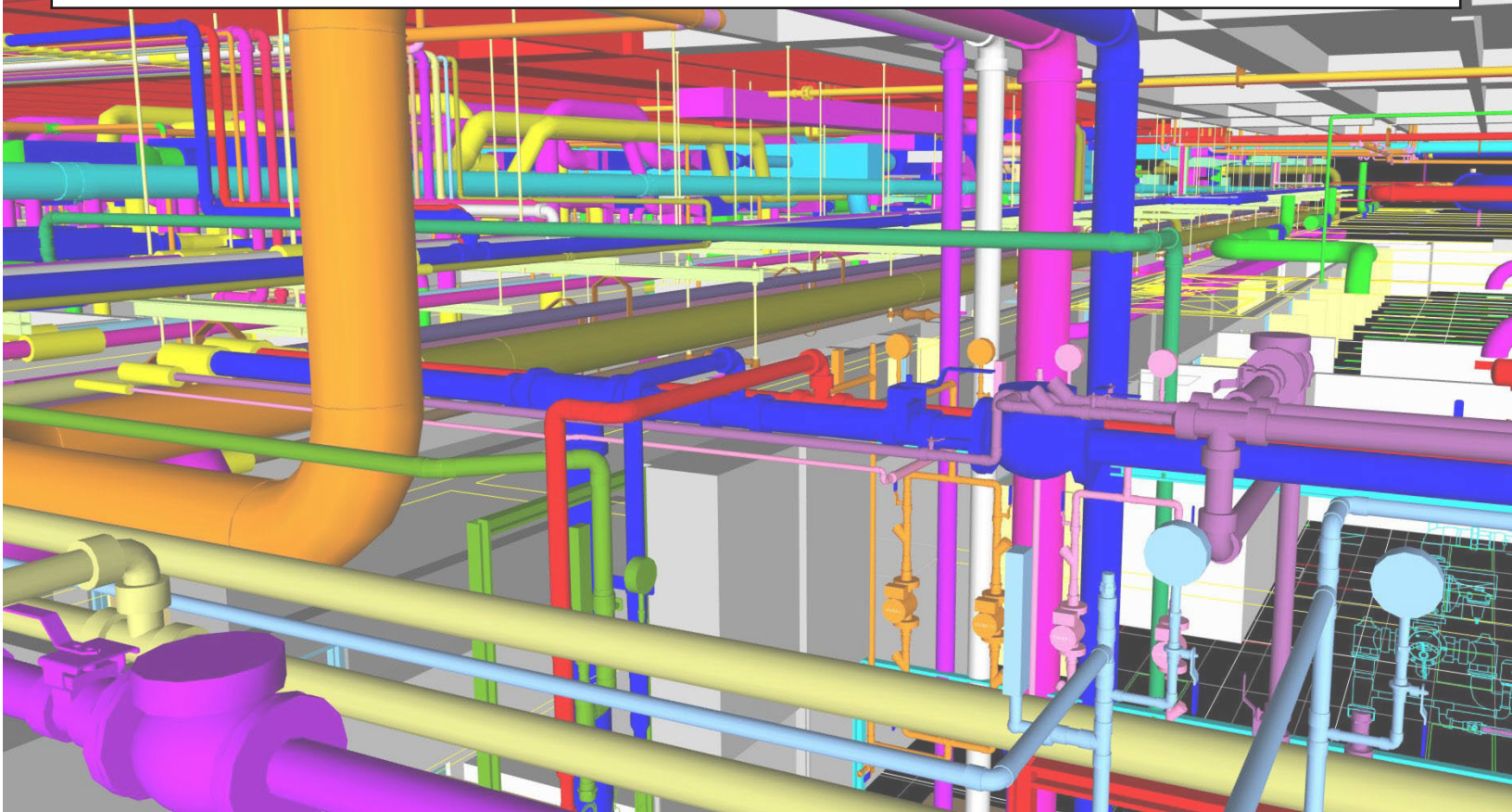


MCAA

Mechanical Contractors Association of America

PROJECT MANAGER'S MANUAL



PCA

Plumbing Contractors of America

MSCA

Mechanical Service Contractors of America

NCPWB

National Certified Pipe Welding Bureau

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INTRODUCTION

The Project Manager is the focal point of every construction project. To the project team, the Project Manager is the boss, the individual with the authority and the answers to problems common to any project. To company officers, the Project Manager is the eyes and ears of the company on the project, responsible for ensuring that the work is completed on time, in accordance with the contract documents, and at a profit. To the project owner, prime contractor and other trades on the job, the Project Manager is the mechanical contractor's ambassador with authority to act on behalf of the company he represents. It is a job with many facets, and a job that requires leadership skills, technical knowledge, sound judgment, common sense, sensitivity to people, excellent communication skills, and a knack for diplomacy.

This edition of the *MCAA Project Manager's Manual* from the Mechanical Contractors Association of America is designed to help you perform all of your job responsibilities. By itself, it is a concentrated source of general information on project management in the construction industry, offering tips for handling day-to-day situations and avoiding some of the most common pitfalls. When supplemented with your company's policies and procedures and specific information about your current projects, it becomes an indispensable tool for effectively managing your responsibilities, whether you are a veteran Project Manager or a newcomer to the job.

Good management relies on good communication, and your success as a Project Manager depends on your ability to communicate clearly and effectively. In a similar way, the success of this manual relies on its ability to communicate information to you and to other Project Managers throughout the industry. If you have questions, comments or suggestions about what this manual contains or how it is presented, the MCAA wants to hear from you. Your feedback plays an important role in making future editions of the *MCAA Project Manager's Manual* as comprehensive and accurate as possible while reflecting the experience and insight of the people it serves.

HOW TO USE THIS MANUAL

Who This Manual Will Assist

