SOV), bar chart schedule, and numerous other items can be transferred from the planning stage to the management stage. As the Project Manager executes the work, items from planning (such as the schedule) can be updated and inserted into the binder. The plans and management products should be updated, as necessary, during the construction management process.

2.2 Other Related Documents

Other documents associated with the Electrical Project Management Process include the Electrical Pre-Construction Planning Process, which was completed as part of an earlier research project. Also, an Alignment Study (Section 3) has been developed to aid contractors in identifying the related activities in the planning and management processes and shows the relationship between planning, management and project performance whereby effective planning combined with effective project management contribute to significantly better performance.

Furthermore, a set of management "Best Practices" and reasons for successful performance were produced and are also compiled in Section 3.

2.3 Organization of the Manual

Chapter 3 presents an overview of the Electrical Project Management Process, including relevant definitions, team member involvement, and guidelines for successful implementation.

Chapter 4 identifies the project management activities. Each set of activities has associated with it a brief instruction sheet that describes the following:

- *Definition* of the activity group
- *What* activities should be performed
- *Instructions* on how to implement the activity, with relevant examples

Tools that support the management activities, including checklists, tables, charts, and forms, are also included. Chapter 5 discusses the electrical project management best practices, while Chapter 6 presents other reasons for successful and less-than-successful performance.

3. Overview of the Project Management Process

Recent research has resulted in the development of a "model" management process that has been used by some of the most successful recent projects in the electrical construction industry. In fact, those projects that used a management process similar to the "model" management process tended to perform more successfully – they achieved an average gross annual profit margin of 27% as compared to projects that were poorly managed and achieved an average loss margin of only 6%. Furthermore, projects that were *well managed* tended to perform *above average* on profitability, budget achievement, schedule achievement, and labor productivity. Section 3.4.1 presents more detailed information on the relationship between management and project performance. This chapter presents an overview of the Electrical Project Management Process, and the next chapter addresses each of the categories of the process and their associated activities.

3.1 Definition of Project Management

Project Management is the process used to manage activities that are performed to ensure a project remains on schedule, within budget, and maintains a safe work environment following execution of the work. In general, project management begins with mobilization and ends shortly after project closeout. Hence, this manual covers the management activities that are performed during the execution phase of a project.

The model electrical project management process includes 81 activities. The activities have been statistically linked to more successful project outcomes. As a result, the successful completion of these 81 management activities will help a project team to efficiently execute a construction project.

3.2 Electrical Project Management Process

Figures 3.1 presents the model electrical project management process that resulted from a detailed analysis of the management processes used on successful projects. The Project Management Process consists of fourteen categories and 81 activities. These categories of activities will be identified in the next few paragraphs and discussed in greater detail in Chapter 4.

3.3 Strategies for Successful Implementation

Provided below are several strategies for successfully implementing a standardize project management process on all electrical projects.

- Top managers must reinforce their commitment to a standardized management process and must ensure proper management is performed on *every* project.
- The model management process should be tailored to each project based on the characteristics of a project. For example, a small project might spend only five minutes on some of the activities, whereas a large project might spend several hours or days on the same activities.
- A system for tracking the success on projects that are well-managed and followed the model management process will demonstrate the benefits of implementing a standardized management process.
- In addition to implementing the model management process, consider implementing a "double-check" system, where the supervisor double checks the management that was performed by the project manager. This will ensure management standardized project management process is used consistently across the company.
- Lessons learned and a feedback loop will be an essential part of your standardized management process. Project Managers and field supervisors should share management practices that worked well or did not work well.

3.4 Expected Benefit

The results of the study sponsored by ELECTRI International revealed that projects that received more effective project management were also more likely to achieve successful outcomes. "Success" was defined by contractors as:

1. The project was profitable
2. The customer was satisfied
3. The project resulted in repeat business
4. The project resulted in good working relationships between the electrical contractor, the general contractor, and the owner
5. The worksite was safe and there were no accidents
6. The project was completed on time
7. The workers took pride in the completed project

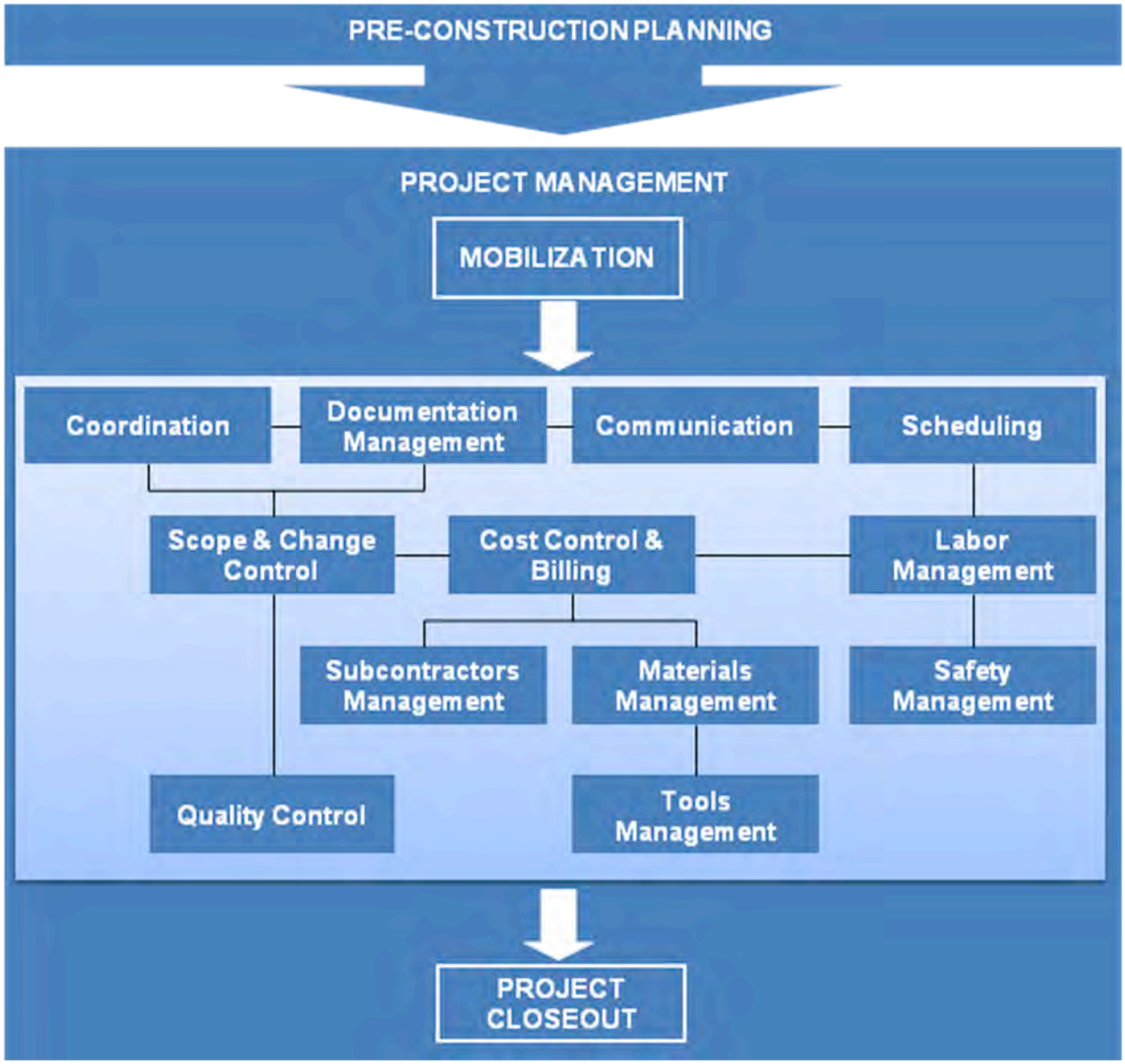


FIGURE 3.1: Overview of the Model Electrical Project Management Process

8. There was good communication and cooperation between the electrical contractor, the general contractor, and the owner
9. The quality of the work was excellent
10. The project achieved its budget goal

Consequently, projects that are managed using the project management process outlined in this technical document can expect to increase their chances of achieving a successful outcome. However, it must be noted that good management *alone* will not guarantee the success of a project. Instead:

> ***Good planning coupled with good project management that takes into account a project's specific characteristics will improve the likelihood of achieving successful project performance***.

Hence, good planning should be performed during the pre-construction stage, and good project management should be applied during the execution stage to maximize the chances of completing a project successfully.

3.4.1. Relationship Between Management and Performance

Overall, projects that implemented a management process that was similar to the model management process presented in this technical document tended to outperform those projects that were poorly managed or whose management process was significantly different from the model process. Figure 3.2 is a graph that plots the Management Match Score (where a higher score indicates more effective management) against the performance measurement index of the 50 surveyed projects. Projects in the upper right quadrant are those projects that were well-managed and also performed well, while those projects in the lower left quadrant were not well-managed and did not perform very well.

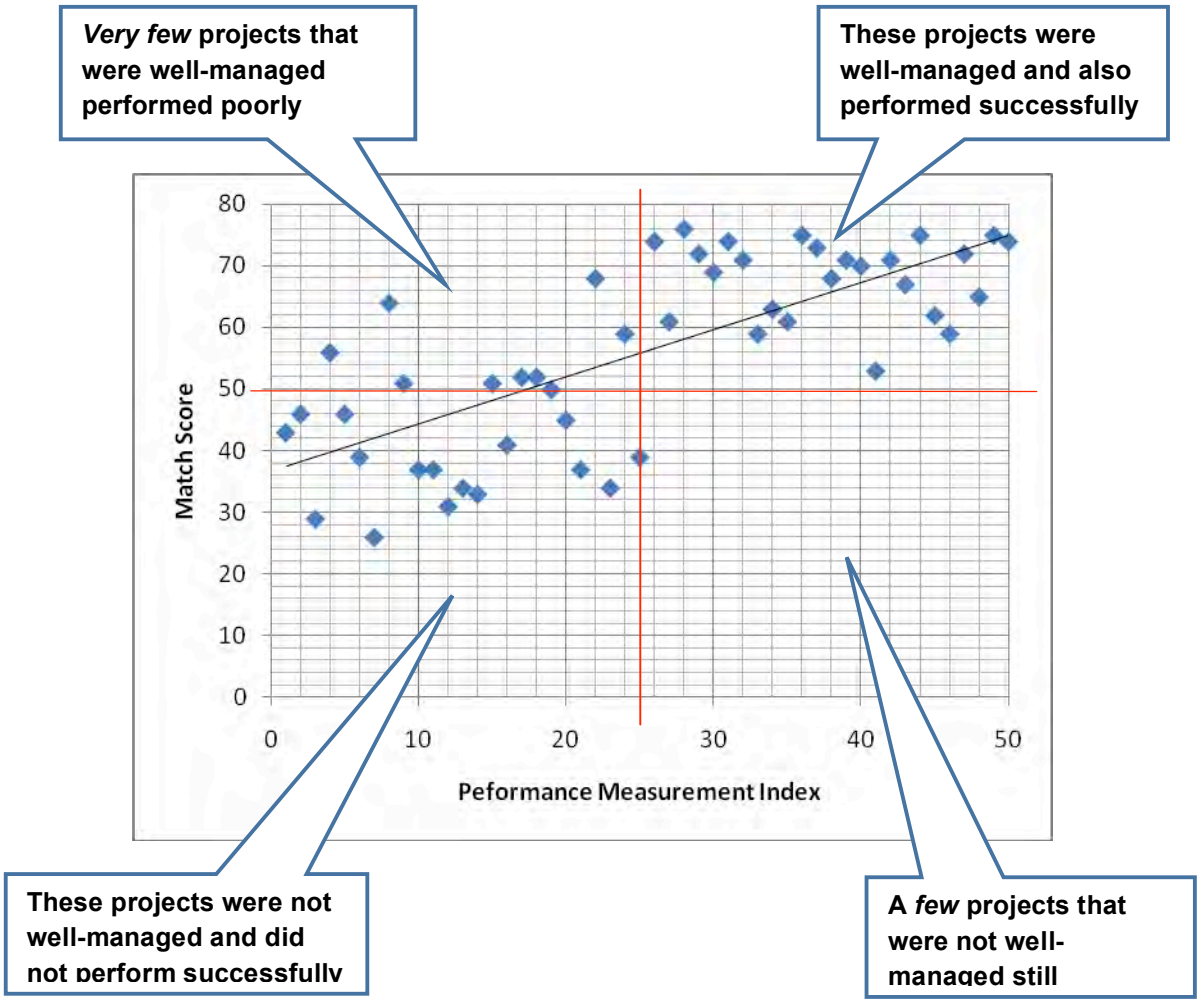


FIGURE 3.2: The Effectiveness of Management Versus the Performance Measurement Index

4. Project Management Activities

4.1 Introduction to the Project Management Activities

Project Management activities are those activities that are performed during the execution of a project. This chapter discusses those management activities that begin during mobilization and are completed at end of construction. Performing these activities will significantly improve the chances that the project will achieve a successful outcome.

4.1.1 Project Management Categories

By examining several well-managed projects, 81 significant activities that occurred during the project management stage were identified. These 81 activities were further divided into fourteen categories of project management activities, including:

1. **Mobilization**
2. **Coordination**
3. **Documentation Management**
4. **Communication**
5. **Scheduling**
6. **Scope & Change Control**
7. **Cost Control & Billing**
8. **Subcontractor Management**
9. **Materials Management**
10. **Tools Management**
11. **Labor Management**
12. **Safety Management**
13. **Quality Control**
14. **Project Closeout**

Table 4.1 provides a sample checklist of the 81 activities that make up the Project Management Process. The activities should be checked off as they are performed to ensure that all activities are performed during the course of executing the project.

4.1.2 Goals of the Project Management Stage

There are three primary goals of the project management process:

1. To completely manage the project in a standardized and efficient manner to ensure that the tools, materials, equipment, and labor are available to complete the project on time and within budget
2. To set up the systems that are needed to efficiently manage the project, such as material purchasing, delivery, and storage; scheduling and tracking; change management; submittal tracking; and numerous other processes that are necessary to manage a successful project
3. To execute the job in a successful manner through efficient jobsite management.

TABLE 4.1: Checklist of Project Management Activities

Project Number: _____

Project Name: _____

Location: _____

Project Manager: _____

Superintendent: _____

PROJECT MANAGEMENT CHECKLIST				
☑	COMPLETION DATE	ACTIVITY CATEGORY	ACT. NO.	ACTIVITY
☐		Mobilization	1	Setup office trailer in a timely manner and in a convenient location
☐			2	Setup storage trailer and lay down area in a convenient location
☐			3	Setup a communication system, such as phone and internet
☐			4	Secure access to the site
☐			5	Bring in the labor, tools and materials that are needed to get started with the work
☐			6	Walk through the jobsite to evaluate and document conditions
☐			7	Make sure the foreman has everything he or she needs to get started with the work
☐		Coordination	8	Attend jobsite meetings and coordinate with other trades
☐			9	Visit the site regularly to identify issues that need coordination
☐		Documenta-tion Management	10	Develop and implement a project file system
☐			11	Implement a documentation control system
☐			12	Implement an RFI tracking and processing system
☐			13	Implement a submittal tracking and processing system
☐			14	Implement a change order tracking and processing system
☐			15	Keep a record of all schedules and updates, including delays
☐			16	Update as-built drawings as portions of the work get completed
☐			17	Keep records of meeting minutes

TABLE 4.1: Checklist of Project Management Activities (continued)

Project Number: _____

PROJECT MANAGEMENT CHECKLIST				
☑	**COMPLETION DATE**	**ACTIVITY CATEGORY**	**ACT. NO.**	**ACTIVITY**
☐		Communica-tion	18	Implement procedures to communicate frequently with the foreman, especially to resolve problems
☐			19	Implement procedures to communicate frequently with vendors and subcontractors
☐			20	Implement procedures to communicate frequently with the General Contractor and Owner
☐			21	Keep the CEO/VP informed of progress and involved with the project through reports, meetings, etc.
☐		Scheduling	22	Review the schedule regularly and identify milestone dates that must be met
☐			23	Review the schedule routinely with field personnel to ensure all parties understand the milestones
☐			24	Identify work that impacts electrical activities
☐			25	Give the General Contractor input on the schedule and activities
☐			26	Update the schedule regularly to track progress
☐			27	Review or establish a look-ahead scheduling process
☐		Scope & Change Control	28	Review and understand the scope of the project
☐			29	Identify problems with the drawings and specifications and develop RFIs
☐			30	Submit change order requests and cost proposals in a timely manner
☐			31	Schedule specific meetings with the GC to discuss change orders and change issues
☐			32	Implement a value engineering system to suggest alternate processes or materials
☐			33	Document official change orders and incorporate them into the budget and schedule
☐			34	Purchase materials or subcontracts and inform the field about the selections
☐			35	Track change orders separately from the original scope
☐			36	Use cost codes to account for activities
☐			37	Track labor costs and compare actual costs to estimated costs

TABLE 4.1: Checklist of Project Management Activities (continued)

Project Number: _____

PROJECT MANAGEMENT CHECKLIST				
☑	**COMPLETION DATE**	**ACTIVITY CATEGORY**	**ACT. NO.**	**ACTIVITY**
☐		Cost Control & Billing	38	Track material and subcontractor costs and compare actual costs to estimated costs
☐			39	Once issued change orders have been approved, include them in the billing process
☐			40	Compare the actual project costs to the budget to track progress
☐			41	Use the schedule of values to track progress
☐			42	Use a pre-bill process to seek preliminary approval of the invoice from the GC
☐			43	Submit invoices of your costs in a timely manner
☐		Subcontractors Management	44	Review the scope and document the subcontractors' scope of work
☐			45	Make sure the subcontractors are licensed and are qualified to do the job
☐			46	Implement subcontracts
☐			47	Determine the subcontractors' schedule based on input from the subcontractors
☐			48	Provide information to the site supervisor and foreman about the subcontractors and the point of contact
☐			49	Schedule onsite visits and walk through the jobsite with the subcontractors
☐			50	Request submittals and shop drawings from the subcontractors
☐		Materials Management	51	Re-check bid documents to verify required materials and identify potential vendors and vendor responsibilities
☐			52	Establish delivery dates for materials and equipment
☐			53	Develop and issue purchase orders for materials and equipment
☐			54	Lock in the pricing for materials and equipment
☐			55	Document purchase orders and keep them in a file system
☐			56	Communicate all material information to field personnel
☐			57	Request submittals, cut sheets and shop drawings from vendors

TABLE 4.1: Checklist of Project Management Activities (continued)

Project Number: _____

PROJECT MANAGEMENT CHECKLIST				
☑	**COMPLETION DATE**	**ACTIVITY CATEGORY**	**ACT. NO.**	**ACTIVITY**
☐		Materials Management (continued)	58	Check material packaging, labels, and status regularly as part of an onsite materials management system
☐			59	Reconcile the invoice with the estimated material costs
☐			60	Implement an effective material handling system on site
☐			61	Schedule material delivery using staged releases to the site based on phases
☐		Tools Management	62	Review contract drawings, specifications, and the bid to identify and purchase special tools
☐			63	Schedule regular delivery and pickup of tools
☐			64	Implement a tool tracking system and track tool usage
☐		Labor Management	65	Identify and maintain the correct crew mix and manpower level
☐			66	Ensure labor hours are turned in by workers in a timely manner
☐		Safety Management	67	Implement a jobsite general safety program
☐			68	Identify safety concerns associated with specific job activities
☐			69	Identify and purchase additional safety equipment as needed
☐			70	Update the safety log regularly and document all incidents
☐			71	Perform job walks regularly to ensure that the safety procedures are being followed
☐		Quality Management	72	Clarify quality requirements for field personnel
☐			73	Check and document the quality of installation through regular site visits
☐			74	Develop and implement commissioning and testing procedures
☐			75	Use a pre-punchlist to identify unresolved quality issues before completion

TABLE 4.1: Checklist of Project Management Activities (continued)

Project Number: _____

PROJECT MANAGEMENT CHECKLIST				
☑	**COMPLETION DATE**	**ACTIVITY CATEGORY**	**ACT. NO.**	**ACTIVITY**
☐		Project Closeout	76	Review specifications as part of the project closeout process
☐			77	Ensure that all punchlist items are completed and signed off in a timely manner
☐			78	Ensure that all change orders and purchase orders are closed before job completion
☐			79	Turn all project closeout documents over to the General Contractor
☐			80	Receive final payment and retainage
☐			81	Demobilize

4.2 Mobilization

Mobilization involves the physical act of setting up the office and storage trailers, installing temporary power and communication systems, and securing the site before work commences on the project. After the site facilities are in place, the Project Manager and Site Supervisor should walk the site to verify current conditions, and then the Site Supervisor should commence work, ensuring the foreman and crews have sufficient materials to execute the work.

4.2.1 What Activities Should be Performed During Mobilization?

The mobilization process consists of seven activities. **Table 4.2** provides the mobilization activities in a checklist.

Activity 1: Setup office trailer in a timely manner and in a convenient location

1.1. Meet with the General Contractor's representative to identify a location on the site for placing the office trailer.

1.2. Set up the office trailer before the crews begin execution.

1.3. Locate the trailer to minimize walking between the trailer, crew locations, toilets, and the General Contractor's office trailer, when possible. This will be beneficial for numerous reasons, including accident reduction (many small accidents occur during walking) and increased productivity.

1.4. Ensure the office trailer has power, communications (phone/internet), a copy of the plans, files, a computer, and other tools necessary for managing the work.

1.5. Make sure, desks enable enough space to read drawings. It is important to be able to display at least two big size documents on the same set of desks. It might also be helpful to display the most important documents on the walls for easy reading.

1.6. Arrange for regular cleaning service for the office trailer.

1.7. It might be necessary to give workers access to a "dry shack": a place where they can change, take breaks, and have meals. These areas should be arranged through the General Contractor.

1.8. Access to water and toilets is very important. Location of a potable water source is necessary for health and safety, especially during hot weather months. Workers should also have access to clean toilets within 200 feet of the work area and on every third floor for multi story construction.

1.9. The job trailer should have a basic first aid kit to handle small injuries, such as cuts and scrapes. Splints and temporary devices necessary for larger injuries should also be available.

Activity 2: Setup storage trailer and lay down area in a convenient location

2.1. Meet with the General Contractor's representative to identify a location on the site for placing the storage trailer and lay down area.

- The location of these facilities will largely be dictated by the General Contractor.

2.2. Locate the storage trailer to minimize walking between the trailer, crew locations, and toilets, when possible.

2.3. Ensure the storage trailer and lay down areas can be secured to prevent theft of materials and tools.

- ***Example*:** Security will likely be site-specific. High-crime areas may need more extensive security features whereas lower crime areas (such as remote locations) may require very minor security measures. Very expensive items may need to be stored off-site at a secure locations to prevent theft.

2.4. If the electrical contractor plans to pre-fabricate items on site and transport them to the installation location, a covered area may be necessary to perform the pre-fabrication operations. This site may also need to be accessible by the crane if the pre-fabricated items are very large or very heavy or at an elevated location.

Activity 3: Setup a communication system, such as phone and internet

3.1. Contact the phone company and have a phone/fax line installed for the trailer.

3.2. Contact the cable company and have internet service established for the computers in the trailer.

- Determine whether a wireless network will be needed and be sure this network is set up when the internet service is established.

Activity 4: Secure access to the site

4.1. Install a fence, if necessary, with gated entries and locks to limit access to the jobsite.

4.2. For renovation projects and other projects in secure areas, consider changing the locks to the areas under construction to prevent entry by unauthorized personnel.

- The facility owner should be consulted to get approval for changing the locks.

4.3. Post appropriate signs to warn potential visitors and the public of the hazards associated with the site.

- Standard signs, such as Hard Hat Area and instructions on where to check in, should be posted. Additional signs may be necessary.

4.4. Implement procedures for checking in and checking out of the jobsite.

- All personnel and visitors on the jobsite should be accounted for in case there is an emergency, so every person on the jobsite (including workers) should be required to sign in and sign out.

Activity 5: Bring in the labor, tools and materials that are needed to get started with the work

5.1. Examine the plans and specifications to identify the first work task to be performed.

5.2. After identifying the first task, develop a list of personnel, tools, and materials that will be needed to implement the first task.

- Identify the crew that will be needed, including the foreman, and arrange for them to arrive on the jobsite.
- Identify and purchase any special tools or equipment that will be needed.
- Be sure the crew has the plans and specifications to complete the work task.

5.3. Establish a three-week look ahead schedule and ensure enough personnel and materials will be available to build up momentum.

- Keep in mind that it often takes time to transition a crew from one job to another. Be sure to schedule the crew at the right time, ensuring they can keep busy for the initiation of the work rather than experiencing a lot of stop and start type of work.

Activity 6: Walk through the jobsite to evaluate and document conditions

6.1. Review the contract to identify the requirements for conducting a pre-execution site visit to establish existing site conditions.

- Often, the contract has language that shifts the risk to the specialty subcontractor for existing conditions that impact execution unless the subcontractor notifies the general contractor of the condition before the work commences.

6.2. Use **Figure 4.1** as a starting point for documenting existing conditions on the jobsite, especially conditions that will negatively impact execution.

6.3. Submit the results of the walk-through to the general contractor in writing so that the general contractor has been formally made aware of any issues that need to be resolved so the work can proceed.

Activity 7: Make sure the foreman has everything he or she needs to get started with the work

7.1. Ensure the foreman has the information, materials, tools, and personnel to execute the work.

TABLE 4.2: Mobilization Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Project Manager: _____

MOBILIZATION CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
1. Setup office trailer in a timely manner and in a convenient location			
☐		1	Meet with the General Contractor's representative to identify a location on the site for placing the office trailer.
☐		2	Set up the office trailer before the crews begin execution.
☐		3	Locate the trailer to minimize walking between the trailer, crew locations, toilets, and the General Contractor's office trailer, when possible. This will be beneficial for numerous reasons, including accident reduction (many small accidents occur during walking) and increased productivity.
☐		4	Ensure the office trailer has power, communications (phone/internet), a copy of the plans, files, a computer, and other tools necessary for managing the work.
☐		5	Make sure, desks enable enough space to read drawings. It is important to be able to display at least two big size documents on the same set of desks. It might also be helpful to display the most important documents on the walls for easy reading.
☐		6	Arrange for regular cleaning service for the office trailer.
☐		7	It might be necessary to give workers access to a "dry shack": a place where they can change, take breaks, and have meals. These areas should be arranged through the GC.
☐		8	Access to water and toilets is very important. Location of a potable water source is necessary for health and safety, especially during hot weather months. Workers should also have access to clean toilets within 200 feet of the work area and on every third floor for multi story construction.
☐		9	The job trailer should have a basic first aid kit to handle small injuries, such as cuts and scrapes. Splints and temporary devices necessary for larger injuries should also be available.

TABLE 4.2: Mobilization Activities Checklist (continued)

Project Number: _____

MOBILIZATION CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
2. Setup storage trailer and lay down area in a convenient location			
☐		1	Meet with the General Contractor's representative to identify a location on the site for placing the storage trailer and lay down area.
☐		2	Locate the storage trailer to minimize walking between the trailer, crew locations, and toilets, when possible.
☐		3	Ensure the storage trailer and lay down areas can be secured to prevent theft of materials and tools.
☐		4	If the electrical contractor plans to pre-fabricate items on site and transport them to the installation location, a covered area may be necessary to perform the pre-fabrication operations. This site may also need to be accessible by the crane if the pre-fabricated items are very large or very heavy or at an elevated location.
3. Setup a communication system, such as phone and internet			
☐		1	Contact the phone company and have a phone/fax line installed for the trailer.
☐		2	Contact the cable company and have internet service established for the computers in the trailer.
4. Secure access to site			
☐		1	Install a fence, if necessary, with gated entries and locks to limit access to the jobsite.
☐		2	For renovation projects and other projects in secure areas, consider changing the locks to the areas under construction to prevent entry by unauthorized personnel.
☐		3	Post appropriate signs to warn potential visitors and the public of the hazards associated with the site.
☐		4	Implement procedures for checking in and checking out of the jobsite.
5. Bring in the labor, tools and materials that are needed to get started with the work			
☐		1	Examine the plans and specifications to identify the first work task to be performed.
☐		2	After identifying the first task, develop a list of personnel, tools, and materials that will be needed to implement the first task.
☐		3	Establish a three-week look ahead schedule and ensure enough personnel and materials will be available to build up momentum.

TABLE 4.2: Mobilization Activities Checklist (continued)

Project Number: _____

MOBILIZATION CHECKLIST FOR PROJECT MANAGEMENT			
☑	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
6. Walk through the jobsite to evaluate and document conditions			
☐		1	Review the contract to identify the requirements for conducting a pre-execution site visit to establish existing site conditions.
☐		2	Use **Figure 4.1** as a starting point for documenting existing conditions on the jobsite, especially conditions that will negatively impact execution.
☐		3	Submit the results of the walk-through to the general contractor in writing so that the general contractor has been formally made aware of any issues that need to be resolved so the work can proceed.
7. Make sure the foreman has everything he or she needs to get started with the work			
☐		1	Ensure the foreman has the information, materials, tools, and personnel to execute the work.

Project Number: _____

Project Name: _____

Location: _____

Project Manager: _____

Scope Review Completion Date: _____

SITE EXISTING CONDITIONS CHECKLIST		
Completed	**Item**	**Condition**
☐	Access routes into and out of the site	
☐	Circulation routes throughout the site	
☐	Material and equipment delivery routes	
☐	Material storage and staging locations	
☐	Office trailer or office space location	
☐	Presence/location of the crane	
☐	Presence/location of the personnel lift	
☐	Presence/location of the materials lift	
☐	Housekeeping conditions	
☐	Special site conditions	
☐	Progress of the other trades	
☐	Work completed to date	
☐	Potential coordination issues with others	
☐	Weather problems	
☐	Delays or potential causes of delay	
☐	Safety issues or concerns	
☐	Other:	

Figure 4.1 Site Existing Conditions Checklist

4.3 Coordination

Coordination requires effective and frequent communication among project stakeholders. Proper coordination can contribute to project success and to the overall satisfaction of project participants. Coordination typically involves attending the jobsite meetings regularly and coordinating the work with other trades on the jobsite. Although coordination meetings occur commonly on construction projects, coordination also occurs less formally and frequently in the field at the point of work.

4.3.1 What Activities Should be Performed During Coordination?

The coordination process consists of two activities. **Table 4.3** provides the coordination activities in a convenient checklist.

Activity 8: Attend jobsite meetings and coordinate with other trades

8.1. The Project Manager, site supervisor, and/or the foreman should attend jobsite coordination meetings to work out conflicts with other trades before the conflicts delay the work.

- **Figure 4.2** provides a master project information sheet. This information will be required by the project management programs for: Change Orders, RFI's, Transmittals and general correspondence.
- Good coordination is really needed all along the project, but especially at the beginning. **Figure 4.3** provides a Kickoff meeting agenda, with everything that the Project Manager has to take care of.

8.2. For conflicts that will delay the work without immediate resolution, the site supervisor should work directly with the other trade(s) to resolve the conflict.

- Be sure to bring the conflict to the attention of the General Contractor.

8.3. Daily coordination among trades has the potential to reduce or eliminate delays, increase teamwork, and improve the flow of work. As a result, daily coordination is strongly recommended.

Activity 9: Visit the site regularly to identify issues that need coordination

9.1. The Project Manager should visit the jobsite, walk the job with the site supervisor, and document issues that will impact, or are already impacting, the work.

- These site visits should occur in advance of the weekly coordination meeting so that specific coordination issues can be raised, and resolved, at the meeting.

TABLE 4.3: Coordination Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Bid Due Date: _____

COORDINATION CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
8. Attend jobsite meetings and coordinate with other trades			
☐		1	The Project Manager, site supervisor, and/or the foreman should attend jobsite coordination meetings to work out conflicts with other trades before the conflicts delay the work.
☐		2	For conflicts that will delay the work without immediate resolution, the site supervisor should work directly with the other trade(s) to resolve the conflict.
☐		3	Daily coordination among trades has the potential to reduce or eliminate delays, increase teamwork, and improve the flow of work. As a result, daily coordination is strongly recommended.
9. Visit the site regularly to identify issues that need coordination			
☐		1	The Project Manager should visit the jobsite, walk the job with the site supervisor, and document issues that will impact, or are already impacting, the work.

MASTER PROJECT INFORMATION SHEET

Project Number: _____

Project Name: _____

Location: _____

City, State Zip: _____

Project Manager Name: _____

Phone Number: _____

Fax Number:_____

Cell Number:_____

E-mail address:_____

Site Contact: _____

Contact Phone Number: _____

Contact Fax Number: _____

Bill to (company name): _____

Billing Address: _____

City, State Zip: _____

Billing Attn. To: _____

Original Contract Amount: _____

FIGURE 4.2 Master Project Information Sheet

Project Number:_____
Project Name:_____
Meeting Time, Date and Location:_____
Project Manager:_____
Estimator: _____
Superintendent: _____
Proj. Foreman: _____

KICKOFF MEETING AGENDA

Agenda Items:

1. Introduction to Attendees
2. Project Scope of Work
3. Contact Information (Owner, General Contractor, Architect, Engineer)
4. Major Material, Equipment Purchases, PO Classifications, Quotes
5. Discuss Subcontractors, Special Vendors
6. Tool Requirements
7. Special Paperwork, Reporting Requirement, Certified Payroll
8. Staff Support Requirements
9. Review Plans and Specifications in Detail
10. Review Estimate Breakdown/ Progress Report
11. Job Schedule/Duration
12. Planning and Scheduling
13. Manpower Requirements
14. Field As Built Drawing Requirements

FIGURE 4.3 Kickoff Meeting Agenda

4.4 Documentation Management

Documentation Management is the process of managing information during the execution of the work. Such information will include daily diaries, meeting minutes, requests for information/clarification, schedules, changes orders, plans, specifications, submittals, photographs, and correspondence. Typically, computer software applications are used to manage and control information and documents, and numerous excellent applications have been developed exactly for this purpose. Web-based document control systems are becoming more common, as well, and occasionally the client and/or general contractor will set up a system for all team members to use. Many of the systems that will be used to execute the work should have been established during the Pre-Construction Planning phase. Hence, readers are encouraged to review the *Electrical Pre-Construction Planning Implementation Manual* published by Electri' International.

4.4.1 What Activities Should be Performed During Documentation Management?

The documentation management process consists of eight activities. **Table 4.4** provides the documentation management activities in a convenient checklist.

Activity 10: Develop and implement a project file system.

10.1. Use the Project File System checklist (**Figure 4.4**) as a starting point for establishing a paper and/or digital Project File.

- Often, companies have a standard software system and standard files that are used on every project. Hence, this task would then entail tailoring the system for the specific project that will be executed.

Activity 11: Implement a documentation control system

11.1. Once the Project File System has been established, implement procedures for controlling documents/information during execution.

- Separate procedures may be needed for RFIs, changes, submittals, schedules, correspondence, etc.

11.2. The process of control necessarily involves reviewing outstanding dates and tracking the progress of responses to questions. Hence, regularly review the outstanding issues, and follow-up to seek solutions.

Activity 12: Implement an RFI tracking and processing system

12.1. Consult the Electrical Pre-Construction Planning Implementation Manual, 2008 published by Electri' International for sample RFI procedures and logs that should be employed during project execution.

- **Figure 4.5** presents a sample procedure that should be employed during project execution. This figure was originally published in the Electrical Pre-Construction Planning Process Implementation Manual, 2008 published by Electri' International.

12.2. Use a log to track all requests for information (RFIs).

- The computerized project file system (i.e., project management software program) will likely provide a system for initiating and tracking RFIs.
- If no computerized project management software system has been implemented, a spreadsheet can be used to track RFIs. **Figure 4.6** provides a sample RFI log originally published in the Electrical Pre-Construction Planning Process Implementation Manual, 2008.

12.3. Ensure each RFI identifies the plan sheet, specification section, scope element, or contract clause that needs more information, and propose a solution to a problem, when possible.

- It is important that the RFI contain all necessary information, such as the plan sheet or specification section, and it articulates the ambiguity, conflict, or omission clearly.
- **Figure 4.7** provides a sample RFI form published in the Electrical Pre-Construction Planning Process Implementation Manual, 2008.
- **Example:** For a quick resolution to your question, identify a possible solution to the issue. For example, if there is a conflict between a conduit and a heating duct, identify a possible relocation route for either the conduit or the duct. The engineer will only have to check your proposed re-route rather than develop an alternate route, which would take more time.

12.4. Ensure each RFI clearly identifies a date when the information is needed and the impact on the progress if the information is not received by the requested date.

- The RFI is a time-sensitive document that often requires an immediate or quick response. Two dates (the date sent and the date a response is needed) should be clearly identified on the RFI.

12.5. Conduct regular reviews of the outstanding issues, and follow-up to seek solutions.

Activity 13: Implement a submittal tracking and processing system

13.1. Use a log to track all submittals, including those of vendors and subcontractors (**Figure 4.8**).

- **Example:** Review the specifications to determine whether the customer has included a submittal log. If so, this information can be transferred to your own company tracking system. If not, use either commercial project management software or create a spreadsheet. Go through each section of the specifications to determine whether it identifies a submittal that you or your suppliers or subcontractors are responsible for providing. Enter this information in your submittal tracking log (see **Figure 4.8** for a sample).
- **Figure 4.9** provides a procedure originally published in the Electrical Pre-Construction Planning Process Implementation Manual published by Electri' International describing a sample submittal tracking procedure that should be employed during project execution
- A submittal log can be used for tracking the progress of the submittal. A submittal log should compare the expected return dates with the actual return dates to identify the variances between expected and actual dates. Significant variances, and their impacts, should be addressed with the General Contractor.

13.2. Implement your company's standard procedures for processing submittals. Submittals that include a product (e.g., sample, cut sheet, shop drawing, etc.) are typically dropped off at the General Contractor's office and documented through the computer submittal tracking system.

- **Figure 4.10** identifies a sample submittal transmittal form originally published in the Electrical Pre-Construction Planning Process Implementation Manual, 2008. However, most commercial project management software programs can be tailored to include a standardized company form.

13.3. Verify that each submittal processing form identifies a "respond no later than" date, and make sure the General Contractor understands the consequences if the date is not met.

- **Example:** Be sure to review the work sequence and schedule carefully to identify when each material or equipment item will be installed. Then, annotate on the submittal form the date you will need an approval in order to order and receive the materials or equipment on time to avoid a delay. This technique also puts the architect/engineer on notice in case there is a delay that is disputed later.

13.4. Conduct regular reviews of the outstanding issues, and follow-up to seek solutions.

Activity 14: Implement a change order tracking and processing system

14.1. Consult the *Electrical Pre-Construction Planning Implementation Manual, 2008* published by Electri' International for sample change procedures and logs that should be employed during project execution.

- **Figure 4.11** depicts a change order procedure (*Electrical Pre-Construction Planning Implementation Manual, 2008*). This example can be tailored to each company's individual needs.

14.2. Use a log to track all changes, including change orders, field changes, and time-and-materials requests.

- **Figure 4.12** provides a sample change order log originally published in the Electrical Pre-Construction Planning Implementation Manual, 2008.

14.3. Implement your company's standard procedures for initiating, requesting, and processing change orders and field changes.

- **Figure 4.13** provides a sample Change Order Proposal Form (Electrical Pre-Construction Planning Implementation Manual, 2008).

14.4. If the change order is disputed among the parties, be sure to submit timely written notice to the General Contractor informing them that additional work has been performed and that you expect compensation for the work. You will essentially reserve your right to file a claim.

- Keep track of the progress of resolving outstanding change orders so that changed work can be billed on the monthly progress payment request.

14.5. Conduct regular reviews of the outstanding change order requests, and follow-up weekly.

Activity 15: Keep a record of all schedules and updates, including delays

15.1. Establish a baseline schedule and have the General Contractor approve the baseline schedule.

- Be sure this baseline schedule gets filed for future reference.
- The electrical contractor should coordinate the submittal schedule with procurement and installation schedule to ensure that the material will be delivered to the jobsite to coincide with the appropriate installation activity.

15.2. Track the schedule weekly, documenting the current progress each week and any changes that have occurred.

- Although this may seem like a tedious exercise, tracking weekly schedules is essential if a claim is ultimately requested. The preparer of the claim will use this information to document delays interruptions.
- Be sure the updated schedule gets filed each week for future reference.

15.3. During weekly update meetings, present your schedule and provide a copy to the General Contractor. This will provide constructive notice to the General Contractor if your work is being delayed or impacted.

Activity 16: Update as-built drawings as portions of the work get completed

16.1. Each day or each week, the foreman or site supervisor should red-line a set of drawings to represent the work that has actually been completed.

16.2. These red-line drawings can then be used to update the official "as-built' drawings.

- Notes describing any changes or differences from the original construction documents should be annotated on the drawings and, from time to time, sent to the engineer for their information.
- Continuous updating of the "as-builts" when the information is fresh in memory will make the transfer process easier upon substantial completion.

Activity 17: Keep records of meeting minutes and project progress

17.1. The meeting minutes should be checked for accuracy and correctness before filing them. Any discrepancies should be brought to the attention of the General Contractor and corrected promptly.