The *MCAA Project Manager's Manual* is for people who manage construction projects. Depending on your company structure and the size of a given project, this may include Project Managers, job supervisors, or working or nonworking foremen. In many cases, responsibilities are shared among employees.

This manual is written as though most jobs have a designated Project Manager overseeing one or more job supervisors or foremen. The authors realize that other management configurations are common, but selected one structure to maintain consistency throughout this manual. On smaller projects, for example, the Project Manager may be the foreman as well. Keep in mind that the number of people who share the management of a job is less important than actually getting the job done. Regardless of whether one person or a whole team handles all the management tasks, the tasks remain the same.

This manual describes those tasks. It gives you and your colleagues a relatively comprehensive list of the duties and considerations involved in planning, organizing, and executing a project while completing it efficiently, safely and profitably. In some cases, it may describe a method of management that varies from or even contradicts your company's established policies and procedures. (Note these instances in the text, and point them out to your company officers when you review the manual with them so any contradictions can be resolved.)

The information contained in this manual was compiled by the MCAA Project Manager's Education Committee and the faculty of MCAA's Institute for Project Management as well as various mechanical contractors and individual consultants from across the country. It reflects not only the experience of men and women who have successfully managed construction projects throughout the country, but also the research of experts in our industry.

How this Manual is Organized

This manual is designed in the order a project usually occurs. It also contains forms and sample letters (called Figures) that can be tailored to your company's needs. In addition, other resources available from MCAA are referenced throughout the manual.

How to Locate Information in this Manual

There are four ways to locate information in this manual:

- The table of contents
- The Adobe® Acrobat Reader® software's search tool
- The topic index, located at the end of the manual
- The list of figures, located at the end of the manual

Table of Contents

The table of contents shows you the topic of each section. By scanning the table of contents you will likely find the section that contains the information you are looking for. Simply click on the section name in order to go directly to the section.