- Numerous meetings occur during the construction process. A written record of the minutes of the meeting should always be saved and distributed to meeting participants. **Figure 4.14** provides an example of a meeting minutes form published in *Construction Jobsite Management*, 2004 by William R. Mincks & Hal Johnston.
- Make sure the minutes are clear and concise – many individuals will be referring to them and using them as a basis for action.
- Delays, conflicts, concerns, and issues identified in the meetings often serve to notify the General Contractor of a problem. These minutes may later be used in claims; hence, their accuracy is essential.

17.2. Ensure the meetings minutes are received in a timely manner and get filed so that they can be retrieved later if necessary.

- Keeping an organized filing system, whether manual or electronic, will be essential for monitoring progress and documenting issues.

17.3. Keep records of project progress.

- Daily documentation of activities taking place on the jobsite is one of the most important tasks the site supervisor will need to perform. Because disputes often arise long after activities have been completed, it is critical that accurate records

of events (i.e., delays, bad weather, missed milestones, etc) are maintained. The main purpose of the daily report is to provide a snapshot of the day's activities and conditions. An example is provided at **Figure 4.15** (*Construction Jobsite Management*, 2004 by William R. Mincks & Hal Johnston).

- Different reports will need to be produced, including daily, weekly and monthly reports, accident reports, video recordings, photos, etc. Weekly and monthly reports are particularly useful for informing upper management about the progress of the project (see **Figure 4.16** published in *Construction Jobsite Management*, 2004 by William R. Mincks & Hal Johnston).

TABLE 4.4: Documentation Management Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Project Manager: _____

Start Date: _____

DOCUMENTATION MANAGEMENT CHECKLIST FOR PROJECT MANAGEMENT			
☑	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
10. Develop and implement a project file system			
☐		1	Use the Project File System checklist (Table 4.4) as a starting point for establishing a paper and/or digital Project File.
11. Implement a documentation control system			
☐		1	Once the Project File System has been established, implement procedures for controlling documents/information during execution.
☐		2	The process of control necessarily involves reviewing outstanding dates and tracking the progress of responses to questions. Hence, regularly review the outstanding issues, and follow-up to seek solutions.
12. Implement an RFI tracking and processing system			
☐		1	Consult the Electrical Pre-Construction Planning Implementation Manual published by Electri' International for sample RFI procedures and logs that should be employed during project execution.
☐		2	Use a log to track all requests for information (RFIs).
☐		3	Ensure each RFI identifies the plan sheet, specification section, scope element, or contract clause that needs more information, and propose a solution to a problem, when possible.
☐		4	Ensure each RFI clearly identifies a date when the information is needed and the impact on the progress if the information is not received by the requested date.
☐		5	Conduct regular reviews of the outstanding issues, and follow-up to seek solutions.

TABLE 4.4: Documentation Management Activities Checklist (Continued)

Project Number: _____

13. Implement a submittal tracking and processing system			
☐		1	Use a log to track all submittals, including those of vendors and subcontractors (Figure 4.11).
☐		2	Implement your company's standard procedures for processing submittals. Submittals that include a product (e.g., sample, cut sheet, shop drawing, etc.) are typically dropped off at the General Contractor's office and documented through the computer submittal tracking system.
☐		3	Verify that each submittal processing form identifies a "respond no later than" date, and make sure the General Contractor understands the consequences if the date is not met.
☐		4	Verify that each submittal processing form identifies a "respond no later than" date, and make sure the General Contractor understands the consequences if the date is not met.
☐		5	Conduct regular reviews of the outstanding issues, and follow-up to seek solutions.
14. Implement a change order tracking and processing system			
☐		1	Consult the *Electrical Pre-Construction Planning Implementation Manual* published by Electri' International for sample change procedures and logs that should be employed during project execution.
☐		2	Use a log to track all changes, including change orders, field changes, and time-and-materials requests.
☐		3	Implement your company's standard procedures for initiating, requesting, and processing change orders and field changes.
☐		4	If the change order is disputed among the parties, be sure to submit timely written notice to the General Contractor informing them that additional work has been performed and that you expect compensation for the work. You will essentially reserve your right to file a claim.
☐		5	Conduct regular reviews of the outstanding change order requests, and follow-up weekly.

TABLE 4.4: Documentation Management Activities Checklist (continued)

Project Number: _____

15. Keep a record of all schedules and updates, including delays			
☐		1	Establish a baseline schedule and have the General Contractor approve the baseline schedule.
☐		2	Track the schedule weekly, documenting the current progress each week and any changes that have occurred.
☐		3	During weekly update meetings, present your schedule and provide a copy to the General Contractor. This will provide constructive notice to the General Contractor if your work is being delayed or impacted.
16. Update as-built drawings as portions of the work get completed			
☐		1	Each day or each week, the foreman or site supervisor should red-line a set of drawings to represent the work that has actually been completed.
☐		2	Any changes from the original drawings should be annotated daily or weekly on the official "as-built" drawings.
17. Keep records of meeting minutes and project progress.			
☐		1	The meeting minutes should be checked for accuracy and correctness before filing them. Any discrepancies should be brought to the attention of the General Contractor and corrected promptly.
☐		2	Ensure the meetings minutes are received in a timely manner and get filed so that they can be retrieved later if necessary.
☐		3	Keep records of project progress.

Project Number: _____

Project Name: _____

Location: _____

Project Manager: _____

FILE SYSTEM CHECKLIST		
Completed	**File Number**	**File Description**
☐		Project Information and Contacts
☐		Cost Estimate and Bid Submission
☐		Contract Agreement
☐		Contract Documents
☐		Budget and Pay Requests
☐		Purchase Orders
☐		Subcontracts
☐		Materials Folders (Fixtures, Switchgear, Fire Alarm, Low Voltage)
☐		Requests for Information
☐		Submittals
☐		Change Orders – Pending
☐		Change Orders – Approved
☐		Correspondence
☐		Meeting Minutes
☐		Daily/Weekly Field Report
☐		Progress Reports
☐		Other

FIGURE 4.4 File System Checklist

STANDARD REQUEST FOR INFORMATION PROCEDURE

1. **TYPES OF INFORMATION:** A Request for Information (RFI) is a formal process for receiving more details about a work process and/or alerting the customer to a potential deficiency in the contract documents. The types of information that must be cycled through the RFI process include: discrepancies between plans and specifications; incomplete design details; conflicts between systems; clarifications about design intent; identification of a changed condition with a request for instructions; missing scope items that would produce a complete product; and many other issues

2. **REQUEST FOR INFORMATION PROCEDURE:**
   a. A hierarchy should be followed when identifying and processing RFIs. Crew members should address questions to their crew foreman. The crew foreman should fill out the Request for Information form (Figure 4.6) and forward it to the Field Supervisor. The Field Supervisor should review the form and forward it to the Project Manager. The Project Manager should review the form and process it.
   b. Fill out the Request for Information form, including a detailed description of the requested information and the date that a response is required. When possible, identify a possible solution to a problem, which might speed up the response time and result in a favorable outcome to the electrical work.
   c. The Project Manager or Field Supervisor should enter the RFI in the Request for Information Log (Table 4.13) and assign it an RFI number. The status will remain "OPEN" until the RFI has received a response from the customer.
   d. The RFI form is forwarded to the customer for a response.
   e. Once a response has been received, the status in the RFI Log is changed to "CLOSED" and the response is distributed to all affected parties.
   f. If the response to the RFI will result in an increase in the scope of work or a change in the contract conditions, the Project Manager should immediately initiate a change order request by processing a Change Order Proposal (Figure 4.3).

FIGURE 4.5 Standard Request for Information Procedure

Project Number:_____

Project Name: _____

Location: _____

Project Manager:_____

REQUEST FOR INFORMATION LOG						
RFI NUMBER	**DATE SUBMITTED**	**DESCRIPTION OF INFORMATION NEEDED**	**SUBMITTED TO**	**DATE OF RESPONSE**	**WHO INITIATED**	**STATUS**

FIGURE 4.6: Request for Information Log

COMPANY NAME COMPANY ADDRESS REQUEST FOR INFORMATION		
PROJECT NUMBER:	**PROJECT NAME:**	**DATE:**
RFI NUMBER:		
TO:	**FROM:**	
METHOD SENT: ☐ **FAX** ☐ **MAIL** ☐ **E-MAIL**		
INITIATED BY:		
DESCRIPTION OF REQUEST:		
ADDITIONAL SUPPORT DOCUMENTS THAT ARE NOT ATTACHED:		
DATE REQUIRED:		
DATE RESPONSE RECEIVED:		
RESPONSE FROM:		
RESPONSE:		

FIGURE 4.7: Request for Information Form

Project Number: _____
Project Name: _____
Location: _____
Project Manager: _____

SUBMITTAL LOG														
CSI section	Date submitted	Revision number	Submitted item	Supplier	Date to A/E		Date approved		Date to supplier		Order date		Delivery date	
					Schdl.	Act.	Schdl.	Act.	Schdl.	Act.	Schdl.	Act.	Schdl.	Act.

FIGURE 4.8: Standard Submittal Log

STANDARD SUBMITTAL PROCEDURE

1. **TYPES OF SUBMITTALS:** Three types of submittals are commonly encountered in construction: (1) shop drawings, (2) product data/cut sheets, and (3) samples. Shop drawings reflect the manufacturer's or equipment designer's technical details for the product specified in the plans and specifications and usually include dimensions and quantities. Product data/cut sheets provide information about the make, model, size, capacity, performance, and finish of a product specified in the plans and specifications. Samples are physical representations of the specified product, such as paint color, brick finish, floor tile, metal roof style and color, and so on.

2. **SUBMITTAL PROCESSING PROCEDURE:**
   a. The Project Manager should review the plans and specifications to identify all of the submittals that are required by the contract documents and begin filling out the Submittal Log (Table 4.14).
   b. While preparing purchase orders for the materials and equipment, the required type and number of submittals should be identified on the Purchase Order Form (Figure 4.11).
   c. When the submittal item is received from the subcontractor/supplier/vendor, the Project Manager should carefully review the submittal to make sure the proposed product conforms to the plans and specifications.
   d. The front sheet of each submittal should be stamped with the company submittal stamp and initialed by the Project Manager to signal a review has been completed.
   e. If binders of submittals are not required, the Project Manager should fill out a Submittal Transmittal Form (Figure 4.8) and forward the proper number of copies to the customer for review and approval. If binders are required, begin assembling binders of all submittals according to their CSI section. The Submittal Log should be updated to reflect the date sent to the customer.
   f. Once copy of each submittal should be retained for the files and one copy should be forwarded to the field. Make sure the copies are marked with their preliminary status (such as, "DRAFT – For Information Only).
   g. Once the submittal has been reviewed and returned by the customer, one copy should be returned to the subcontractor/supplier/vendor, and the Submittal Log should be updated.
   h. If the submittal was approved, one approved copy should be retained for the files and one copy sent to the field with the annotation, "APPROVED FOR CONSTRUCTION."
   i. If the submittal was rejected, the submittal process will have to be repeated.

FIGURE 4.9: Standard Submittal Procedure

COMPANY NAME

COMPANY ADDRESS

SUBMITTAL TRANSMITTAL FORM

PROJECT NUMBER: _____ DATE: _____

PROJECT NAME: _____

CSI SECTION: _____

TO: FROM:

QTY	SUBMITTAL DESCRIPTION	FOR YOUR REVIEW	FOR YOUR APPROVAL	FOR YOUR FILES	FOR INFORMATION ONLY	DATE REQ'D

Please return _____ copies.

Additional Comments: _____

_____

Signature: _____

Date: _____

FIGURE 4.10: Submittal Transmittal Form

STANDARD CHANGE ORDER PROCEDURE

1. **TYPES OF CHANGES:** Three types of changes are commonly encountered in construction: (1) request for quotation, (2) field change directive, and (3) disputed changes to the work. A request for quotation (RFQ) typically occurs when the customer acknowledges that a change is needed and requests an estimate of the cost prior to approving the change. A field change directive is an order given in the field to immediately execute a change before the cost of the work has been negotiated. Disputed changes are changes to the work that are necessary to continue making progress but are not acknowledged by the customer as a change to the contract requirement. Disputed changes are difficult to recover and require careful documentation to maximize your chances of receiving compensation.

2. **REQUEST FOR QUOTATION PROCEDURE:**
   a. Enter the change order request in the Change Order Log and assign it a C.O. number. The status will remain "OPEN" until the C.O. has been approved by the customer.
   b. The Project Manager should develop a written recap of the requested scope of work, identifying all inclusions, exclusions, and qualifications.
   c. The Project Manager should develop a cost estimate for the scope of work. If the scope is large or complex, the Project Manager may request assistance from the Estimator.
   d. The cost estimate should include direct costs (labor, materials, equipment, subcontractors, expediting fees, etc.), indirect costs (jobsite overhead, home office overhead, insurance premiums, bonds, etc.), and profit (which is added after all other costs have been tallied).
   e. The Project Manager will fill out a Change Order Proposal with the scope of work and quoted price.
   f. The Change Order Proposal is forwarded to the customer for approval.
   g. Once the approval has been received, the status in the Change Order Log is changed to "APPROVED" and the work is implemented.

3. **FIELD CHANGE DIRECTIVE PROCEDURE:**
   a. A Field Change Directive (FCD) is often issued by the owner's representative, architect/engineer, or general contractor. The Field Superintendent and foremen are authorized to accept an FCD only if the issuing authority signs a Field Change Form.
   b. If the FCD is received by a foreman, the foreman should notify the Field Supervisor immediately.
   c. FCDs are typically performed on a Time and Materials (T&M) basis.
   d. The issuing authority and the Field Supervisor/foreman should verbally agree to the scope of work, and this scope should be documented on the Field Change Form. The foreman and issuing authority should each sign the Field Change Form.
   e. The FCD is entered into the Change Order Log and assigned a C.O. number. The status will remain "OPEN" until the FCD has been paid by the customer.

FIGURE 4.11: Standard Change Order Procedure

STANDARD CHANGE ORDER PROCEDURE (continued)

f. All labor, materials, equipment, and subcontracts that are used to complete the work should be annotated on the Field Change Form.
g. The Field Change Form is forwarded to the Project Manager, who will add the markup and calculate the total cost of the work.
h. The Field Change Form is then forwarded to the Accounting Department where it will be entered into the accounting system as a separate line item and invoiced during the next billing cycle.
i. Once the FCD has been paid, the status in the Change Order Log is changed to "APPROVED."

4. **PROCEDURE FOR DISPUTED CHANGES:**
   a. The disputed work should be processed similar to an RFQ.
   b. The Project Manager and/or Field Supervisor should develop a detailed written scope of the work that is outside the original contract scope of work, identifying plans, specifications, other contract documents, and qualifications that support their position.
   c. The Project Manager should develop a cost estimate for the scope of work. If the scope is large or complex, the Project Manager may request assistance from the Estimator.
   d. The cost estimate should include direct costs (labor, materials, equipment, subcontractors, expediting fees, etc.), indirect costs (jobsite overhead, home office overhead, insurance premiums, bonds, etc.), and profit (which is added after all other costs have been tallied).
   e. The Project Manager will fill out a Change Order Proposal with the scope of work and quoted price.
   f. The disputed Change Order Proposal is entered into the Change Order Log and assigned a C.O. number. The status will remain "OPEN" until the C.O. has been approved or rejected by the customer.
   g. The Change Order Proposal is forwarded to the customer for approval.
   h. Once an approval or rejection has been received, the status in the Change Order Log is changed to "APPROVED" or "REJECTED."

FIGURE 4.11: Standard Change Order Procedure (continued)

Project Number: _____

Project Name: _____

Location: _____

Project Manager: _____

CHANGE ORDER LOG							
C.O. NUMBER	DATE SUBMITTED	DESCRIPTION OF CHANGE	WHO INITIATED	WHO AUTHORIZED	ASSOCIATED RFI NUMBER	C.O. AMOUNT	STATUS

FIGURE 4.12: Change Order Log

COMPANY NAME

COMPANY ADDRESS

CHANGE ORDER PROPOSAL

PROJECT NUMBER: _____

PROJECT NAME: _____

DATE: _____

TO: _____ **FROM:**

_____

_____

_____

DESCRIPTION OF CHANGED WORK:

COST OF THE CHANGED WORK:

Description	Labor	Materials	Equipment	Other	Subcontracts	Total

Labor Burden _____%
Bond Premium _____%
Liability Insurance _____%

Subtotal _____

Overhead _____
Profit _____

TOTAL _____

TIME EXTENSION _____ calendar days
APPROVED BY: _____ **DATE:** _____

FIGURE 4.13: Change Order Proposal

Project Number:_____

Project Name:_____

Meeting Time, Date and Location:_____

Estimator:_____

Project Manager:_____

MEETING MINUTES

Parties in Attendance:

NAME	FIRM	PHONE	E-MAIL

Minutes from the Previous Meeting:

Project Progress:

Item No.	Description	Status	Due Date	Responsibility
1.				
2.				
3.				
4.				
5.				

Meeting Notes Taken by:_____

FIGURE 4.14: Meeting Minutes Form

Project Number:_____

Project Name:_____

Meeting Time, Date and Location:_____

Estimator:_____

Project Manager:_____

DAILY REPORT

Weather: **Wind:**
Temp: **Precipitation:**

Work in progress:

LABOR:

EQUIPMENT:

ITEM	FIRM	HRS. IN USE	HRS. IDLE

MATERIAL DELIVERY:

FROM	FOR	TIME	ITEMS

VISITORS:

VISITOR	FIRM	PURPOSE	TIME

OCCURRENCES:

Signature:_____
Date:_____

FIGURE 4.15: Daily Report Form

Project Number:_____

Project Name:_____

Meeting Time, Date and Location:_____

Estimator:_____

Project Manager:_____

MONTHLY REPORT

Prepared by:

Summary of Activities:

Schedule Analysis:

Cost Analysis:

Change Orders:

Summary:

Signature:_____

Date:_____

FIGURE 4.16: Monthly Report Form

4.5 Communication

Communication refers to oral interactions and written correspondence related to the job. While formal communication is essential to ensure important information is conveyed to a person who has authority to act and make decisions, informal communication that occurs daily on the jobsite is also extremely important. One of the most common ways to communicate is face to face, and this is often the predominant method for communicating in construction. Oral communication relies on interactions between the parties, and this may result in instantaneous resolution of issues. However, some verbal communications will need to be followed up with written verification of the conversation. Communication among the parties has the potential to establish a strong sense of teamwork when the proper trust has been established among the stakeholders. Hence, many successful projects have reported that good communication among the stakeholders was a key factor that contributed to success. Key characteristics often noted on teams that have good coordination and communication include honesty, trust, integrity, competence in respective roles, commitment to the project's objectives, and dissemination of information.

4.5.1 What Activities Should be Performed During Communication?

The communication process consists of four activities. **Table 4.5** provides the communication activities in a convenient checklist.

Activity 18: Implement procedures to communicate frequently with the foreman, especially to resolve problems

18.1. The site supervisor should arrange a formal daily meeting with the foreman to exchange information and address issues.

- It may be necessary to formally meet more than once a day; for example, a morning meeting before work commences and an afternoon meeting after work ceases may be necessary to ensure all issues have been identified.

18.2. Implement informal communication procedures to supplement the formal meetings.

- Informal communications are valuable for establishing good personal relationships, for quick and effective resolution of problems and for deciding upon courses of action.
- For example, establish "rules" for when the foreman should contact the site supervisor to seek information or approval (e.g., if the foreman has been asked to do additional work by the general contractor).

Activity 19: Implement procedures to communicate frequently with vendors and subcontractors

19.1. The site supervisor should arrange a formal weekly or bi-weekly phone call with vendors and subcontractors to provide an update on the progress of the work and the status of materials and services that have been ordered.

- Keeping the vendors and subcontractors informed about progress will prevent materials and services from arriving too early or too late.
- Furthermore, early notice that material, equipment, or a service will be late will allow the site supervisor to plan a work-around

19.2. Vendors and subcontractors should receive copies of the most current schedule and meeting minutes as one method for keeping them updated on the progress of the work.

- These documents should be discussed in the formal in-person or phone conferences so that all parties understand the milestones for delivering materials, equipment, or services.
- Coordination of electrical subcontractors is one of the major responsibilities of the project team.

Activity 20: Implement procedures to communicate frequently with the General Contractor and Owner

20.1. The site supervisor should attend the formal weekly update and progress meetings with the General Contractor and/or owner to provide (and receive) an update on the progress of the work and current issues.

- Coordination issues, delays, differing conditions, etc,. should be identified at these meetings so that issues can be resolved.
- The meetings are typically held at the jobsite and often present a positive opportunity to move the project forward. A typical agenda for this type of meetings contain items such as the review of the last meeting minutes, the review of submittals status, and the review of the schedule. An example is provided at **Figure 4.17** (*Construction Jobsite Management*, 2004 by William R. Mincks & Hal Johnston).
- The electrical contractor should keep a list of their open issues rather than rely on the General Contractor's list, and these issues should be submitted to the General Contractor each week.

20.2. The site supervisor should arrange a formal daily meeting with the General Contractor to exchange information and address issues.

- It may be necessary to formally meet once a day; for example, a morning meeting before work commences may be necessary to resolve daily issues that cannot wait to be addressed in the weekly meeting.

20.3. Implement informal communication procedures with the General Contractor to supplement the formal meetings.

- For example, establish "rules" for when the site supervisor should contact the General Contractor to seek information or approval (e.g., if the electrical contractor discovers a changed condition that may cause a delay)

Activity 21: Keep the CEO/VP informed of progress and involved with the project through reports, meetings, etc.

21.1. The CEO/VP should receive an update report monthly or weekly that identifies progress of the work, work hours expended versus work hours earned, open issues, pending change orders, and sources of delay.

- If a significant issue is hindering progress, the CEO/VP can assist with resolving the issue at a higher level.

21.2. The CEO/VP should be invited to, and should attend, the project update meeting at least once per month to demonstrate their support and assist with resolving issues.

- The CEO/ VP presence will reinforce the notion that the electrical contractor is a committed team member that will be fair but also expects to be treated fairly.

TABLE 4.5: Communication Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Project Manager: _____

Start Date: _____

COMMUNICATION CHECKLIST FOR PROJECT MANAGEMENT			
☑.	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
18. Implement procedures to communicate frequently with the foreman, especially to resolve problems			
☐		1	The site supervisor should arrange a formal daily meeting with the foreman to exchange information and address issues
☐		2	Implement informal communication procedures to supplement the formal meetings
19. Implement procedures to communicate frequently with vendors and subcontractors			
☐		1	The site supervisor should arrange a formal weekly or bi-weekly phone call with vendors and subcontractors to provide an update on the progress of the work and the status of materials and services that have been ordered
☐		2	Vendors and subcontractors should receive copies of the most current schedule and meeting minutes as one method for keeping them updated on the progress of the work
20. Implement procedures to communicate frequently with the General Contractor and Owner			
☐		1	The site supervisor should attend the formal weekly update and progress meetings with the General Contractor and/or owner to provide (and receive) an update on the progress of the work and current issues
☐		2	The site supervisor should arrange a formal daily meeting with the General Contractor to exchange information and address issues
☐		3	Implement informal communication procedures with the General Contractor to supplement the formal meetings
21. Keep the CEO/VP informed of progress and involved with the project through reports, meetings, etc.			
☐		1	The CEO/VP should receive an update report monthly or weekly that identifies progress of the work, work hours expended versus work hours earned, open issues, pending change orders, and sources of delay
☐		2	The CEO/VP should be invited to, and should attend, the project update meeting at least once per month to demonstrate their support and assist with resolving issues

Project Number:_____

Project Name:_____

Meeting Time, Date and Location:_____

Project Manager:_____

CONSTRUCTION MEETING AGENDA

Agenda Items:

1. Introduction to Attendees
2. Review of last Meeting Minutes
3. Submittal Status Reveiw
4. Schedule Status Review
5. RFI's Review
6. Change Order Status
7. New Business Discussion

*Copies of logs, schedules and past meeting minutes should be provided to all attendees for better clarification and communication during the meeting.

FIGURE 4.17: Project Meeting Agenda

4.6 Scheduling

As identified in the *Electrical Pre-Construction Planning Process Implementation Manual,* the project schedule is a manifestation of the project plan and should be used as a tool to communicate the plan to all team members, including field personnel, owners, and other contractors on the jobsite. Consequently, during the planning process, a separate bar chart schedule should be developed, and this schedule should be used to track progress during execution of the work. The electrical schedule should be provided to the General Contractor at the commencement of the work, and updates should be provided regularly to alert the General Contractor of any issues and delays. From the project schedule, a look-ahead schedule that is used to monitor field installation is strongly recommended for use. The site supervisor can use the look-ahead schedule to plan the work day-to-day, and short-term milestones can be identified for accomplishment.

4.6.1 What Activities Should be Performed During Scheduling?

Scheduling consists of six activities. **Table 4.6** provides the scheduling activities in a convenient checklist.

Activity 22: Review the schedule regularly and identify milestone dates that must be met

22.1. As mentioned under Activity 15, current progress should be annotated weekly on the schedule and any changes should be brought to the attention of the General Contractor if the change resulted from a delay, changed condition, or additional work.

22.2. Short-term milestone dates that must be met, should be annotated for further discussion with the site supervisor, foreman, vendors, and subcontractors.

22.3. As mentioned under Activity 15, present your schedule during weekly update meetings with the General Contractor, and provide a copy to the General Contractor.

- This will provide constructive notice to the General Contractor if your work is being delayed or impacted.

22.4 Keep an archive of all weekly schedules with comments and annotations in order to understand what went right/wrong and what needs to be improved. This documentation will also be useful in case a claim arises against the General Contractor or from a Subcontractor.

Activity 23: Review the schedule routinely with field personnel to ensure all parties understand the milestones

23.1. During the formal meeting of the Project Manager, site supervisor, and foreman, the schedule should be reviewed to determine the short and long-term milestones that must be met.

23.2. The short-term milestones should be given special attention to ensure the dates are achievable.

Activity 24: Identify work that impacts electrical activities

24.1. Each week, and sometimes each day, the Project Manager and site supervisor should identify activities that must be coordinated with other trades, and the proper coordination should be implemented

- There are two types of activities that can impact the electrical work. The first are those activities that are required for the electrical contractor to perform its work, such as installation of HVAC equipment before power can be hooked up. The second are activities that potentially conflict with electrical activities, especially activities that are performed in the same geographic space.

24.2. If an upcoming (but not immediate) coordination issue is identified the Project Manager should introduce the issue at the Weekly Coordination Meeting with the General Contractor to initiate coordination.

- **Example:** One way to continuously resolve conflicts is to circulate coordination drawings every week. These drawings (provided in .dwg format) allow each contractor to create a layer that shows their upcoming work. Then, at the weekly meeting, all layers are displayed so that all parties clearly see the potential conflicts and resolutions can be developed.

Activity 25: Give the General Contractor input on the main schedule and the activities that need to be reviewed by all parties

25.1. Each week at the Weekly Update Meeting, the Project Manager should review the electrical schedule with the customer, general contractor, other trade contractors, and suppliers to resolve any conflicts.

- **Note:** The Electrical Contractor often adapts its schedule to the General Contractor's schedule.

25.2. The Project Manager should ensure the electrical schedule has been integrated into the General Contractor's overall project schedule each week so that their requirements are properly taken into consideration.

- **Example:** The electrical contractor should ask the general contractor to add all of the electrical line items to the baseline project schedule and provide a digital file to simplify the task.

Activity 26: Update the schedule regularly to track progress

26.1. Weekly updates to the schedule should be made to ensure tasks are being completed as planned and, if not, the reasons for task incompletion is identified and corrected.

26.2. The schedule should be used to document progress and identify corrections that need to be made.

26.3. The schedule should also be used to document delays in the work caused by other parties which might result in a claim. Hence, weekly schedule updates are an important part of the control process.

- Every week, the schedule needs to be discussed at the Weekly Meeting so that the general contractor is aware of any delays or issues. Claims will be easier to defend if the general contractor is made aware of all issues.

Activity 27: Review or establish a look-ahead scheduling process

27.1. The look-ahead scheduling process should use the project schedule to look ahead to the work that must be completed in the next one, two, or three weeks.

- **Note:** The Electrical Subcontractor should endeavor to obtain an accurate weekly update of the schedule by the general contractor so that look-ahead schedules are reflective of actual work on the horizon.

27.2. Once the Project Manager, site supervisor, and foreman have established the current look-ahead schedule, the workers, materials, and equipment that are needed to complete the work should be ordered or arranged.

- **Example:** Special equipment or materials that require a longer-lead shipping and delivering time will need to be closely coordinate with the look-ahead schedules to make sure they are on site when needed.
- **Example**: Look-ahead scheduling can also be used to determine whether sufficient workers are on site to complete the work. If there are insufficient workers to complete the expected workload, the electrical contractor will need to hire additional worker or have the on-site workers work overtime.

27.3. As part of the look-ahead scheduling process, the site supervisor should talk to the foremen to determine whether they have the tools and materials needed to complete the work and to discuss possible ways to improve productivity.

27.4. The look-ahead schedule should also be used to identify specific coordination issues that will need attention during the schedule timeframe.

27.5. Because some activities may be on the critical path, the look-ahead schedule should be compared to the baseline schedule to identify any activities that are particularly important.

- **Example:** The Critical Path is the path of activities that determine the duration of the project. Therefore, it is essential that all activities on this path be completed on time.

27.6. For repetitive tasks, maintaining the same crew will often result in an improvement in productivity. This improvement can be tracked and, as a result of the improvement, the duration of tasks can be revised.

27.7. Be sure to account for the possibility of bad weather for those tasks that will be performed outside during the look-ahead period.

- **Example:** Snow, wind, high or very cold temperatures can delay the construction. Ten-day forecasts can be helpful for determining the expected weather during this time.

27.8. If needed, the electrical contractor may be able to negotiate more time for completing tasks that are not on the critical path. The reasons for the extra time must be explained to the general contractor's Project Manager and all parties must agree to the no-cost change to the schedule.

TABLE 4.6: Scheduling Process Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Project Manager: _____

Start Date: _____

SCHEDULING PROCESS CHECKLIST FOR PROJECT MANAGEMENT			
☑.	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
22. Review the schedule regularly and identify milestone dates that must be met			
☐		1	As mentioned under Activity 15, current progress should be annotated weekly on the schedule and any changes should be brought to the attention of the General Contractor if the change resulted from a delay, changed condition, or additional work.
☐		2	Short-term milestone dates that must be met, should be annotated for further discussion with the site supervisor, foreman, vendors, and subcontractors.
☐		3	As mentioned under Activity 15, present your schedule during weekly update meetings with the General Contractor, and provide a copy to the General Contractor.
☐		4	Keep an archive of all weekly schedules with comments and annotations in order to understand what went right/wrong and what needs to be improved. This documentation will also be useful in case a claim arises against the General Contractor or from a Subcontractor.
23. Review the schedule routinely with field personnel to ensure all parties understand the milestones			
☐		1	During the formal meeting of the Project Manager, site supervisor, and foreman, the schedule should be reviewed to determine the short and long-term milestones that must be met.
☐		2	The short-term milestones should be given special attention to ensure the dates are achievable.
24. Identify work that impacts electrical activities			
☐		1	Each week, and sometimes each day, the Project Manager and site supervisor should identify activities that must be coordinated with other trades, and the proper coordination should be implemented.
☐		2	If an upcoming (but not immediate) coordination issue is identified the Project Manager should introduce the issue at the Weekly Coordination Meeting with the General Contractor to initiate coordination.

TABLE 4.6: Scheduling Process Activities Checklist

Project Number: _____

SCHEDULING PROCESS CHECKLIST FOR PROJECT MANAGEMENT			
☑.	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
25. Give the General Contractor input on the main schedule and the activities that need to be reviewed by all parties			
☐		1	Each week at the Weekly Update Meeting, the Project Manager should review the electrical schedule with the customer, general contractor, other trade contractors, and suppliers to resolve any conflicts.
☐		2	The Project Manager should ensure the electrical schedule has been integrated into the General Contractor's overall project schedule each week so that their requirements are properly taken into consideration.
26. Update the schedule regularly to track progress			
☐		1	Weekly updates to the schedule should be made to ensure tasks are being completed as planned and, if not, the reasons for task incompletion is identified and corrected.
☐		2	The schedule should be used to document progress and identify corrections that need to be made
☐		3	The schedule should also be used to document delays in the work caused by other parties which might result in a claim. Hence, weekly schedule updates are an important part of the control process.
27. Review or establish a look-ahead scheduling process			
☐		1	The look-ahead scheduling process should use the project schedule to look ahead to the work that must be completed in the next one, two, or three weeks.
☐		2	Once the Project Manager, site supervisor, and foreman have established the current look-ahead schedule, the workers, materials, and equipment that are needed to complete the work should be ordered or arranged.
☐		3	As part of the look-ahead scheduling process, the site supervisor should talk to the foremen to determine whether they have the tools and materials needed to complete the work and to discuss possible ways to improve productivity.
☐		4	The look-ahead schedule should also be used to identify specific coordination issues that will need attention during the schedule timeframe.
☐		5	Because some activities may be on the critical path, the look-ahead schedule should be compared to the baseline schedule to identify any activities that are particularly important.

TABLE 4.6: Scheduling Process Activities Checklist

Project Number: _____

SCHEDULING PROCESS CHECKLIST FOR PROJECT MANAGEMENT			
☑.	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
27. Review or establish a look-ahead scheduling process (continued)			
☐		6	Because some activities may be on the critical path, the look-ahead schedule should be compared to the baseline schedule to identify any activities that are particularly important.
☐		7	For repetitive tasks, maintaining the same crew will often result in an improvement in productivity. This improvement can be tracked and, as a result of the improvement, the duration of tasks can be revised.
☐		8	Be sure to account for the possibility of bad weather for those tasks that will be performed outside during the look-ahead period.
☐		9	If needed, the electrical contractor may be able to negotiate more time for completing tasks that are not on the critical path. The reasons for the extra time must be explained to the general contractor's Project Manager and all parties must agree to the no-cost change to the schedule.

4.7 Scope & Change Control

Scope Control involves reviewing the scope of work to understand what is and is not included in the project scope, and then closely monitoring the project to ensure that work beyond the contractual scope is not performed without additional compensation. Change Control involves managing changes to the work, including those that have been formally requested by the General Contractor or are orally directed on the jobsite. Change requests (verbal and written) should be documented by the Project Manager or site supervisor and should be formalized in a written change order request sent to the General Contractor for approval. Scope and change control also include monitoring changes to ensure proper compensation is received and documenting other impacts resulting from the changes (such as cumulative impacts of change).

4.7.1 What Activities Should be Performed During Scope & Change Control?

The scope & change control process consists of ten activities. **Table 4.7** provides the scope & change control activities in a convenient checklist.

Activity 28: Review and understand the scope of the project

28.1. Consult the Electrical Pre-Construction Planning Process Implementation Manual published by Electri' International for additional information about conducting a scope review.

28.2. Complete the Scope Review checklist (**Figure 4.18**), originally published in the Electrical Pre-Construction Planning Process Implementation Manual, and ensure both the Project Manager and site supervisor understand the scope of work.

- Review the schedule to understand the timeline for completing work tasks and review the work strategy that has been developed based on the schedule.

Activity 29: Identify problems with the drawings and specifications and develop RFIs

29.1. Review the plans and specifications together to identify any discrepancies that require clarification. Develop Requests for Clarification for scope items that are not clearly defined.

29.2. Also identify any items that are not included in the scope that ordinarily would be a scope item. These excluded items should be verified by the General Contractor.

Activity 30: Submit change order requests and cost proposals in a timely manner

30.1. Change orders may take time to process, and work performed under a change order cannot be billed until the change order has become official Therefore, change order requests should be submitted as soon as the change has been identified.

- **Note:** See **Figure 4.11** for a sample change order procedure.
- **Note:** See **Figure 4.13** for a sample change order form.

Activity 31: Schedule specific meetings with the general contractor to discuss change orders and change issues

31.1. Although numerous meetings are scheduled each week, primarily to provide a status update or to coordinate efforts, an entirely separate meeting should be scheduled with the General Contractor to review changes and change orders.

- If a significant issue is hindering progress, the CEO/VP can assist with resolving the issue at a higher level.

31.2. The change order log (Activity 14), with the list of all outstanding change order requests, should be reviewed to determine the progress of receiving the requested change orders.

- The Electrical Contractor should identify the impact of delays in processing a change order.
- Change order requests that are denied should be annotated as potential claims if the Electrical Contractor believes they are an actual change.

31.3. Likewise, new changes should be discussed to determine the General Contractor's position – for example, does the GC agree or disagree that the extra work is indeed a change? Change order requests should subsequently be developed and submitted for all changes to the work.

- Even if the GC disputes the work, a change order request should be submitted, specifically stating the desired increase in time and/or money. If the change order is denied, it can be turned into a claim later.

Activity 32: Implement a value engineering system to suggest alternate processes or materials

32.1. Consult the Electrical Pre-Construction Planning Implementation Manual published by Electri' International for additional information about value engineering that may have been performed during planning.

- Activity 11 in the Electrical Pre-Construction Planning Implementation Manual specifically addresses value engineering.

32.2. Although most value engineering should have occurred during bidding and planning, a process for regularly seeking out cost and time saving changes should be implemented.

- Opportunities that do not require customer approval are particularly appealing.
- The process will necessarily require identification of opportunities well ahead of the time when they must be implemented.
- It may be necessary to assign one person to conduct a thorough value engineering review. Then, additional opportunities can be identified during construction.

32.3. Present value engineering (VE) opportunities to the General Contractor, including cost and time difference between the as-bid and VE options.

- The Project Manager should determine the cost and time savings or expenditure to implement a VE option.
- Although the goal is typically cost savings, occasionally a VE option will be selected to save time. Hence, there will likely be a tradeoff.

Activity 33: Document official change orders and incorporate them into the budget and schedule

33.1. Once change orders have been approved, they should be immediately incorporated into the budget so that they can be billed.

- However, as noted in Activity 35, changes should be tracked separately so that the Electrical Contractor can identify any additional impacts caused by the changes but not captured in the change order.

33.2. Likewise, once change orders have been approved, they should be immediately incorporated into the schedule so that they can be properly integrated with the other work.

Activity 34: Purchase materials or subcontracts and inform the field about the selections

34.1. Consult the Electrical Pre-Construction Planning Implementation Manual published by Electri' International for additional information about the buyout process that may have been performed during planning.

- Activities 19 through 24 in the Electrical Pre-Construction Planning Implementation Manual specifically address buyout.

34.2. Activities 19 through 24 in the Electrical Pre-Construction Planning Implementation Manual specifically addresses buyout.

- This will entail reviewing vendor/subcontractor pricing; negotiating the price; issuing contracts; placing orders; and, requesting submittals.

34.3. The field supervisor should be made aware of the vendors and subcontracts that have been awarded contracts during pre-construction planning and after execution.

- The field supervisor should keep a list of vendors/subcontractors (**Figure. 4.19**). These vendors/subcontractors should be contacted regularly to keep them informed of work progress and to be made aware of any problems that arise.

Activity 35: Track change orders separately from the original scope

35.1. The resources expended to complete work under a change order should be tracked separately from the original scope of work.

- This includes materials, labor, and equipment costs

35.2. Additional costs incurred because of the changes, which was not captured in the original change request, may need to be filed as a claim.

Activity 36: Use cost codes to account for activities

36.1. Consult the Electrical Pre-Construction Planning Implementation Manual published by Electri' International for additional information about cost code development that may have been performed during planning.

- Activity 27 in the Electrical Pre-Construction Planning Implementation Manual specifically addresses development of a cost code scheme.

36.2. If a cost code scheme was not developed during planning, it should be developed as part of this activity.

- Typically, a company has a standard set of cost codes. Hence, this activity essentially involves assigning a cost code to the work activities.

36.3. The cost code scheme should also be used to resource-load your schedule so that activities can be linked to specific cost codes and tracked accordingly.

- Cost codes assigned to resources in a resource-loaded schedule can be used to track overages and underruns of costs for specific activities.
- This can help you identify materials that were more expensive than estimated (for example) or better/worse productivity than expected.

Activity 37: Track labor costs and compare actual costs to estimated costs

37.1. Actual labor costs that exceed estimated labor costs may be a sign of poor productivity, changes, or scope increases. Hence, any variance should be investigated to find its cause.

- Labor hours and labor costs should be tracked regularly (at least weekly) so that variances can be immediately investigated.
- Corrections can often be made if the variance is caught early.

TABLE 4.7: Scope & Change Control Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Project Manager: _____

Start Date: _____

SCOPE & CHANGE CONTROL CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
28. Review and understand the scope of the project			
☐		1	Consult the *Electrical Pre-Construction Planning Process Implementation Manual* published by Electri' International for additional information about conducting a scope review
☐		2	Complete the Scope Review checklist (**Figure 4.18**), originally published in the *Electrical Pre-Construction Planning Process Implementation Manual,* and ensure both the Project Manager and site supervisor understand the scope of work.
☐		3	Review the schedule to understand the timeline for completing work tasks and review the work strategy that has been developed based on the schedule.
29. Identify problems with the drawings and specifications and develop RFIs			
☐		1	Review the plans and specifications together to identify any discrepancies that require clarification. Develop Requests for Clarification for scope items that are not clearly defined.
☐		2	Also identify any items that are not included in the scope that ordinarily would be a scope item. These excluded items should be verified by the General Contractor.
30. Submit change order requests and cost proposals in a timely manner			
☐		1	Change orders may take time to process, and work performed under a change order cannot be billed until the change order has become official Therefore, change order requests should be submitted as soon as the change has been identified.
31. Schedule specific meetings with the GC to discuss change orders and change issues			
☐		1	Although numerous meetings are scheduled each week, primarily to provide a status update or to coordinate efforts, an entirely separate meeting should be scheduled with the General Contractor to review changes and change orders.