The Adobe® Acrobat Reader® software's search tool

The free Adobe® Acrobat Reader® software includes a valuable search tool that will highlight each instance where that term or phrase occurs in the manual. The software is readily available at www.adobe.com/acrobat and as an app for mobile devices. Check your device's store for availability and details.

Index

The topic index at the end of the manual lists words or phrases and the page number(s) of the reference.

List of Figures

The list of figures at the end of the manual provides a quick reference of the figures available within the manual. Each of these figures is provided in standard Microsoft Office programs so that you can customize it for your company's specific needs.

Putting this Manual to Work

The *MCAA Project Manager's Manual* is a working resource designed for quick and comprehensive reference. Don't put it on a shelf in your office and forget about it. Use it. It will save you time and effort and prevent you from having to search multiple sources to track down answers to questions. The more you understand the responsibilities of your job, the better equipped you will be to make confident decisions, which in turn will inspire others' confidence in you.

You are welcome to use any of the forms found in this manual as a part of your management routine. You are also encouraged to modify the forms to meet your particular needs.

WHAT IS A PROJECT MANAGER?

The Project Manager is the person responsible for accomplishing or arranging everything required for a project so the company can earn the maximum fair profit, maintain relationships, and obtain more work. Successful project management requires knowledge of the project at all times, including when a project is going to be finished, how much it will cost, and the financial position of the project at different stages during construction. The broad scope of the Project Manager's duties makes it a challenging and rewarding position, carrying with it sizable responsibility and demanding a unique blend of skills, knowledge and personality traits.

The Importance of the Project Manager

In the course of research for this manual, dozens of mechanical contracting company officers were asked for their views on the role and importance of the Project Manager within their organizations. *Without exception, all agreed that the Project Manager is one of the most important individuals in their companies.* The reasons are clear. The Project Manager is the one person with a complete understanding of and authority for the project and is the link between the company and the market. The Project Manager's performance directly affects not only the profits for a particular project, but also the overall financial health of the organization, and the relationships that are developed.

The Role of the Project Manager

The combination of site logistics, construction materials and methods, trade contractors and their personnel, and contract terms and conditions makes each construction project a unique situation. The procedures outlined in this manual present a proactive approach to dealing effectively with issues that could arise. More importantly, however, this manual emphasizes the importance of planning ahead so issues *won't* arise. These procedures also provide a solid foundation for efficient project management. The primary elements of this process are:

- Proper planning of all aspects of the project
- Diligent monitoring and adjustment throughout the project

The Project Manager is entrusted with the proper and effective management of millions of dollars of cost expenditures. The thoughtful and informed application of the best practices described in this manual will help you succeed in your role as Project Manager.

Specific Responsibilities

A Project Manager's responsibilities fall into three general categories: resource management, team coordination, and liaison activities.

Resource Management

Resource management involves planning, organizing, scheduling, and efficiently using:

- Budgets

- Company money and investments
- Construction equipment and tools
- Installed equipment
- Labor
- Material
- Subcontractors
- Time

Resource management begins with viewing these resources as pieces of the same jigsaw puzzle and then drawing on experience and technical knowledge to make the pieces fit together as snugly as possible. Project Managers who optimize their resources help eliminate wasted time and cost to ensure their projects turn a fair profit.

Team Coordination

Team coordination focuses on planning and scheduling project activities in three groups: field crews, shop crews, and office personnel. Successful teams obsessively focus on the field crews to maximize their productivity with the mantra “work finished right, the first time.”

Communication skills are essential because effective field performance relies on everyone involved understanding both the scope of the project and his role in completing it. Here, too, is the test of a Project Manager's sensitivity to people and situations, and his ability to adjust to changing circumstances. Team coordination is crucial to the success of a project, and it is an area where personalities, competition or hostility among the three groups, as well as unforeseen events, can cause problems for a Project Manager who is caught unaware.

Liaison Activities

Liaison activities refer to instances in which the Project Manager serves as the company's ambassador and diplomat to many individuals and groups, including:

- Architects and engineers
- Construction managers
- Federal, state, and local authorities
- General/prime contractors
- Labor
- News media and the public

- Other trade contractors
- Project owners
- Subcontractors
- Suppliers and manufacturers

In this role, the Project Manager needs to have a clear vision not only of his goals for the project, but also of the company's goals within the construction market. The Project Manager has to be sensitive to the relationships among the various individuals and organizations involved in the project. He needs to know when to stand firm and when to compromise. Like team coordination, the Project Manager's liaison responsibilities require perception and judgment, as well as exceptional communication skills.

The Skills You Need

The skills a Project Manager needs depend on the structure of the company, the types and organization of projects, and the abilities and duties of other members of the project team. Company executives throughout the mechanical industry agree, however, that certain skills are required for success in almost any project management role. Among those skills that are identified most often are:

- Ability to communicate ideas clearly
- Ability to cope with stressful situations
- Ability to handle several tasks simultaneously
- Ability to listen
- Attention to detail
- Basic mathematics
- Business sense
- Diplomacy
- Foresight
- Good reading and writing skills
- Inclination to gather information and weigh options before acting
- Self-discipline

- Sound judgment
- Technical skills

What You Need to Know

Skill and knowledge go hand in hand. Skill provides the ability to achieve something, and knowledge provides direction and information about what must be achieved and how. The knowledge areas that company executives most often identify as essential for every Project Manager are:

- A working knowledge of people
- Basic methods of effective leadership
- Technical knowledge of construction methods
- Technical knowledge of mechanical systems
- Understanding of the company's goals and operating procedures
- Understanding of how the construction industry operates

Project management skills and knowledge can be learned, and should be expanded continually. The mechanical contracting industry changes so quickly that what a Project Manager relies on today may be outdated tomorrow. You must be a student of the industry, constantly looking for ways to increase knowledge and skill.

What a Company Looks for in a Project Manager

Hiring a Project Manager or promoting someone within the company to the position of Project Manager is not an easy decision for any company executive. It always involves risk, including the risk of entrusting millions of dollars of company resources, even the future of the company itself, to an individual who has yet to prove himself. The right choice can mean a dramatic improvement in the entire company's performance. Justify the confidence they have in you by utilizing all resources available to improve your skills and value as a Project Manager.

SECTION 1: CUSTOMER RELATIONS

The Customer as Employer

Your customers, including project owners, prime contractors, and design professionals, are your company's employers. They define the work to be done and pay your company to complete it. They gauge your performance on every project and use their assessments to decide whether to employ you on the next project. To keep getting work and getting paid, your company must constantly prove itself and steadily strengthen its relationships with its customers. That is the role of customer relations.

Customer relations have another role, as well. They help every project go more smoothly. Effective customer relations make discussion, negotiation, cooperation, and compromise possible.

As Project Manager, you are your company's chief representative on the project. All information and instructions cross your desk. You make decisions and you attend meetings. If you do your job well, your company is viewed as doing well. If you establish good working relationships with the customer and the other trades, your entire company enjoys those relationships.

Customer relations are an important part of your job, and you should approach it with the same sense of organization that you exercise in other aspects of your work.

Establish Procedures and Assign Responsibilities

The first step to developing good customer relationships is to identify your customers. Depending on the type and complexity of the project, your customer might be the project owner, the design professional, and/or the prime contractor or construction manager. Establish specific lines of communication and responsibility with each customer. Make sure everyone on the project team knows his role in customer relations by:

- Distributing a complete list of your customer's representatives on the project with their business addresses, e-mail addresses, and telephone numbers so that everyone knows how to get in touch with them when necessary.
- Establishing and enforcing policies for accepting verbal orders from the customer and settling conflicts with the customer.
- Assigning responsibilities for customer relations to individuals on the project team. In particular, make sure everyone who will have regular contact with the customer representatives (your job supervisor or foremen, safety director, etc.) understands his duties and limitations regarding communications with the customer.