TABLE 4.7: Scope & Change Control Activities Checklist (continued)

Project Number: _____

31. Schedule specific meetings with the GC to discuss change orders and change issues (continued)			
☐		2	The change order log (Activity 14), with the list of all outstanding change order requests, should be reviewed to determine the progress of receiving the requested change orders
☐		3	Likewise, new changes should be discussed to determine the General Contractor's position – for example, does the GC agree or disagree that the extra work is indeed a change? Change order requests should subsequently be developed and submitted for all changes to the work.
32. Implement a value engineering system to suggest alternate processes or materials			
☐		1	Consult the *Electrical Pre-Construction Planning Implementation Manual* published by Electri' International for additional information about value engineering that may have been performed during planning.
☐		2	Although most value engineering should have occurred during bidding and planning, a process for regularly seeking out cost and time saving changes should be implemented.
☐		3	Present value engineering opportunities to the General Contractor, including cost and time difference between the as-bid and VE options.
33. Document official change orders and incorporate them into the budget and schedule			
☐		1	Once change orders have been approved, they should be immediately incorporated into the budget so that they can be billed.
☐		2	Likewise, once change orders have been approved, they should be immediately incorporated into the schedule so that they can be properly integrated with the other work.
34. Purchase materials or subcontracts and inform the field about the selections			
☐		1	Consult the *Electrical Pre-Construction Planning Implementation Manual* published by Electri' International for additional information about the buyout process that may have been performed during planning.
☐		2	If the buyout process was not completed during planning, the Project Manager should continue buying out the job after executing the work.
☐		3	The field supervisor should be made aware of the vendors and subcontracts that have been awarded contracts during pre-construction planning and after execution

TABLE 4.7: Scope & Change Control Activities Checklist (continued)

Project Number: _____

35. Track change orders separately from the original scope			
☐		1	The resources expended to complete work under a change order should be tracked separately from the original scope of work.
☐		2	Additional costs incurred because of the changes, which was not captured in the original change request, may need to be filed as a claim.
36. Use cost codes to account for activities			
☐		1	Consult the *Electrical Pre-Construction Planning Implementation Manual* published by Electri' International for additional information about cost code development that may have been performed during planning.
☐		2	If a cost code scheme was not developed during planning, it should be developed as part of this activity.
☐		3	The cost code scheme should also be used to resource-load your schedule so that activities can be linked to specific cost codes and tracked accordingly.
37. Track labor costs and compare actual costs to estimated costs			
☐		1	Actual labor costs that exceed estimated labor costs may be a sign of poor productivity, changes, or scope increases. Hence, any variance should be investigated to find its cause.

Project Number: _____

Project Name: _____

Location: _____

Project Manager/Field Supervisor: _____

Scope Review Completion Date: _____

SCOPE AND SCHEDULE REVIEW ITEMS			
Completed	**Completed By?**	**Date Completed?**	**Item to Review**
☐			Contract
☐			Plans
☐			Specifications
☐			Cost estimate and bid breakdown
☐			Referenced/applicable codes or regulations
☐			Quality requirements
☐			Safety requirements
☐			Special conditions
☐			Addendums
☐			Temporary power and lighting requirements
☐			Owner/CM/GC-furnished materials
☐			Vendor pricing and qualifications
☐			Owner/CM/GC schedule
☐			Internal schedule submitted with bid
☐			Work sequence and work by others
☐			Required coordination with other trades
☐			Material and equipment deliveries
☐			Anticipated weather problems or holidays
☐			Required labor
☐			Labor rates and potential increases
☐			Crew mix
☐			Administrative procedures (submittals/RFIs/changes)

FIGURE 4.18: Scope & Schedule Review Items

Project Number: _____

SCOPE AND SCHEDULE REVIEW ITEMS			
Completed	**Who furnishes?**	**Who installs?**	**What to Review in the Plans and Specifications**
☐			Access doors
☐			Asbestos abatement
☐			Carpentry (miscellaneous)
☐			Clean up
☐			Conduit (sizes and quantities)
☐			Crane
☐			Cutting and patching
☐			Demolition and removal
☐			Electric motors
☐			Electric starters
☐			Excavation and backfill
☐			Fire alarm wiring
☐			Fire alarm devices
☐			Hand dryers
☐			Hoists for personnel
☐			Hoists for materials
☐			Interior layout
☐			Painting
☐			Panels
☐			Scaffolding
☐			Site access
☐			Site surveying
☐			Temporary power
☐			Underground utilities
☐			Wire (and/or pipe and wire)

FIGURE 4.18: Scope & Schedule Review Items (continued)

Project Number: _____
Project Name: _____
Location: _____
Project Manager: _____

Name of the company	Contact person	Address	Telephone	Email	Vendor/ Subcontractor	Service perform or material deliver

FIGURE 4.19. Sample List of Vendors and Suppliers

4.8 Cost Control & Billing

Cost Control begins by reviewing the project costs to understand what is and is not included in the budget, and then closely monitoring costs to ensure that costs are not exceeded or that additional costs resulting from changes are processed accordingly. Control also refers to the actions taken in order to bring any deficiencies of the project back into conformance. Billing involves the submission of invoices for work that has been performed. Both Cost Control and Billing together encompass tracking and forecasting the financial aspects of the project.

4.8.1 What Activities Should be Performed During Cost Control & Billing?

The cost control & billing process consists of six activities. **Table 4.8** provides the cost control & billing activities in a convenient checklist.

ACTIVITY 38: Track material and subcontractor costs and compare actual costs to estimated and earned costs

38.1 Establish a database or spreadsheet to record all material and subcontract costs (**Figure 4.21**).

38.2 Set up fields in the spreadsheet to record estimated costs, earned costs, and actual costs.

38.3 Compare actual costs to earned and estimated costs to identify any cost variances that exist.

38.4 Identify mitigation measures to reduce or eliminate any cost variances.

ACTIVITY 39: Once change orders have been approved, include them in the billing process

39.1. Often, change order work is completed before the official change order has been received. In such cases, the Project Manager should bill for the change order work immediately following receipt of the change order.

39.2. For large changes that span more than one billing cycle, the change order work should be billed along with the regular billing items but payment should be tracked separately.

- Change order costs should be tracked separately from the original scope of work so that cost growth can be properly accounted for.
- Two types of cost growth are typically present on a job: changed costs that are recoverable and costs that exceed the original estimate and are not recoverable.

ACTIVITY 40: Compare the actual project costs to the budget and earned value to track progress

40.1. As mentioned in Activity 38, a database or spreadsheet should be established to record estimated, actual, and earned costs (see **Figure 4.22**).

- Additional information about Earned Value Management Systems can be found in Humphreys, G.C. (2002). Project management using earned value. Orange, CA: Humphreys & Associates.
- Earned value, also known as the Budgeted Cost for Work Performed (BCWP) refers to:
  - The determination of the value of how much work has been performed on the basis of what was "budgeted" for that work
  - It is the budgeted cost for work that has been accomplished or value of the work that has actually been completed
- Budgeted cost for work scheduled –BCWS
  - It is the budgeted cost for the project based on the original schedule and estimated resources.
  - "What you thought you were going to spend"
- Actual cost of work performed -ACWP
  - Actual cost of the work that has been accomplished to date
  - "What you actually spent"
- Schedule variance (SV) = BCWP –BCWS
  - The difference between the budgeted cost for work scheduled and the budgeted cost for work performed.
  - SV>0, ahead of schedule
  - SV<0, behind schedule
- Cost variance (CV) = BCWP –ACWP
  - The difference between the budgeted and actual costs of work performed.
  - CV>0, under budget
  - CV<0, over budget
- Schedule performance index - SPI
  - SPI = BCWP/BCWS
  - This ratio provides a direct relationship between work performed and work scheduled based on budgeted costs.
  - SPI>1, ahead of schedule
  - SPI<1, behind schedule
- Cost performance index - CPI
  - CPI = BCWP/ACWP
  - This ratio provides a direct relationship between budgeted cost for work performed and actual costs.
  - CPI>1, under budget
  - CPI<1, over budget
- Based on these basic values, you can forecast:

- Budget at completion (BAC) – Original total cost estimate of the project.
- Estimated cost at completion (EAC) –The forecasted cost to complete the project based on the work performed to date and estimates of future costs and conditions.

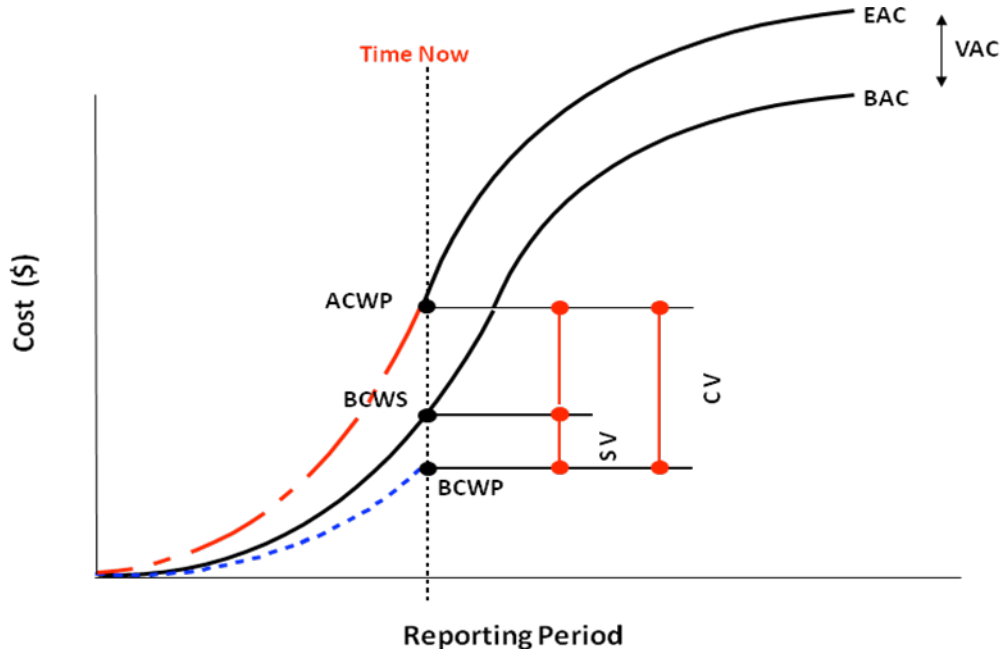


Figure 30. Earned Value Progress Measurement Diagram

40.2. Compare actual costs to earned and estimated costs to identify any cost variances that exist. The difference between budgeted costs and actual costs is the cost variance – an indication of cost performance.

40.3. Identify mitigation measures to reduce or eliminate any cost variances.

ACTIVITY 41: Use the schedule of values to track progress

41.1. In addition to comparing budgeted costs to actual costs, the Project Manager should routinely examine the schedule of value to determine whether billed costs are aligned with expected expenditures to date (see **Figure 4.23**).

41.2. Differences between expected costs billed to date and actual billed costs should be investigated, and corrective actions should be identified if necessary.

ACTIVITY 42: Use a pre-bill process to seek preliminary approval of the invoice from the general contractor

42.1. A preliminary invoice should be prepared by the project manager and submitted to the General Contractor so that sufficient time is available to have the invoice reviewed by the General Contractor. This is often called a "pencil copy."

42.2. The preliminary invoice may have corrections made by the General Contractor, and these modifications should be resolved prior to submitting the actual invoice.

42.3. In some cases, a meeting with the General Contractor may be helpful to resolve any issues and receive preliminary approval of the invoice.

ACTIVITY 43: Submit invoices of your costs in a timely manner

43.1. Annotate the due date of all invoices each month, and make sure sufficient time has been built into the invoicing process to allow the invoice to be reviewed by all involved parties.

43.2. A delay in submitting an invoice could mean waiting up to 90 days or longer to get paid, which can negatively impact the cash flow of the company. As a result, all invoices should be submitted on time.

TABLE 4.8. Cost Control & Billing Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Project Manager: _____

COST CONTROL & BILLING CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
38. Track material and subcontractor costs and compare actual costs to estimated and earned costs			
☐		1	Establish a database or spreadsheet to record all material and subcontract costs
☐		2	Set up fields in the spreadsheet to record estimated costs, earned costs, and actual costs
☐		3	Compare actual costs to earned and estimated costs to identify any cost variances that exist
☐		4	Identify mitigation measures to reduce or eliminate any cost variances
39. Once change orders have been approved, include them in the billing process			
☐		1	Often, change order work is completed before the official change order has been received. In such cases, the Project Manager should bill for the change order work immediately following receipt of the change order
☐		2	For large changes that span more than one billing cycle, the change order work should be billed along with the regular billing items but payment should be tracked separately
40. Compare the actual project costs to the budget and earned value to track progress			
☐		1	As mentioned in Activity 39, a database or spreadsheet should be established to record estimated, actual, and earned costs
☐		2	Compare actual costs to earned and estimated costs to identify any cost variances that exist. The difference between budgeted costs and actual costs is the cost variance – an indication of cost performance
☐		3	Identify mitigation measures to reduce or eliminate any cost variances
41. Use the schedule of values to track progress			
☐		1	In addition to comparing budgeted costs to actual costs, the Project Manager should routinely examine the schedule of value to determine whether billed costs are aligned with expected expenditures to date
☐		2	Differences between expected costs billed to date and actual billed costs should be investigated, and corrective actions should be identified if necessary

TABLE 4.8. Cost Control & Billing Activities Checklist (continued)

Project Number: _____

COST CONTROL & BILLING CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
42. Use a pre-bill process to seek preliminary approval of the invoice from the GC			
☐		1	A preliminary invoice should be prepared by the project manager and submitted to the General Contractor so that sufficient time is available to have the invoice reviewed by the General Contractor. This is often called a "pencil copy."
☐		2	The preliminary invoice may have corrections made by the General Contractor, and these modifications should be resolved prior to submitting the actual invoice
☐		3	In some cases, a meeting with the General Contractor may be helpful to resolve any issues and receive preliminary approval of the invoice
43. Submit invoices of your costs in a timely manner			
☐		1	Annotate the due date of all invoices each month, and make sure sufficient time has been built into the invoicing process to allow the invoice to be reviewed by all involved parties
☐		2	A delay in submitting an invoice could mean waiting up to 90 days or longer to get paid, which can negatively impact the cash flow of the company. As a result, all invoices should be submitted on time

PROJECT NUMBER: _____

PROJECT NAME: _____

LOCATION: _____

PROJECT MANAGER: _____

MATERIAL AND LABOR TRACKING REPORT

CSI DIVISION	DESCRIPTION	LABOR	MATERIALS	EQUIPMENT	SUBCONTRACTS	OH&P (15%)	TOTAL

FIGURE 4.21 Budget Breakdown and Tracking Spreadsheet

PROJECT NUMBER: _____

PROJECT NAME: _____

LOCATION: _____

PROJECT MANAGER: _____

SCHEDULE OF VALUES

(A) LINE ITEM	(B) DESCRIP-TION	(C) CONTRACT VALUE	(D) CHANGE ORDER	(E) TOTAL ESTIMATES =(C+D)	(F) COMMITED COST	(G) COMMITED COST INVOICED	(H) NON COMMITED COST INVOICED	(I) TOTAL (F+H)°	(J) COST TO COMPLETE	(K) TOTAL ESTIMATED COST AT COMPLETION =(I+J)	(L) VARIANCE =(K-E)

FIGURE 4.22 Earned Value Spreadsheet

PROJECT NUMBER: _____

PROJECT NAME: _____

LOCATION: _____

PROJECT MANAGER: _____

SCHEDULE OF VALUES

(A) LINE ITEM	(B) DESCRIPTION	(C) CONTRACT VALUE	(D) PREVIOUSLY COMPLETED	(E) COMPLETED THIS PERIOD	(F) = (D+E) COMPLETED TO-DATE	(G) = (F/C) % COMPLETE	(H) = (C-F) BALANCE TO FINISH	(I) RETAINAGE

TABLE 4.23 Company Schedule of Value

4.9 Subcontractor Management

The subcontractor management process involves understanding each subcontractor's scope of work, developing and administering the contract, establishing a schedule for subcontracted work, and processing submittals and shop drawings. Management of subcontractors requires open lines of communication and overall good teamwork and coordination. Electrical contractor personnel should strive to achieve mutual trust and respect with all subcontractors because the success of operations will primarily be achieved through cooperation. Fairness and timely payments will be necessary to ensure the subcontractor's business remains viable. Fairness will also be conducive to future partnerships.

4.9.1 What Activities Should be Performed During Subcontractor Management?

The subcontractor management process consists of seven activities. **Table 4.9** provides the subcontractor management activities in a convenient checklist.

ACTIVITY 44: Review the scope and document the subcontractors' scope of work

44.1. In conjunction with Activity 28, review the scope of work to identify work that will be performed by subcontractors.

44.2. Determine whether the scope of the subcontracted service includes "labor and equipment" or ""labor, materials and equipment"

44.3. Ensure the subcontractors' scope of work has been documented so that the site supervisor and foreman can avoid requesting extra work or they understand when the requested work is outside the scope.

- Often the foreman or site supervisor can inadvertently order extra work beyond a subcontractor's scope, resulting in additional costs to the electrical contractor. To avoid unexpected extra costs, the site supervisor and foreman should be familiar with subcontractors' scope of work.

ACTIVITY 45: Make sure the subcontractors are licensed and are qualified to do the job

45.1 Review critical details of the scope of work prior to award to ensure the subcontractor is capable of doing the work. This will avoid future conflicts and litigation.

- During interviews of the subcontractors, prepare a non exhaustive list of what as to be performed. The review of the scope should consist of:
  - A description of work to be performed
  - Any clarifications about the items included in the bid
  - A list of specific items which will not be included
  - Any commercial exceptions noted by the bidder

45.2 Prior to awarding a contract, check the subcontractor's references.

- Subcontractors should be requested to provide references for recently completed projects as part of the bidding process.
- These references should be contacted to determine how well the contractor has performed on previous jobs and how well they are likely to perform on the current job.
- Questions to ask the references are identified in **Figure 4.24**, along with a suggested scoring system where 1 = poor and 5 = excellent.

45.3 Prior to awarding a contract, check the subcontractor's license status.

- Typically, licenses can be looked up on the internet through the licensing board website.
- Visit your state's licensing board website to make sure your subcontractor has an active license and no disciplinary action taken against them.

ACTIVITY 46: Implement subcontracts

46.1. Check to make sure the subcontracts were developed during the pre-construction planning or procurement phase of the project. If they were not, the first step is to develop subcontracts based on the scope of work and bid submitted by the subcontractor.

- Consult the *Electrical Pre-Construction Planning Implementation Manual* published by Electri' International for additional information about developing and issuing contracts.

46.2. Ensure the subcontract has been signed and executed by all parties prior to the subcontractor mobilizing to the jobsite.

- If a complete contract has not been approved and signed, but the work needs to proceed, issue a letter contract that authorizes the subcontractor to begin work.

46.3. The project manager and site supervisor should review the contract to understand the terms and conditions.

- Consider housing a copy of the contract in the job trailer so that the project manager and site supervisor can refer to it if they have questions about conformance or scope of work.

46.4. The project manager and site supervisor should establish a system for verifying that the subcontractor is performing the work in accordance with the contract documents.

- "Implementation of the contract" essentially means ensuring that the contractor performs the work in accordance with the contract documents (plans, specifications, general conditions, etc.). Hence, verification of conformance is a critical aspect of contract implementation.

ACTIVITY 47: Determine the subcontractors' schedule based on input from the subcontractors

47.1. Finalize the subcontractors' schedules by outlining the tasks that need to be completed and assigning a start date, duration, and completion date to each task.

- This activity may have been completed during pre-construction planning. If so, review the schedule to verify it is realistic and achievable.

47.2. Input from the subcontractor will be essential to ensure that the schedule is realistic and that the subcontractor "buys in" to the schedule.

- Hold a meeting with the subcontractor to review their work tasks and schedule. Identify potential obstacles and remove the obstacles so work can proceed as expected.

ACTIVITY 48: Provide information to the site supervisor and foreman about the subcontractors and their point of contact

48.1. Distribute a contact list to the site supervisor and foreman that has the subcontractors' company names, point of contact, and phone number.

ACTIVITY 49: Schedule onsite visits and walk through the jobsite with the subcontractors

49.1. Prior to initiating work, make sure the subcontractor is prepared on-site to perform the job at full efficiency.

- If an on-site office is necessary, one should be rented prior to starting work.
- Access should be made to electricity, water, sanitary, and other utilities to perform the job.