Emphasize to everyone on the project team that:

- The customer is your company's employer and deserves its best product.
- Only by consistently giving customers your best can you get repeat business.
- The owner's architect/engineer is the project designer and deserves full support in coordinating and building the project.
- The mechanical contractor is a part of the prime contractor's or construction manager's support team.
- The contract identifies the project's overall coordinator and the mechanical contractor's legal contact for the project. Only that contact, or the person he designates, is authorized to issue instructions or approve or reject changes in the project.

Communicate regularly with your customer in order to:

- Discuss project progress.
- Keep him or her informed of upcoming mechanical activities.
- Mutually resolve problems related to mechanical activities, such as scheduling, access to facilities and coordination with other trades.
- Air grievances before they become items of contention.

Meetings are discussed further in **Section 17: Conferences and Meetings**.

The Role of Entertainment

Providing entertainment is a useful and acceptable means of developing rapport with customers and key business associates. However, it is no substitute for professionalism, good preparation, and effective business communications.

Low-key entertainment, such as lunches and sporting events, helps to establish effective communication and soothe adversarial relationships. Providing very expensive or lavish entertainment, however, must be approached with extreme caution. A customer or business associate may regard it as an attempt to buy goodwill or special advantage or as a substitute for abiding by the contract documents. Many companies have strict policies forbidding their employees from accepting any kind of gift or entertainment; being insensitive to such policies can be extremely damaging to good relations and could place your customer in a difficult situation.

Tips for Communication

To establish and maintain smooth customer relations on a project, you should know your authorized contact on the project and make it a rule to accept instructions from that contact only. Talk with your contact often to ensure a steady flow of information regarding work areas,

time schedules, storage and other matters, and to keep daily problems from turning into long-term crises.

In addition, you should insist that all directions and communications you give to or receive from your authorized contact be specific and in writing.

All businesses are built on relationships. If your company's relationships with its customers are successful, the company will likely be successful as well. A customer who is satisfied with the product and service you provide is likely to give your company repeat business and recommend it to new clients. If the relationship between company and customer sours, however, it not only eliminates repeat business, but word of it spreads to potential customers, making it more difficult for your company to get new work.

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin JM 6, "Working with Owners"
 - Bulletin MK 5, "Listening to Our Customers"
 - Bulletin MK 6, "Public Relations: An Important Marketing Tool for the Mechanical Contractor"

SECTION 2: ESTIMATING

Every company has its own system for estimating. This section is not intended to teach the skill of estimating a project, but rather to identify types of bids and give information and tools relevant to estimating projects. The MCAA *WebLEM*® details the estimating process and is the basis for most company estimating systems. (See reference at the end of this section). A discussion of which projects to bid and how to make those decisions will be available soon in an MCAA *Management Methods Manual* Bulletin on “Developing the Go/No Go Decision Matrix.”

Types of Estimates

There are two types of estimates that may be prepared. The first type is known as a *prime estimate*. On this type of bid the contractor submits a price directly to the owner for the entire project and will act as the prime contractor.

The second type of estimate is a *subcontractor estimate* where the contractor will submit a price for a particular scope of work to a prime contractor or construction manager. In this case, the contractor will have a contract with the prime contractor or construction manager.

Prime Estimates

Since your company will be responsible for the entire scope of work for the project, it is crucial for the estimator to review *all* of the plans and specifications, especially the General Conditions (Division 00). Your company will be taking subcontractor bids for specific scopes of work and care must be taken that there are no holes (work not accounted for by a cost) in the estimate that the prime contractor (you) will have to cover. Any work performed that is not included in the estimate automatically makes the project less profitable.

Typically, there is a bid form to be used on prime estimates. Sometimes, use of an improper form can disqualify your bid.

Subcontractor Estimates

Many times, your company will be bidding the mechanical portion of the work to several prime contractors. For this reason, it is a good idea to prepare and send a “scope of work with price to follow” letter at least a day in advance of the bid. This will allow the prime contractors time to review the scope and make sure they have everything covered that you may have excluded. Be sure to outline your scope very clearly and list what you have included and, perhaps more importantly, what you have excluded, in addition to assumptions you made such as schedule, day-only work, etc. Take the time to draft a clear and complete scope letter. A good scope letter will reduce confusion and conflict.

When preparing to bid the project, contact applicable subcontractors and suppliers for their quotes and confirm their intention to bid. Review their scopes thoroughly to ensure you have no holes in *your* price.

General Estimating Help

Read and review the specifications for special conditions, bonding requirements, insurance requirements, alternates, etc. Ensure you have adjusted your price, as necessary, and that you have received and acknowledged all of the addenda.

Value Engineering

Value engineering is the process through which contract costs can be reduced for the customer while improving project profitability or project award potential. During the estimating phase of a project, value engineering built into the estimate provides the customer with cost-saving ideas for systems or equipment that meet the project requirements, but can be furnished and installed at less cost to the customer. The Project Manager and the estimator can look for these cost-saving ideas as a means of adding value to the estimate and increasing the potential of contract award. After receipt of a contract, value engineering can improve the customer's perception of the company while improving project profitability. Through cost-savings recommendations to the customer, contract costs can be reduced by installing less expensive job components than were specified, provided they satisfy the customer and design requirements. Through careful negotiations, the Project Manager can provide a portion of these cost savings to the customer and a portion to the bottom line.

The following figures can be found at the end of this manual:

- ["Estimating Form" \(Figure 2.1\)](#)
- ["Estimating Checklist" \(Figure 2.2\)](#)
- ["Sample Scope Letter" \(Figure 2.3\)](#)
- ["Pre-Bid Checklist" \(Figure 2.4\)](#)

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin ES 1, "'Rule of Thumb' Parameter Estimating"
 - Bulletin MK 4, "Value Engineering"
- *WebLEM®*

SECTION 3: SUBCONTRACTS AND SUBCONTRACTORS

The Importance of Subcontractors

Subcontractors are a vital part of any construction operation. They provide the special skills that few mechanical contractors have in-house. These special skills may include sheet metal work, temperature controls, mechanical insulation, testing and balancing, core drilling, fire caulking, commissioning, and LEED® certification. If your company does prime contract work, this skill list could include other trades not associated with mechanical work. Because subcontractors could perform a major part of your company scope of work, the work they do and how they do it can very easily damage or enhance your company's reputation and relationships.

Finding a subcontractor that does high quality work at a fair price is important. Maintaining good relations with that subcontractor is just as important, as are coordinating the subcontractor's efforts with those of the rest of the project team and monitoring progress on the project.

Fewer conflicts arise between a subcontractor and the rest of the project team if that subcontractor is made a part of the team from the beginning. Involving the subcontractor in Pre-Construction Planning (and later in Short Interval Planning) enhances the entire project effort by:

- Establishing two-way communication with the subcontractor right from the start.
- Tapping the subcontractor's experience and expertise.
- Making the subcontractor a functioning member of the project team, with a stake in the profitable completion of the project.

Subcontractors perform a major percentage of the work involved in a typical mechanical construction project. This makes them responsible for a considerable share of the project's profits. It also gives them the right to recognition when they complete their work successfully.

Assigning Responsibilities

The Project Manager must assign responsibilities for keeping each subcontractor fully informed, handling situations that arise, and monitoring each subcontractor's progress and quality control. To do this, the planning meeting should devote time to answering the following questions:

- Who is authorized to give orders to the subcontractors?
- Who must approve subcontractor drawings before work can begin?
- Who is the subcontractor's daily contact on the job?