49.2. A schedule should be established for verifying the subcontractors performance by walking through the site with the subcontractor.

- Regular weekly or bi-weekly walk-throughs are recommended.

49.3. During the walk-through, conformance with contract documents should be verified and discrepancies should be noted (see **Figure 4.25**).

49.4. Routine checks on safety and security should be made throughout the performance period.

49.5. Following each walk-though, the project manager or site supervisor should send a list summarizing the results, with a deadline for correcting any deficiencies.

- The list should be sent to the subcontractor as an attachment to a formal letter. The purpose of the letter is to provide adequate notification of any discrepancies that have been found that need to be corrected.

49.6. Following the walk-through, both parties should agree on the task or percentage of each task that has been achieved.

- Accurate (rather than early) cash flow will be necessary, so parties should avoid front loading the billing.

49.7. Following each walk-through, the schedule should be updated to reflect current and future work accurately.

ACTIVITY 50: Request and process submittals and shop drawings from the subcontractors

50.1. Consult the *Electrical Pre-Construction Planning Implementation Manual* published by Electri' International for additional information about processing submittals and shop drawings.

- The manual contains numerous samples of forms and processes that can be used to process and track submittals and shop drawings.

50.2. Develop a list of required submittals and shop drawings and send the list to the subcontractor.

- This activity should be performed while reviewing the plans, specifications, and contract documents.

50.3. Track the submission, processing, and approval of submittals and shop drawings using a computerized tracking system.

- The system should have been set up during the pre-construction planning phase of the project.

50.4. Maintain copies of all submittals and shop drawings in the job trailer so that the site supervisor can verify that installed work conforms to the approved documents.

TABLE 4.9. Subcontractors Management Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Project Manager: _____

SUBCONTRACTORS MANAGEMENT CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
44. Review the scope and document the subcontractors' scope of work			
☐		1	In conjunction with Activity 28, review the scope of work to identify work that will be performed by subcontractors
☐		2	Determine whether the scope of the subcontracted service includes "labor and equipment" or ""labor, materials and equipment"
☐		3	Ensure the subcontractors' scope of work has been documented so that the site supervisor and foreman can avoid requesting extra work or they understand when the requested work is outside the scope
45. Make sure the subcontractors are licensed and are qualified to do the job			
☐		1	Review critical details of the scope of work prior to award to ensure the subcontractor is capable of doing the work. This will avoid future conflicts and litigation
☐		2	Prior to awarding a contract, check the subcontractor's references
☐		3	Prior to awarding a contract, check the subcontractor's license status
46. Implement subcontracts			
☐		1	Check to make sure the subcontracts were developed during the pre-construction planning or procurement phase of the project. If they were not, the first step is to develop subcontracts based on the scope of work and bid submitted by the subcontractor
☐		2	Ensure the subcontract has been signed and executed by all parties prior to the subcontractor mobilizing to the jobsite
☐		3	The project manager and site supervisor should review the contract to understand the terms and conditions
☐		4	The project manager and site supervisor should establish a system for verifying that the subcontractor is performing the work in accordance with the contract documents

TABLE 4.9. Subcontractors Management Activities Checklist (continued)

Project Number: _____

SUBCONTRACTORS MANAGEMENT CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
47. Determine the subcontractors' schedule based on input from the subcontractors			
☐		1	Finalize the subcontractors' schedules by outlining the tasks that need to be completed and assigning a start date, duration, and completion date to each task
☐		2	Input from the subcontractor will be essential to ensure that the schedule is realistic and that the subcontractor "buys in" to the schedule
48. Provide information to the site supervisor and foreman about the subcontractors and the point of contact			
☐		1	Distribute a contact list to the site supervisor and foreman that has the subcontractors' company names, point of contact, and phone number
49. Schedule onsite visits and walk through the jobsite with the subcontractors			
☐		1	A schedule should be established for verifying the subcontractors performance by walking through the site with the subcontractor
☐		2	During the walk-through, conformance with contract documents should be verified and discrepancies should be noted (quality control)
☐		3	Coordination and safety is a subject that should be tackle especially after talking to the superintendant and to the project manager
☐		4	Following each walk-though, the project manager or site supervisor should send a list summarizing the results, with a deadline for correcting any deficiencies
☐		5	Tasks performed and % of completion have to be checked and agreed in order to avoid payment litigation
☐		6	The Schedule has to be checked and reviewed
☐		7	A summary of this meetings has to be made and signed by both parties

TABLE 4.9. Subcontractors Management Activities Checklist (continued)

Project Number: _____

SUBCONTRACTORS MANAGEMENT CHECKLIST FOR PROJECT MANAGEMENT			
50. Request and process submittals and shop drawings from the subcontractors			
☐		1	Consult the Electrical Pre-Construction Planning Implementation Manual published by Electri' International for additional information about processing submittals and shop drawings
☐		2	Develop a list of required submittals and shop drawings and send the list to the subcontractor
☐		3	Track the submission, processing, and approval of submittals and shop drawings using a computerized tracking system
☐		4	Maintain copies of all submittals and shop drawings in the job trailer so that the site supervisor can verify that installed work conforms to the approved documents

PROJECT NUMBER: _____

PROJECT NAME: _____

LOCATION: _____

PROJECT MANAGER: _____

	Grade from 1 to 5 (5 = excellent)			
	Company 1	**Company 2**	**Company 3**	**Company 4**
Technical issues resolved on previous projects				
Adequacy of materials used				
Adequacy of labor in terms of experience and quantity of workers needed to perform the job				
Subcontractor Project Manager performance				
Subcontractor Field Supervisor performance				
Financial Strength				
Safety Performance (check with OSHA)				
Ability to communicate with others				
Ability to cooperate with others				
Total number of points				
Company chosen				

Figure 4.24 Sample References Check Form

PROJECT NUMBER: _____

PROJECT NAME: _____

LOCATION: _____

PROJECT MANAGER: _____

Further Description of the location (floors, building number):	
Participant Name: Contractors **-** **-**	**Participant Name: Subcontractors** **-** **-**
Scope of Inspection:	
Reason of inspection: (Re inspection/ Usual Control)	

Item, task or action that needs correction	**Re-inspection date scheduled**	**Date of correction**	**Date of re-inspection by the subcontractor and contractor**	**Additional comments**

FIGURE 4.25 Project Inspection Report

4.10 Materials Management

Materials Management refers to the process of sourcing, purchasing, expediting, receiving, inspecting, storing, and onsite-handling of materials and equipment needed to complete the work. During the planning process, plans should have been developed for materials storage locations and site facilities to ensure these facilities are located efficiently and promote maximum productivity of workers and equipment. Often a materials manager will be appointed on larger projects to make sure that materials are received when and where they are needed and to avoid loss of materials, theft, damage, or poor quality items.

4.10.1 What Activities Should be Performed During Materials Management?

The materials management process consists of eleven activities. **Table 4.10** provides the materials management activities in a checklist.

ACTIVITY 51: Re-check bid documents to verify required materials and identify potential vendors and vendor responsibilities

51.1. The Project Manager and site supervisor should review the cost estimate to understand the types and quantities of materials that are needed to complete the work.

- Any discrepancies in materials resulting from a difference between what has been estimated and how the Project Manager intends to complete the work should be resolved prior to ordering materials.
- The type of contract will also be an important consideration. If the contract is a unit price contract, attention needs to be paid to the quantity of materials called for on the project documents and actually used in the field because these two values may differ significantly.

51.2. If vendor selection was not performed during the pre-construction planning stage, then the Project Manager will need to identify qualified vendors and receive quotations.

- This is essentially the “buyout” of the project. If it has not been completed, vendor prequalification may be necessary before requesting quotations
- In some cases when an alliance relationship has been established, the Project Manager may be required to select an alliance vendor
- Be sure to keep track of the quotations (via log or computer system) and to sum up the results for the purpose of comparing bidders (see **Figures 4.26 and 4.27**). It may be necessary to select the second low bidder if the first low bidder submits a bid that differs from the RFP.

51.3. A supplement to the request for quotations that outlines specific responsibilities of vendors is important to reduce confusion, conflicts, and claims.

51.4. In some cases, particular equipment or materials will need to have the cut sheets submitted along with the bid so that approval can be obtained by the architect / designer.

ACTIVITY 52: Establish delivery dates for materials and equipment

52.1. The Project Manager and Site Supervisor should review the schedule to determine when specific materials and equipment need to be delivered.

- Materials and equipment that are delivered too soon to the jobsite can create storage problems, opportunities for damage and theft, and financial loss (cash flow, etc.).
- However, ordering materials "just in time" can also create problems because deliveries might be delayed. This can result in workarounds that ultimately decrease productivity and increase the cost of labor.
- Consequently, a compromise must be achieved in which materials are delivered on time for installation but not too soon.

52.2. While the vendor should be provided with a copy of the schedule as part of the quotation process, a separate materials and equipment delivery schedule may be necessary to ensure the vendors are clear about required dates.

ACTIVITY 53: Lock in the pricing for materials and equipment

53.1. After receiving quotations, the Project Manager should contact each vendor to review their quote. Of particular importance is making sure that the vendors have the correct scope of work in their bid.

- **Note:** A scope review sheet should be developed to guide the discussion between the Project Manager and vendor. Any discrepancies should be resolved before selecting a vendor.

53.2. Once vendors have been selected and a final price has been negotiated, the project manager should issue a purchase order or letter contract to lock in the pricing.

- Some vendors may only guarantee their price for a limited time so it is important to secure the bid with a written acceptance of the offer.
- For very long-duration construction projects, the price of some material can drop or increase by up to 20% during a given year. The Electrical Contractor should initiate discussions with the owner and General Contractor about including an escalation clause that will cover the variability in material costs.
- Two types of purchase orders are common (see **Figure 4.28** for an example):
  - Long term purchase order: For large quantities of materials that will be used for the duration of the project.

- Short term purchase order: Typically used for small quantities or limited items and placed with local manufacturers or vendors.

ACTIVITY 54: Develop and issue purchase orders for materials and equipment

54.1. As soon as quotes are negotiated and accepted, the project manager or purchasing agent should develop and issue the purchase order.

54.2. The purchase order should contain the scope of work, specific information about the materials, and the required delivery date.

ACTIVITY 55: Document purchase orders and keep them in a file system

55.1. A copy of all purchase orders should be kept at the jobsite so that the site supervisor can verify the scope of materials and equipment that will be provided by each vendor.

- Purchase orders will be used to verify receipt of all materials and equipment when it is delivered to the site.
- They will also be used to resolve disputes about what should be provided by the vendor.
- A schedule of materials and equipment delivery dates should be constructed from the purchase orders so that the site supervisor can keep track of expected deliveries.

55.2. A separate copy of all purchase orders should be kept by the purchasing agent and will likely be maintained in the Materials Management Information System.

- The purchasing department will use this information to confirm invoices and to expedite and track shipments

ACTIVITY 56: Communicate all material information to field personnel

56.1. The site supervisor should discuss scope of work and delivery dates with foremen to make them aware of the timeline for receiving and installing materials and equipment.

56.2. The site supervisor should also make sure that the on-site materials manager can access all purchase orders and can contact all vendors to expedite deliveries or resolve issues.

- ***Note:*** A list of all vendors should be kept on site with contact information.

ACTIVITY 57: Request submittals, cut sheets and shop drawings from vendors

57.1. If the submittals, cut sheets, and shop drawings were not requested during the pre-construction planning process, they should be requested when a vendor is selected and a purchase order is issued.

57.2. In many cases, material cut sheets for standard items will be submitted along with the quote and these will be processed following the issue of the purchase order.

57.3. Develop a log of required submittals, cut sheets, and shop drawings (if this has not already been done in the planning phase) and use the log to keep track of submissions.

ACTIVITY 58: Check material packaging, labels, and status regularly as part of an onsite materials management system

58.1. As materials arrive on site, a designated individual must inspect the items to ensure no damaged items have been delivered.

- The individual may be the site supervisor, a full time materials manager, or a part time appointed materials manager.
- Establish who is authorized to sign for receipt of the delivered materials.
- Ensure the receipt for materials is reviewed by the site supervisor and a copy if placed on file in the field office.

58.2. All items must also be recorded so that a record of delivery and condition are maintained by the electrical contractor.

58.3. If a bar coding system is used, all items must be tagged with a bar code and must be annotated in the materials management information system.

ACTIVITY 59: Reconcile the invoice with the estimated material costs

59.1. As materials and equipment are received, actual costs (as identified on invoices) should be entered into the accounting system.

59.2. Actual invoices costs should be compared to original estimated costs and should be reconciled with the purchase order.

59.3. Discrepancies between bid/estimated costs and actual invoiced costs should be discussed with the vendor.

- If the vendor is not able to adequately justify the additional costs, they probably will not get paid the amount over the purchase order price.

ACTIVITY 60: Implement an effective material handling system on site

60.1. A variety of on-site material handling strategies are available. The electrical contractor will need to craft a strategy that best fits the characteristics of the project.

- **Example:** In some cases, a materials manager and staff will work directly on the jobsite if the job is large enough to warrant a full time operation. The materials manager is responsible for purchasing, expediting, receiving, inspecting, recording, storing, and dispensing materials.
- **Example:** A concession operation may also be warranted where a vendor keeps a consumables trailer on site and re-stocks items each week. The electrical contractor must monitor quantities to be sure there are enough materials to continue working each day.

ACTIVITY 61: Schedule material delivery using staged releases to the site based on phases

61.1. Although nearly all materials and equipment, other than consumables, will be ordered during the buyout phase, arrange delivery based on project phases so that materials do not have to be stored on site.

61.2. Numerous options exist for delivery of materials and equipment, and the Electrical Contractor should understand at what point payment and responsibility for shipment transfers from the vendor to the contractor.

- Free On Board (FOB) – Site: Essentially the vendor takes care of the delivery, including insurance, until it is delivered to the site.
- Free On Board (FOB) – Warehouse: The Electrical Contractor must make arrangements to get the materials from the vendor's warehouse to the jobsite.
- Other options also exist, and the contractor must establish at what point and location responsibility for materials transfers from the vendor to the contractor.

61.3. Make arrangement with vendors to deliver materials directly to the point where they will be installed

- This might mean that a union driver will need to be hired or that the vendors need to collaborate with the teamsters union to ensure a union employee is assisting with deliveries.

61.4. Ensure the schedule depicts when various materials will be needed based on the project phases.

TABLE 4.10. Materials Management Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Project Manager: _____

MATERIALS MANAGEMENT CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
51. Re-check bid documents to verify required materials and identify potential vendors and vendor responsibilities			
☐		1	The Project Manager and site supervisor should review the cost estimate to understand the types and quantities of materials that are needed to complete the work
☐		2	If vendor selection was not performed during the pre-construction planning stage, then the Project Manager will need to identify qualified vendors and receive quotations
☐		3	A supplement to the request for quotations that outlines specific responsibilities of vendors is important to reduce confusion, conflicts, and claims
☐		4	In some cases, particular equipment or materials will need to have the cut sheets submitted along with the bid so that approval can be obtained by the architect/designer
52. delivery dates for materials and equipment			
☐		1	The Project Manager and Site Supervisor should review the schedule to determine when specific materials and equipment need to be delivered
☐		2	While the vendor should be provided with a copy of the schedule as part of the quotation process, a separate materials and equipment delivery schedule may be necessary to ensure the vendors are clear about required dates
53. Lock in the pricing for materials and equipment			
☐		1	After receiving quotations, the Project Manager should contact each vendor to review their quote. Of particular importance is making sure that the vendors have the correct scope of work in their bid
☐		2	Once vendors have been selected and a final price has been negotiated, the project manager should issue a purchase order or letter contract to lock in the pricing

TABLE 4.10. Materials Management Activities Checklist (continued)

Project Number: _____

☑	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
54. Develop and issue purchase orders for materials and equipment			
☐		1	As soon as quotes are negotiated and accepted, the project manager or purchasing agent should develop and issue the purchase order
☐		2	The purchase order should contain the scope of work, specific information about the materials, and the required delivery date
55. Document purchase orders and keep them in a file system			
☐		1	A copy of all purchase orders should be kept at the jobsite so that the site supervisor can verify the scope of materials and equipment that will be provided by each vendor
☐		2	A separate copy of all purchase orders should be kept by the purchasing agent and will likely be maintained in the Materials Management Information System
56. Communicate all material information to field personnel			
☐		1	The site supervisor should discuss scope of work and delivery dates with foremen to make them aware of the timeline for receiving and installing materials and equipment
☐		2	The site supervisor should also make sure that the on-site materials manager can access all purchase orders and can contact all vendors to expedite deliveries or resolve issues
57. Request submittals, cut sheets and shop drawings from vendors			
☐		1	If the submittals, cut sheets, and shop drawings were not requested during the pre-construction planning process, they should be requested when a vendor is selected and a purchase order is issued
☐		2	In many cases, material cut sheets for standard items will be submitted along with the quote and these will be processed following the issue of the purchase order
☐		3	Develop a log of required submittals, cut sheets, and shop drawings (if this has not already been done in the planning phase) and use the log to keep track of submissions
58. Check material packaging, labels, and status regularly as part of an onsite materials management system			
☐		1	As materials arrive on site, a designated individual must inspect the items to ensure no damaged items have been delivered
☐		2	All items must also be recorded so that a record of delivery and condition are maintained by the electrical contractor
☐		3	If a bar coding system is used, all items must be tagged with a bar code and must be annotated in the materials management information system

TABLE 4.10. Materials Management Activities Checklist (continued)

Project Number: _____

☑	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
59. Reconcile the invoice with the estimated material costs			
☐		1	As materials and equipment are received, actual costs (as identified on invoices) should be entered into the accounting system
☐		2	Actual invoices costs should be compared to original estimated costs and should be reconciled with the purchase order
☐		3	Discrepancies between bid/estimated costs and actual invoiced costs should be discussed with the vendor
60. Implement an effective material handling system on			
☐		1	A variety of on-site material handling strategies are available. The electrical contractor will need to craft a strategy that best fits the characteristics of the project
61. Schedule material delivery using staged releases to the site based on phases			
☐		1	Although nearly all materials and equipment, other than consumables, will be ordered during the buyout phase, arrange delivery based on project phases so that materials do not have to be stored on site
☐		2	Numerous options exist for delivery of materials and equipment, and the Electrical Contractor should understand at what point payment and responsibility for shipment transfers from the vendor to the contractor
☐		3	Make arrangement with vendors to deliver materials directly to the point where they will be installed
☐		4	Ensure the schedule depicts when various materials will be needed based on the project phases

PROJECT NUMBER: _____

PROJECT NAME: _____

LOCATION: _____

PROJECT MANAGER: _____

SUBCONTRACTOR/SUPPLIER/VENDOR BID ANALYSIS					
ITEM TYPE: _____	**VENDORS**				
REVIEW ITEMS:	**BUDGET**	**VENDOR A**	**VENDOR B**	**VENDOR C**	**VENDOR D**
Was the item bid per plans and specs? [Yes/No]					
Was the item bid per the scope of work? [Yes/No]					
Are the workers union or non-union?					
How long will it take to order and deliver the item?					
List any exclusions					
Was tax included in the bid price? [Yes/No]					
Base bid price					
List any alternate pricing provided					
List adjusted bid price if alternates accepted					
Did the vendor acknowledge all addenda? [Yes/No]					

FIGURE 4.26 Subcontractor/Supplier/Vendor Comparison Spreadsheet

PROJECT NUMBER: _____

PROJECT NAME: _____

LOCATION: _____

PROJECT MANAGER: _____

SUBCONTRACTOR/SUPPLIER LIST				
ITEM TYPE: _____				
Use comparison spreadsheet to rank order vendors 1 to 4				
VENDORS	**CONTACT PERSON**	**TELEPHONE**	**EMAIL ADDRESS**	**LOCATION**
CURRENT VENDOR				
VENDOR 1				
VENDOR 2				
VENDOR 3				
VENDOR 4				

FIGURE 4.27 Subcontractor/Supplier/Vendor Ranking Form

PROJECT NUMBER: _____

PROJECT NAME: _____

LOCATION: _____

PROJECT MANAGER: _____

Date:

Ship to (Head office or job site address

Ship via

Required Ship Date

Quantity	**Description of the item**	**Cost**
	Total Cost	

NOTE: MATERIAL SAFETY DATA SHEETS ARE REQUIRED WITH ALL SHIPMENTS

SHIPPING INSTRUCTIONS:

Additional Requirements:

1. Submit _____ copies of shop drawings/details/performance data for review/approval
2. Submit _____ copies of O&M manuals or _____ copies of wiring diagrams for review/ approval

Name, Date and Signature	Name, Date and Signature

Figure 4. 28 Sample Purchase Order Form

4.11 Tools Management

Tools Management is a unique aspect of project execution that primarily concerns subcontractors and general contractors that self-perform some of the work. To perform the work tasks, consumables (particularly tools) are needed. But without proper management, tools can become broken or lost and can become a very expensive line item. Hence, Tools Management addresses the purchase and handling of tools needed to perform the work.