- Who coordinates the efforts of the subcontractors and your crews to ensure a smooth installation process?
- Who is responsible for monitoring the progress and quality of the subcontractor?
- Who handles conflicts arising between the mechanical contractor's field personnel and the subcontractor's field personnel?

Because the job supervisor or foreman has the most regular contact with the subcontractors and their employees, the Project Manager could assign the bulk of these responsibilities to him or her. The Project Manager should also instruct the job supervisor or foreman to:

- Keep in mind that every subcontractor on the job is working for your company and should be treated with the same respect and fairness as other employees.
- Read and thoroughly understand each subcontractor's contract and be familiar with pertinent submittal data specifications and scope.
- Consult with you if he has questions about a subcontractor's obligations.
- Share all job-related information with the subcontractors' foremen.
- Involve all subcontractors in the planning and coordination process.
- Maintain good working relationships with each subcontractor to ensure cooperation, quality craftsmanship, and effective performance on the current project as well as future projects.
- Make sure that each subcontractor receives, unloads and properly stores all equipment that your company furnishes for subcontractor installation.
- Insist that each subcontractor updates as-built drawings regularly.
- Monitor all subcontractors' progress and consult with each one to resolve problems and conflicts that affect timely installation.
- Regularly submit information on each subcontractor's progress for use both in preparing the monthly progress bill and in keeping your company posted on the subcontractors' compliance to the project schedule.
- Remember that subcontractors can affect your company's reputation as much as your own work.

Always remember that these guidelines will vary from company to company.

When to Issue a Subcontract vs. a Purchase Order

Issue a subcontract if *any* labor is being provided. Issuing a subcontract with proper language binds the subcontractor to the terms and conditions of your contract with the prime contractor, construction manager, or owner. It provides your company with the assurance that the subcontractor accepts and understands the risk he has taken. The contract will detail the level of insurance required from the subcontractor and allow the Project Manager or accounting department to ensure proper insurance certificates are filed for the project.

Issuing a subcontract is a serious matter. Never issue a subcontract to a subcontractor unless your company has first received your contract. To do so can place your company in legal jeopardy.

Never forget that a subcontractor, like every other member of the project team, works best when he has the respect of colleagues, knows what his responsibilities are, and receives feedback on his performance.

The following items may be useful in managing subcontractors:

- ["Termination of Subcontract Letter" \(Figure 3.1\)](#)
- ["Subcontract Change Order" \(Figure 3.2\)](#)
- ["Subcontract Worksheet" \(Figure 3.3\)](#)
- ["Subcontract Checklist" \(Figure 3.4\)](#)

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin SC 1, "Suggested Subcontract Form"

SECTION 4: JOINT VENTURES

What is a Joint Venture?

A *joint venture* is a cooperative effort in which two or more companies combine their resources to earn a joint profit and each company shares the resulting profit (or loss) in proportion to the resources it has contributed to the effort. The purpose of a joint venture is to allow companies that are not, on their own, qualified or equipped to tackle a project to form a temporary partnership that is properly qualified and equipped.

The details of each joint venture vary with the agreement between the parties. Most are formed for one project or undertaking only and are characterized by joint project control and management with full sharing of profits and losses. Because a joint venture is a short-term arrangement, it is not a true partnership in the legal sense. Nonetheless, most of the rules that govern partnerships apply to joint ventures and the rights of two parties.

Joint Ventures in Construction

In the construction industry, a joint venture can be between two or more corporations or firms in the same field or in different fields. Two mechanical contractors, neither of which alone has the capacity to bid or complete a particular project, might form a joint venture that enables them to cooperatively bid and perform the work as a single entity. Or, a mechanical contractor might join with an architect, engineer, prime contractor, and electrical contractor to furnish an owner with a “turnkey” project.

Occasionally, companies that have the ability and capacity to bid and perform the work on their own form joint ventures as well. When the intention of such a venture is to reduce or eliminate competition, there is danger of violating existing antitrust laws.