4.11.1 What Activities Should be Performed During Tools Management?

The tools management process consists of three activities. **Table 4.11** provides the tools management activities in a checklist.

ACTIVITY 62: Review contract drawings, specifications, and the bid to identify and purchase special tools

62.1. Examine the plans and specifications and assemble a list of standard tools that will be needed for the job.

- See **Figure 4.29** for a tool log for the tools that may be needed on the project. The list is going to be different for each particular project.

62.2. Examine the plans and specifications and assemble a list of special tools that will be needed for the job.

62.3. Purchase standard and special tools well ahead of the time they will be needed on the jobsite, and assign responsibility for their management to the site supervisor.

ACTIVITY 63: Schedule regular delivery and pickup of tools

63.1. Prior to commencing work, arrange to have tools picked up for maintenance or repair, and new, maintained, or repaired tools dropped off, on a regular basis, such as weekly, bi-weekly, or monthly.

- One benefit of systematic tool maintenance, repair, or replacement is the elimination of the delay in replacing a tool once it has been damaged, resulting in a positive impact on productivity.
- An additional benefit of regular tool maintenance, repair, or replacement is that a better price may be obtained by entering into a standard service agreement.

63.2. Establish standard procedures for maintenance, repair, or replacement of tools.

- Establish "rules" for determining when a tool needs to be maintained or replaced if it is not broken. For example, a tool may become unsafe even if it is not broken, which should trigger tool maintenance, repair, or replacement.
- Establish a routine tool inspection program, and a specific time to examine tools (such as weekly). Push responsibility down to the lowest level.
- Establish a routine maintenance schedule for specific tools, and ensure all tools follow the maintenance schedule.

ACTIVITY 64: Implement a tool tracking system and track tool usage

64.1. The site supervisor or foreman should implement a tool tracking system that documents: (1) who each tool is assigned to, (2) how long the tool has been in use, (3) when the tool is due for maintenance or replacement, and (4) current status (e.g., in use, in maintenance, in repair, etc).

- See **Figure 4.30** for a sample tool tracking system. Although a paper version is depicted, this system should be developed in a spreadsheet or database program.
- The tool tracking system should have automatic alerts or reports that can identify tools that need maintenance and the status of all tools on the job.

TABLE 4.11. Tools Management Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Project Manager: _____

TOOLS MANAGEMENT CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
62. Review contract drawings, specifications, and the bid to identify and purchase special tools			
☐		1	Examine the plans and specifications and assemble a list of standard tools that will be needed for the job
☐		2	Examine the plans and specifications and assemble a list of special tools that will be needed for the job
☐		3	Purchase standard and special tools well ahead of the time they will be needed on the jobsite, and assign responsibility for their management to the site supervisor
63. Schedule regular delivery and pickup of tools			
☐		1	Prior to commencing work, arrange to have tools picked up for maintenance or repair, and new, maintained, or repaired tools dropped off, on a regular basis, such as weekly, bi-weekly, or monthly
☐		2	Establish standard procedures for maintenance, repair, or replacement of tools
☐		3	Purchase standard and special tools well ahead of the time they will be needed on the jobsite, and assign responsibility for their management to the site supervisor.
64. Implement a tool tracking system and track tool usage			
☐		1	The site supervisor or foreman should implement a tool tracking system that documents: (1) who each tool is assigned to, (2) how long the tool has been in use, (3) when the tool is due for maintenance or replacement, and (4) current status (e.g., in use, in maintenance, in repair, etc)

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Project Manager: _____

TOOL LOG

Tool Number	Status	Description	Manufacturer	Model Number	Purchase	
					Date	Cost

***Status Code:**

MS: missing

OK: no problems

OR: sent out for repair

OS: taken out of service

FIGURE 4.29 Sample Tool Log

TOOL TRACKING SYSTEM										
TRANSFER		TRANSFERRED TO		EMPLOYEE		TOOL				
NO.	DATE	NO.	DESCRIPTION	NO.	ALIAS	NO.	STATUS	DESCRIPTION	TIME ALREADY IN USE	MAINTENANCE/ REPLACEMENT DATE

FIGURE 4.30 Tool Tracking System

4.12 Labor Management

Labor Management involves the scheduling, tracking and management of labor. The Project Manager and site supervisor should review the labor plan and schedule to determine the number and experience level of the electricians needed to perform the work. Then, the proper crew mix should be determined in order to balance experience with labor costs. Once, the proper crew mix has been determined, and the crew has initiated the work, crew productivity should be monitored to evaluate whether the correct crew size and mix has been assembled, and whether the labor hours expended are equal to or less than estimated.

4.12.1 What Activities Should be Performed During Labor Management?

The labor management process consists of two activities. **Table 4.12** provides labor management activities in a checklist.

ACTIVITY 65: Identify and maintain the correct crew mix and manpower level

65.1. Review the labor plan and schedule to determine the number and experience level of the electricians needed to perform the work.

- Establish the proper crew mix in order to balance experience with labor costs.

65.2. Once, the proper crew mix has been assembled, monitor crew productivity to evaluate whether the correct crew size and mix has been achieved.

- Labor productivity is the rate at which tasks are completed, and is often defined as the output per labor hour.
- Many factors can affect labor productivity on a project, such as lack of information, crowded conditions, weather, morale, etc. Site supervisors should be familiar with the most common factors that impact labor productivity so that any barriers can be removed.

65.3. Track whether the labor hours expended are equal to or less than estimated.

- See **Figure 4.31** for an example progress report.

ACTIVITY 66: Ensure labor hours are turned in by workers in a timely manner

66.1. Establish procedures that must be followed by workers for turning in labor hours.

- Procedures may include specific days, specific times of day, format, etc. for documenting labor hours expended.

- Accurate reporting of field labor is necessary to process payroll correctly. The other objective is to substantiate actual costs as they are being accrued on individual project tasks. This is important for two reasons. The first reason is to allow management to compare actual to planned productivity. The second reason is to allow management to support actual or potential cost overruns that are not the responsibility of the electrical contractor and may be recoverable under the terms of the contract.
- The originating document for labor information is the employee's time card; see **Figure 4.32** (*Construction Jobsite Management*, 2004 by William R. Mincks & Hal Johnston).
- A weekly quantity report may also be useful. It compares work activities to the cost codes and the amount of work accomplished last week, this week, to date, and amount to complete. See **Figure 4.33** (*Construction Jobsite Management*, 2004 by William R. Mincks & Hal Johnston).
- The weekly quantity report and time card combined with the accounting data are returned to the field in the form of a weekly labor cost report; see **Figure 4.34** (*Construction Jobsite Management*, 2004 by William R. Mincks & Hal Johnston). This is an important tool used by the field staff to analyze the progress and predict final cost and schedule for the different work activities.
- Procedures for recording labor hours (*Construction Jobsite Management*, 2004 by William R. Mincks & Hal Johnston):

1. Each hourly-wage individual on the project staff is required to prepare and maintain a time card on a daily basis.
2. One time card is required per project per individual. An individual assigned to two or more projects should keep a separate time card for each project.
3. The forms should be filled in throughout the day, but in any case they must be filled out at least once per day at a minimum.
4. To report work activities, cost codes or field codes are used to identify each activity.
5. All completed forms are to be returned to the project management office each week on a designated day.

66.2. Once the procedures have been established, a system should be implemented to monitor the submission of labor hours.

- The procedures must include a method to track which workers have turned in their hours on time and which ones have not.
- All companies should implement a labor reporting system that will provide information to accounting for payroll and information to establish cost and productivity control during the job.
- The foreman or site supervisor should be responsible for monitoring compliance.
- Consider using an incentive/disincentive for timely submission of hours.

TABLE 4.12. Labor Management Checklist

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Project Manager: _____

LABOR MANAGEMENT CHECKLIST FOR PROJECT MANAGEMENT

☑	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
65. Identify and maintain the correct crew mix and manpower level			
☐		1	Review the labor plan and schedule to determine the number and experience level of the electricians needed to perform the work
☐		2	Once, the proper crew mix has been assembled, monitor crew productivity to evaluate whether the correct crew size and mix has been achieved
☐		3	Track whether the labor hours expended are equal to or less than estimated
66. Ensure labor hours are turned in by workers in a timely manner			
☐		1	Establish procedures that must be followed by workers for turning in labor hours
☐		2	Once the procedures have been established, a system should be implemented to monitor the submission of labor hours

SAMPLE PROGRESS REPORT					
Monday, August 17, 2009					
	ESTIMATED VALUES			**PROJECTED COMPLETED VALUES**	
System Description	**Material**	**Total Hours**	**% Complete**	**Completed Material**	**Completed Labor Hrs**
Lighting Fixtures	$148,186.19	7,083.36	5%	$7,409.31	354.17
Lighting Controls	$5,090.69	543.63	0%	-	-
Devices & Power Branch	$10,493.50	1,226.11	0%	-	-
Switchgear & Distribution	$29,476.47	1,596.26	38%	$11,201.06	606,58
Bussduet	$334.08	807.55	75%	$250,56	605.66
Distribution Feeders	$245,507.10	4,599.35	25%	$61,376.78	1,149.84
Fire Alarm System	$13,900.96	1,353.82	20%	$2,780.19	270.76
Equip. Feeders	$17,318.90	3,007.93	0%	-	-
Phone/Data Service Entrance	$5,646.97	116.53	80%	$4,517.58	93.22
Phone/Data Risers	$42,504.29	1,851.09	15%	$6,375.64	277.66
Card Access System	$900.02	110.2	0%	-	-
Voice /Data Conduit Branch	$533.25	68.2	0%	-	-
Area of Rescue System	$12,620.92	615.02	0%	-	-
Grounding Service	$1,418.42	98.02	10%	$141.84	9.80
Grounding Hogan System	$33,282.18	746.03	10%	$3,328.22	74.60
Demolition	$0.00	2,071.68	45%	-	240.35
Temporary	$5,633.59	343.36	70%	$3,943.51	240.35
Sub Totals	**$572,848**	**26,238.14**		**$101,325**	**4,614.91**

FIGURE 4.31 Sample Progress Report

Project:_____ **Prepared by:**_____

Date:_____ **Week ending:**_____

EMPLOYEE	HOURLY RATE	SUN Act No Hrs	MON Act No Hrs	TUE Act No Hrs	WED Act No Hrs	THUR Act No Hrs	FRI Act No Hrs	SAT Act No Hrs	TOTAL HOURS	GROSS AMOUNT
No. Name										
No. Name										
No. Name										
No. Name										
No. Name										
No. Name										

FIGURE 4.32 Sample Time Card

Project:_____ **Prepared by:** _____
Week ending:_____ **Date**_____

COST CODE	WORK ACTIVITY	UNIT	TOTAL LAST WEEK	TOTAL THIS WEEK	TOTAL TO DATE	TOTAL TO COMPLETE

FIGURE 4.33 Weekly Quantity Report

Project:_____ **Prepared by:**_____
Week ending:_____ **Date:**_____

COST CODE	WORK ACTIVITY	UNIT	QUANTITY			LABOR COSTS			TO DATE		PROJECTED	
			Budget	This week	To date	Budget	This week	To date	+	( )	+	( )

FIGURE 4.34 Weekly Labor Cost Report

4.13 Safety Management

Safety Management includes all jobsite safety related activities that have been implemented to keep workers and the public safe during the construction process. It typically involves establishing standard procedures to ensure the worksite conforms to Occupational Safety and Health regulations. Activities might range from ensuring workers have the proper protective gear to administering lock out/tag out procedures. Given that a negative safety record can significantly impact a company's insurance rate, proactive safety programs have become a necessity in the construction industry. The right safety attitude begins at the top – hence, workers and management alike must embrace safety as part of their culture.

4.13.1 What Activities Should be Performed During Safety Management?

The safety management process consists of five activities. **Table 4.13** provides the safety management activities in a checklist.

ACTIVITY 67: Implement a jobsite general safety program

67.1. If the Electrical Contractor is implementing a safety program for the first time, consult the Occupational Safety and Health Act (OSHA) for general guidelines.

- The key elements of a safety program that conforms to OSHA guidelines include (Construction Jobsite Management, 2004, Mincks & Johnston):
  - Management commitment
  - Hazard assessment and control
  - Safety planning, rules, and work procedures
  - Safety and health training

67.2. **Figure 4.35** provides a company safety policy outline developed by OSHA from *Construction Jobsite Management* by William R. Mincks &Hal Johnston, 2004.

67.3. Consider hiring a full-time safety management who can ensure standardization across projects.

- As a minimum, appoint someone on the jobsite to be the on-site safety manager

ACTIVITY 68: Identify safety concerns associated with specific job activities

68.1. Conduct on-site meetings with all workers to reinforce the dangers of the jobsite and the consequences of unsafe actions.

- Topics that should be discussed might include correct usage of tools and equipment, work practices and attitudes at the jobsite.

- Regular safety training should be routine for the contractor.
- **Figure 4.36** provides a safety meeting report form (*Construction Jobsite Management*, 2004, William R. Mincks & Hal Johnston).

68.2. Workers should have the opportunity to express their concern about any unsafe condition on the site during the on-site safety meeting.

ACTIVITY 69: Identify and purchase additional safety equipment as needed

69.1. Personal protective equipment (PPE) should be a standard part of an overall safety plan.

- The proper use of personal protective equipment should be explained in the company's general safety manual.
- There are eight categories of personal protective equipment (*Construction Jobsite Management* 2004, William R. Mincks & Hal Johnston):
  1. Eye and face protection
  2. Head protection
  3. Hand protection
  4. Foot protection
  5. Respiratory protection
  6. Hearing protection
  7. Body protection
  8. Protection from falls when working at heights

69.2. Determine whether other safety equipment is needed in addition to PPE.

ACTIVITY 70: Update the safety log regularly and document all incidents

70.1. Keep detailed records of all safety incidents or near misses, and document and share lessons learned.

- **Figure 4.37** provides a sample accident recording form (Construction Operations Manual of Polices and Procedures 2007, Andrew M. Citiviello, Jr. , Sidney M. Levy).
- An accident form should be filled out no later than 24-hours after the incident happened.
- The report should contain information about the injured person (if there is one), the foreman of the crew, and any witnesses. Photographs should also be taken.

ACTIVITY 71: Perform job walks regularly to ensure that the safety procedures are being followed

71.1. The jobsite must be inspected regularly in order to identify actual or potential hazards.

71.2. A field safety inspection procedure should be implemented in order to standardize the inspection process.

- **Figure 4.38** provides sample field safety inspection procedures (*Construction Operations Manual of Policies and Procedures,* 2007, Andrew M. Citiviello, Jr. and Sidney M. Levy).
- Each safety inspection should be recorded.
- **Figure 4.39** provides a sample jobsite safety inspection report form (*Construction Operations Manual of Policies and Procedures*, 2007, Andrew M. Citiviello, Jr. & Sidney M. Levy).

TABLE 4.13. Safety Management Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Project Manager: _____

SAFETY MANAGEMENT CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
67. Implement a jobsite general safety program			
☐		1	If the Electrical Contractor is implementing a safety program for the first time, consult the Occupational Safety and Health Act (OSHA) for general guidelines
☐		2	**Figure 4.35** provides a company safety policy outline developed by OSHA and adapted by Mincks &Johnston, 2004
☐		3	Consider hiring a full-time safety management who can ensure standardization across projects
68. Identify safety concerns associated with specific job activities			
☐		1	Conduct on-site meetings with all workers to reinforce the dangers of the jobsite and the consequences of unsafe actions
☐		2	Workers should have the opportunity to express their concern about any unsafe condition on the site during the on-site safety meeting
69. Identify and purchase additional safety equipment as needed			
☐		1	Personal protective equipment (PPE) should be a standard part of an overall safety plan
☐		2	Determine whether any other safety equipment is needed in addition to PPE
70. Update the safety log regularly and document all incidents			
☐		1	Keep detailed records of all safety incidents or near misses, and document and share lessons learned
71. Perform job walks regularly to ensure that the safety procedures are being followed			
☐		1	The jobsite must be inspected regularly in order to identify actual or potential hazards

Safety policy outline adapted from CAL/OSHA:

I. Corporate and Management Commitment

A. Policy Statement
May include safety and health goal

Illustrates management involvement in work place safety and health

B. Objectives for the safety and Health Program
Based on the priorities of your workplace

Should be measurable with time frames for completion

C. Assignment of Responsibility for S and H
Descriptions of duties

Policy on accountability

II. Hazard Assessment and Control

A. Hazard Assessment and Correction
Initial survey by safety consultant or other professional

Periodic surveys and samplings

Employee reporting of hazards

Tracking of identified hazards and their correction.

B. Accident Investigation
Identification of causes and their correction

Preventive actions

Monitoring workplace injuries and illnesses

C. Record Keeping
Log and Summary of Occupational Injuries and Illnesses

Material safety data sheets

Employee access to personal medical and exposure records

Other required or appropriate records

D. Equipment monitoring and maintenance program
Production equipment

Personal protection equipment

FIGURE 4.35 Sample Safety Policy Outline

III. Safety planning, rules, and work procedure

A. Control of potential hazard
Regarding equipment design, purchasing, engineering, maintenance and use

B. Safety rules
General

Specific to tasks, based on safe work procedures

System for informing employees

C. Work procedures
Analysis of tasks, based on safe work procedures

Implementation

D. Employee involvement
Reporting hazards

Enforcement of rules

Disciplinary procedures and reorientation

E. Emergency procedures
First aid

Emergency medical

Fire, egress

IV. Safety and health training, initial and refresher

A. Supervisor
Safety and health policy, rules and procedures

Hazards of the workplace and how they are best controlled

Accident investigation

B. Employees
New employee safety orientation

General and specific rules

Use of personal protective equipment

Preparation for emergencies

Training required by OSHA requirement

Safe work procedures

FIGURE 4.35 Sample Safety Policy Outline (continued)

Project Number:_____

Project Name:_____

Date of the meeting:_____

Project Manager:_____

SAFETY MEETING REPORT FORM

Topic or Area of Discussion:_____

_____

_____

_____

Summary of Specific Items Discussed:_____

_____

_____

_____

Conclusion or Changes to the Jobsite to create a safer work place:_____

_____

_____

_____

Action Items needing immediate abatement:_____

_____

_____

Remarks or comments:_____

_____

_____

REPORT BY: _____

DATE: _____

FIGURE 4.36 Safety Meeting Report Form

Project Number:_____

Project Name:_____

Date:_____

Project Manager:_____

ACCIDENT REPORT

INJURED EMPLOYEE:
Name:_____
Address:_____
Social Security Number:_____

ACCIDENT LOCATION:_____

ACCIDENT DESCRIPTION:_____

FIRST AID APPLIED? _____

MEDICAL TREATMENT REQUIRED:_____
_____
_____

LOST TIME DUE TO ACCIDENT (ESTIMATE):_____

Foreman:_____
Witnesses:_____

CAUSE OF ACCIDENT:_____
_____
_____
ACTION TAKEN: _____
_____

REPORT BY: _____
DATE: _____

FIGURE 4.37 Sample Accident Report Form

Field Safety and Loss Control Inspection Procedures

1. Be aware in advance of what you plan to inspect.
2. Review applicable regulations. Familiarize yourself with the hazards that are associated with the operation or equipment that you intend to inspect.
3. Schedule the inspection at a time that will allow a maximum opportunity to view operations and work practices. Midmorning or early-afternoon are often good times.
4. Be alert to all hazards, and do not merely run through the checklist. A checklist is only a reminder. Hazards unique to a specific situation should not be overlooked.
5. Choose a systematic inspection route. Cover the entire area footprint and leave nothing out. When reinspecting a work area, approach from a different direction or use a different route to gain a different perspective of jobsite conditions.
6. Take notes, and be sure to note the exact description and/or location of every hazard when observed. Include ideas for corrective action. Do not wait until after the inspection to record hazardous conditions or unsafe actions; details might get forgotten.
7. Look for the source cause(s) of adverse conditions and practices. Think in terms of correction action only. Do not focus on fixing blame.
8. If an unsafe piece of equipment or condition is observed, the supervisor shall warn the employees of the hazard(s) involved. If a life-threatening hazard exists, the operation must be immediately suspended. The work should then be allowed to resume only after the supervisor is satisfied that the hazard has been thoroughly corrected.

FIGURE 4.38 Sample Safety Inspection Procedures

Project Number:_____

Project Name:_____

Date:_____

Project Manager:_____

JOBSITE SAFETY INSPECTION REPORT

SUPERINTENDENT:_____

LOCATION:_____

OBSERVED HAZARD:_____

_____

_____

Responsibility of: ☐**Company** ☐**Trade/Subcontractor**

HAZARD LOCATION:_____

_____

_____

Work recommended to be Stopped in the Hazard Location: ☐**Yes** ☐**No**

Work stopped in the Hazard Location: ☐**Yes** ☐**No**

Corrective Action Required: **Date:** **Time:**

Inspection Performed By:_____

Date: _____

FIGURE 4.39 Jobsite Safety Inspection Report

4.14 Quality Management

Management of the quality of the work is a critical aspect of construction that is largely the responsibility of the general contractor and subcontractors. A high quality end product often results in higher customer satisfaction, fewer warranty issues, and an overall positive reputation as being "quality conscious." To ensure quality is achieved on a project, it is important that the electrical contractor implement a contractor quality control (CQC) program that involves routine checking of the actual work against specified quality standards, as well as developing standard procedures for commissioning, testing, and closeout. Because each project is different, and projects have become more complex, the contractor should become aware of any particular quality requirements or challenges unique to the current project.

4.14.1 What Activities Should be Performed During Quality Management?

The quality management process consists of four activities. **Table 4.14** provides the quality management activities in a checklist.

ACTIVITY 72: Clarify quality requirements for field personnel

72.1. The Project Manager or site supervisor should review the specifications, identify all references to quality, and list them in a table.

- **Figure 4.40** represents an example of a Quality Requirements Checklist.

72.2. The table should be given to the foremen so that they can review the specifications to better understand the specific quality requirements.

- Properly planning and organizing the quality control requirements before the project starts is essential to achieving effective quality control during the project.

72.3. Quality expectations should be discussed during a meeting between the site supervisor and the foremen, and any company-specific requirements should be identified.

- The objectives of the quality control program are to ensure that every quality requirement is addressed, to implement effective actions on the site to achieve quality work, and to avoid duplication of effort.

ACTIVITY 73: Check and document the quality of installation through regular site visits

73.1. Using the list of specified quality requirements (see for an example **Figure 4.40**), the site supervisor and/or project manager should walk the site to ensure compliance with the requirements.

- The site supervisor is responsible for evaluating the activities that are being performed at the site and for making sure that the end product satisfies the contract specifications.
- Evaluations should take place many times during the construction process.
- Establishing a quality control evaluation plan that shows when, where and by whom evaluations are needed can potentially improve quality on the project. See **Figure 4.41** for an example of a report on quality verification.

73.2. Any discrepancies should be noted in the table, and the foremen should be made aware of each discrepancy and correct them.

- The exact location of the discrepancy, the nature of the problem, the date annotated, and the required correction date should be noted in the table.

ACTIVITY 74: Develop and implement commissioning and testing procedures

74.1. Standardized commissioning and testing procedures for common types of equipment simplifies the process and improves the chances that these processes will be completed with minimum problems.

- This equipment will include transformers, panels, HVAC equipment, alarm systems, etc.

74.2. Assigning one person to be responsible for commissioning and testing for all jobs within the company is an efficient way to build up special expertise that can improve the efficiency of commissioning and testing.

- However, the individual selected for this position should also strive to share knowledge about the commissioning and testing process so that foremen and other workers have a working knowledge of the procedures.

ACTIVITY 75: Use a pre-punch list to identify unresolved quality issues before completion

75.1. A preliminary punch list (i.e., pre-punch list) precedes the official punch list and is essentially a list of discrepancies that need to be corrected before the final inspection.

- The punch list is the final step of the quality control process. While a Zero punch list is the goal, it rarely is achieved. However, using a pre-punch list can get you closes to that goal.

75.2. The pre-punch list should be assembled either on a continuous basis so that deficiencies get corrected throughout the course of the project or during the last 5% of the project to ensure very few discrepancies remain before the final inspection.

- **Figure 4.42** presents an example of a pre-punchlist

TABLE 4.13. Quality Management Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Project Manager: _____

QUALITY MANAGEMENT CHECKLIST FOR PROJECT MANAGEMENT			
☑	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
72. Clarify quality requirements for field personnel			
☐		1	The Project Manager or site supervisor should review the specifications, identify all references to quality, and list them in a table.
☐		2	The table should be given to the foremen so that they can review the specifications to better understand the specific quality requirements.
☐		3	Quality expectations should be discussed during a meeting between the site supervisor and the foremen, and any company-specific requirements should be identified.
73. Check and document the quality of installation through regular site visits			
☐		1	Using the list of specified quality requirements, the site supervisor and/or project manager should walk the site to ensure compliance with the requirements.
☐		2	Any discrepancies should be noted in the table, and the foremen should be made aware of each discrepancy and correct them.
74. Develop and implement commissioning and testing procedures			
☐		1	Standardized commissioning and testing procedures for common types of equipment simplifies the process and improves the chances that these processes will be completed with minimum problems.
☐		2	Assigning one person to be responsible for commissioning and testing for all jobs within the company is an efficient way to build up special expertise that can improve the efficiency of commissioning and testing.
75. Use a pre-punch list to identify unresolved quality issues before completion			
☐		1	A preliminary punch list (i.e., pre-punch list) precedes the official punch list and is essentially a list of discrepancies that need to be corrected before the final inspection
☐		2	The pre-punch list should be assembled either on a continuous basis so that deficiencies get corrected throughout the course of the project or during the last 5% of the project to ensure very few discrepancies remain before the final inspection.

Project Number:_____
Project Name:_____
Inspector:_____
Date and Time:_____
Area/System Inspected:_____

Item	Electrical Work or System Being Inspected	Description	Comply			If NO, Remarks	Date
			Yes	No	N/A		
1.		Shop Drawings Submitted & Approved?					
2.		Submittals Approved?					
3.		Coordinated Drawings					
4.		Appropriate UL label/listing?					
5.		Complete precedent work of others?					
6.		Incoming/Primary service complete?					
7.		Electrical Closets Complete?					
8.		Work area clear of debris or stored materials?					
9.		Are concrete mounting bases complete?					
10.		Sufficient access space surrounding equipment?					
11.		All cable termination are tight?					
12.		Vibration and noise control is complete?					
13.		Cable & Wire runs in neat & workman like?					
14.		Are power cable phases color coded?					
15.		Switch label is complete?					
16.		Stubups are coordinated with equip. location?					

FIGURE 4.40 Example of Quality Requirements Checklist

Item	Electrical Work or System Being Inspected	Description	Comply			If NO, Remarks	Date
			Yes	No	N/A		
17.		Has switch and breaker wiring been coordinated?					
18.		Are panelboards securely mounted to wall?					
19.		Have disconnect switches been installed within sight of control motors?					
20.		Has switchgear and electrical equipment been protected from overhead plumbing?					
21.		Are conductor splices and terminations tight and secure?					
22.		Have the correct connectors been used for splices?					
23.		Is EMT and flexible metallic conduit being used only within areas allow by specifications?					
24.		Has liquid-tight flexible conduit been used for outdoor motor and vibration mounted motor connections?					
25.		Are conduit/raceway runs adequately supported?					
26.		Have electrical wall and floor penetrations been firestopped/sealed/caulked?					
27.		Have busway been adequately supported with provisions for movement and expansion?					
28.		Have specified materials been used in hazardous, wet and outdoor locations?					
29.		Are pull boxes, tap boxes, splice boxes and cable support boxes adequately supported?					
30.		Are pull boxes, tap boxes, splice boxes and cable support boxes accessible?					

FIGURE 4.40 Example of Quality Requirements Checklist (Continued)

Item	Electrical Work or System Being Inspected	Description	Comply			If NO, Remarks	Date
			Yes	No	N/A		
31.		Are light fixtures frames coordinated with ceiling type?					
32.		Are fixtures adequately supported?					
33.		Have electrical equipment components been grounded?					
Additional Remarks: _____ Signed: _____							

FIGURE 4.40 Example of Quality Requirements Checklist (Continued)

Project Number:_____
Project Name:_____
Inspector:_____
Date and Time:_____
Area/System Inspected:_____

REPORT ON QUALITY VERIFICATION

Construction or Work Areas Requiring Corrective Action

a.
b.
c.

Items Presently Being Performed at Variance with Plans and Specifications

a.
b.
c.

Items Rejected or Questioned by the Architect, Engineer, and/or Owner

a.
b.
c.

Test and/or Inspection Results at Variance with Plans and Specifications

a.
b.
c.

Lack of Cooperation by the Subcontractors or Suppliers

a.
b.
c.

Lack of or Tardy Cooperation by the Architect, Engineer and/or Owner

a.
b.
c.

Other Q.C. Items and Requiring Further Attention

a.
b.
c.

FIGURE 4.41 Report on Quality Verification

Project Number:_____
Project Name:_____
Inspector:_____
Date and Time of inspection:_____

PRE-PUNCH LIST

Item No.:	Location:	Item /Description of Completion or Correction:
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
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_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Reviewed by: **Prepared by:**

FIGURE 4.42 Example of Pre-Punch List

4.15 Project Closeout

Project Closeout is the process of finishing the work, correcting any minor deficiencies (i.e., punch list items), turning over attic stock items to the facility occupants, submitting Operations and Maintenance Manuals, submitting as-built drawings to the general contractor or owner. After all punch list items have been completed and all deliverables have been turned over, the electrical contractor will then demobilize from the site. A smooth closeout process can make a positive lasting impression on the owner; therefore, the contractor should strive to keep up the momentum until all final closeout activities have been completed.

4.15.1 What Activities Should be Performed During Project Closeout?

The project closeout process consists of six activities. **Table 4.15** provides the project closeout activities in a checklist.

ACTIVITY 76: Review specifications as part of the project closeout process

76.1. The plans and specifications should be reviewed to identify and develop a list of any work items that might have been missed.

76.2. The plans and specifications should also be reviewed to identify and develop a list of "deliverables" that must be provided to the general contractor prior to demobilization.

- Some contracts may require spare parts and materials be left with the owner so that the owner can use them in the future for maintenance and repair. If the specification does not clarify which items should be given to the owner, the contractor should seek clarification and may need to negotiate with the owner.

ACTIVITY 77: Ensure that all punch list items are completed and signed off in a timely manner

77.1. In conjunction with Activity 75, a series of pre-punch lists should be developed to identify and resolve outstanding work issues.

- Issues should be resolved as they are identified so that the final punch list has a minimum number of outstanding work issues.

77.2. Be sure that work identified on the punch list is part of the original scope of work.

- If the punch list contains items not included in the original scope, the contractor should request a change order. If there is an extra cost due to this change order, the parties will need to negotiate a price.

77.3. Conduct a walkthrough with the General Contractor to identify and document final unresolved work issues.

- These unresolved work issues become the final Punch List, and completion of these items will be necessary to receive final payment (see **Figure 4.43**).

77.4. Resolve all remaining work issues and get the signature of the General Contractor signifying completion of all punch list items.

- A final walkthrough will be necessary to verify that all punch list items have been completed
- Ideally, the final punch list should be cleared prior to demobilizing to avoid incurring additional expenses for re-mobilizing

ACTIVITY 78: Ensure that all change orders and purchase orders are closed before job completion

78.1. The paperwork for approved change orders and purchase orders should be processed and the work should be billed prior to demobilization.

78.2. All requested but unresolved change orders should be converted to a claim, if necessary.

78.3. Purchase orders should be processed (i.e., verify materials or services have been received) and paid by the electrical contractor.

ACTIVITY 79: Turn all project closeout documents over to the General Contractor

79.1. Turn over Operations and Maintenance Manuals, as-built drawings, warranties, and other documents to the General Contractor as part of the closeout process.

79.2. An original warranty should be delivered to the General Contractor, who will then give it to the owner.

- According to the American Institute of Architects, common defect liability periods are three months.

ACTIVITY 80: Receive final payment and retainage

80.1. A final bill should be submitted upon completion of the work.

- The final bill should be submitted following completion of the punch list.

- Along with the final bill should be a request for a release of the remaining retainage.

80.2. Before the retainage is released by the owner, the contractor typically must provide a lien waiver to declare that they have been paid for the work that has been complete, which releases the owner from liability for non-payment.

80.3. For bills that have not been paid within 60 or 90 days, follow up with a phone call to find out when the funds will be paid.

80.4. For final billings that are disputed, begin the claims process.

ACTIVITY 81: Demobilize

81.1. Arrange to have all temporary utilities disconnected.

81.2. Arrange to have the job trailer and materials storage trailers removed from the site.

81.3. A final cleaning of the jobsite may be necessary as part of the demobilization process.

TABLE 4.15. Project Closeout Activities Checklist

Project Number: _____

Project Name: _____

Location: _____

Estimator: _____

Project Manager: _____

PROJECT CLOSEOUT CHECKLIST FOR PROJECT MANAGEMENT			
☑	**COMPLETION DATE**	**ITEM NO.**	**SUB-ACTIVITIES**
76. Review specifications as part of the project closeout process			
☐		1	The plans and specifications should be reviewed to identify and develop a list of any work items that might have been missed
☐		2	The plans and specifications should also be reviewed to identify and develop a list of "deliverables" that must be provided to the general contractor prior to demobilization
77. Ensure that all punch list items are completed and signed off in a timely manner			
☐		1	In conjunction with Activity 75, a series of pre-punch lists should be developed to identify and resolve outstanding work issues
☐		2	Conduct a walkthrough with the General Contractor to identify and document final unresolved work issues
☐		3	Resolve all remaining work issues and get the signature of the General Contractor signifying completion of all punch list items
78. Ensure that all change orders and purchase orders are closed before job completion			
☐		1	The paperwork for approved change orders and purchase orders should be processed and the work should be billed prior to demobilization
☐		2	All requested but unresolved change orders should be converted to a claim, if necessary
☐		3	Purchase orders should be processed (i.e., verify materials or services have been received) and paid by the electrical contractor
79. Turn all project closeout documents over to the General Contractor			
☐		1	Turn over Operations and Maintenance Manuals, as-built drawings, warranties, and other documents to the General Contractor as part of the closeout process

TABLE 4.15. Project Closeout Activities Checklist (continued)

Project Number: _____

PROJECT CLOSEOUT CHECKLIST FOR PROJECT MANAGEMENT			
☑	COMPLETION DATE	ITEM NO.	SUB-ACTIVITIES
80. Receive final payment and retainage			
☐		1	A final bill should be submitted upon completion of the work
☐		2	For bills that have not been paid within 60 or 90 days, follow up with a phone call to find out when the funds will be paid
☐		3	For final billings that are disputed, begin the claims process
81. Demobilize			
☐		1	Arrange to have all temporary utilities disconnected
☐		2	Arrange to have the job trailer and materials storage trailers removed from the site

PROJECT NUMBER: _____

PROJECT NAME: _____

LOCATION: _____

PROJECT MANAGER: _____

FINAL PUNCH LIST					
NUMBER	**DATE INSPECTED**	**DESCRIPTION OF PUNCH LIST ITEM**	**IN THE ORIGINAL SCOPE (Y/N)**	**COMPLETED (Y/N/Ongoing)**	**ACTUAL COMPLETION DATE**

Figure 4.43 Final Punch List Elements

5. Project Management Best Practices

5.1. Introduction to Project Management Best Practices

A significant element of the research project was the investigation of the project management practices used on several successful electrical projects. Ultimately, the project management activities that were performed on these successful projects were used to assemble a list of the best project management practices in the electrical construction industry. This section identifies the 10 best project management practices that can lead to better project performance.

5.2. The Ten Best Project Management Practices

Identified in the next few pages are 10 best practices used on successful electrical construction projects. While the previous sections of this implementation guide presented the activities that should be performed as part of a comprehensive project management process, this section provides suggestions for further improvement to the management activities by implementing specific best practices that have been tested on successful projects.

Best Practice 1: Establish an effective project controls system that includes cost/schedule/labor/change control, tracking, reporting, and forecasting.

Benefits:

The old adage is true: *If you can measure it, you can manage it*. Contractors reported that effective systems for measuring progress and monitoring changes and performance were essential for identifying variances and making corrections, leading to better outcomes.

Best Practice 2: Develop and implement a pre-construction planning process in order to set up the systems for managing the project.

Benefits:

In two separate studies, contractors reported that the combination of good planning and good project management resulted in better overall performance. Although good planning alone or good project management alone tends to improve performance, the combination of both produces more successful outcomes.

Best Practice 3: Assign experienced personnel to the job (including project manager, field supervisor, and foremen) who have worked on a diverse range of projects.

Benefits:

In two separate studies, contractors reported that the people they selected to manage the work – such as project managers, field supervisors, and foremen – made the *biggest* difference to the outcome of the project. Hence, careful selection of experienced personnel can increase your chances of having a successful outcome.

Best Practice 4: Create an environment that encourages constant, open communication, especially between the Project Manager and field personnel and also between the Project Manager and other parties.

Benefits:

Research conducted in the field of psychology has demonstrated the importance of open communication in building trust and positive relationships among parties. Consequently, the communication ability of the Project Manager and field supervisor are critical to building a rapport among team members and may ultimately impact the outcome of the project.

Best Practice 5: Implement a documentation process and/or software that promotes documenting changes, conditions, notices, schedules, delays, etc.

Benefits:

Best Practices 5, 6, and 7 go hand-in-hand. They address the need to appropriately document progress and problems using standardized procedures. For legal and contractual purposes, a standardized process and system(s) for storing documents is important to ensure progress can be tracked and problems can be supported by appropriate backup information.

Best Practice 6: Ensure appropriate software is being used by project personnel to record conditions, document statuses, and track progress.

Benefits:

Numerous project management and scheduling software programs exist that contain functions for documenting changes, RFIs, correspondence, logs, schedules, and more. As mentioned in Best Practice 5, a system(s) for storing documents is important legally and contractually to ensure progress can be tracked and problems can be documented.

Best Practice 7: Develop standardized procedures (for estimating, documentation, reporting, controlling, etc.) and ensure all personnel are using the standard procedures to promote consistency among practices.

Benefits:

Standardization within a company can ensure that all personnel are documenting information in the same way, producing the same reports, keeping the same records, tracking the same metrics, and so on. Standardization reduces the amount of procedural variability that can produce inconsistency within a company.

Best Practice 8: To cut waste, increase productivity, and improve efficiency, establish a process for prefabricating components of the job.

Benefits:

Contractors are increasingly using prefabrication to increase the efficiency of installation and decrease problems in the field. Contractors that have implemented substantial prefabrication processes have reported significant increases in productivity and efficiency. Prefabrication is also considered an important aspect of lean construction principles that strive to cut waste and costs from construction processes.

Best Practice 9: Ensure the company has a reliable process for establishing accurate cost estimates, or establish a standardized estimating process.

Benefits:

Following the completion of the research on pre-construction planning and project management, it became apparent that projects that experienced an inaccurate bid were very likely to turn out poorly. Consequently, a good estimate is critical to success. Contractors should implement a standardized estimating process and use an estimating software that helps them produce sound cost estimates.

Best Practice 10: Establish a materials buyout, ordering, management, and storing plan to increase the efficiency of the procurement process.

Benefits:

Numerous studies have documented the importance of receiving materials on time and the negative impact that can occur when materials are delivered late or when they are of poor quality. A standardized procurement process that involves purchasing, expediting, storing, and managing materials is, therefore, critical to making sufficient progress and avoiding delays and other negative impacts caused by materials mismanagement.

6. Reasons for Successful or Less-than-Successful Performance

6.1 Introduction to the Performance Reasons

It has been demonstrated that good project management can improve a contractor's chances of project success and poor project management may have a negative impact on performance. However, most contractors believe there are several other factors that contribute to good or poor performance. The purpose of this section is to identify the most common factors that contractors believe contribute to the performance on their projects.

6.1.1 The Most Common Reasons Projects Performed Successfully

Nearly 50 Project Managers were interviewed about the performance of their electrical projects. These Project Managers were encouraged to identify all of the factors they believed contributed to the performance of their projects. Identified below are the top reasons contractors believed projects performed successfully:

- A high level of productivity was achieved on the project, which saved time and costs.
- The project was completed ahead of schedule, which also resulted in lower costs.
- The project implemented prefabrication methods, which saved time and costs.
- Materials were bought out at a lower cost than estimated, which resulted in a savings to the project.
- The cost estimate was accurate.
- A baseline schedule was developed; hence, look-ahead scheduling and progress were measured against the baseline.
- The project did not experience any delays.

6.1.2 The Most Common Reasons Projects Performed Less-than-Successfully

Identified below are the top reasons contractors believed projects performed less-than-successfully:

- The workforce achieved poor labor productivity due to delays, lack of coordination, numerous changes, and other reasons.
- There were many delays in the progress of work.
- The material costs were higher than estimated.
- The flow of work was inefficient and poorly managed.
- The project exceeded its cost estimate.
- The project experienced poor coordination among its internal and external team members.
- The project personnel did an inadequate job managing the labor.



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