Advantages of Joint Ventures

Contractors enter into a joint venture for many reasons. Among the most common are:

- To guard against mistakes in bidding by cross-checking and dual estimating
- To increase working capital
- To provide or expand bonding capacity or decrease bonding cost
- To strengthen management skills and technical expertise
- To secure specialized and complementary skills
- To increase the labor supply
- To pool equipment

- To reduce overhead expenses
- To share the risk of loss
- To involve a local contractor who is familiar with local market conditions, suppliers, labor, licensing and permit procedures, etc. in cases where an out-of-town contractor forms a joint venture with a local contractor
- To meet MBE/WBE/DBE requirements

Essentially, all of these advantages boil down to one: a joint venture gives the parties involved the ability to bid and perform larger and/or more complicated or specialized projects.

Risks of Joint Ventures

A joint venture holds all of the risks of a partnership but none of the safeguards and limitations of a corporation. Consequently, a company must be extremely careful in selecting its venturing partners. The size of the risk in terms of dollars and reputation depends on each company's ability to cooperate and communicate with the other. It also relies on the financial strength of all parties involved. The benefits of a joint venture can be lost overnight through the insolvency or bankruptcy of one member.

Joint Ventures and the Project Manager

In most cases, the existence of a joint venture will not affect the Project Manager's control of the project at all; but in some it will, and the Project Manager must have a clear understanding of the project's organization and ground rules before starting work. The Project Manager must establish from the start how project management is to be handled; what limits, if any, the joint venture places on his authority; and to whom he reports.

The Project Manager also must lend full support to making the joint venture successful for the company. This means developing and maintaining good communications and cooperation with the company's joint venture partner. Conflicts that cannot be resolved in the field should be referred to the proper channels within the company.

The Project Manager must understand that a joint venture creates a merger of separate corporate cultures. Each corporate entity has its distinctive requirements and procedures. The Project Manager must become aware of these differences, determine the potential impact on project performance, and then establish a specific set of procedures that will satisfy the needs of each corporate entity while accomplishing the overall goals of the joint venture. A meeting would be advisable to clarify and identify all corporate requirements and to establish the mutually acceptable procedures that will be implemented to the completion of the project.

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*

- Bulletin JV 1, "Joint Ventures"

SECTION 5: CONTRACTS AND CONTRACT DOCUMENTS

What is a Contract?

A *contract* is a document or set of documents that declares the expectations and responsibilities of the parties involved in a project *and* protects each party's rights regarding that project. Although it is legally binding, the real essence of any contract is that it is an expression of trust between the parties. The parties to a construction project contract might be a project owner and the mechanical contractor, a prime contractor and the mechanical contractor, or a construction manager (acting as the project owner's agent) and the mechanical contractor. In cases where the mechanical contractor acts as the prime contractor, the company has a contract not only with the project owner but with each of the other trades on the job. The same situation occurs whenever one company subcontracts to another.

A contract is necessary because each party has its own expectations, which sometimes conflict with the expectations of the other party. The mechanical contractor expects a reasonable profit, satisfactory working conditions, fair treatment, and timely payment. The customer expects quality work at a reasonable cost, timely completion, and fair treatment.

Both sets of expectations are based on the desire for profit. Seen from this perspective, the contract becomes the ground on which each party tries to establish conditions that maximize profit. The mechanical contractor wants a contract that allows maximum opportunities for doing a quality job at the lowest reasonable cost and for the highest reasonable fee. The customer, on the other hand, wants the contract to ensure quality work for the lowest reasonable fixed price or fee. This is where the potential for conflict arises.

The contract recognizes that the conflict exists but also expresses each side's willingness to compromise for mutual benefit and to trust the other's fairness. With money at stake, it is easy to see why the contract is so important: it sets the ground rules for the project. It defines the business relationship and provides guidelines for dealing with the unforeseen events that plague every project and threaten one or both parties' profits.

Many contractors accept the contractual relationship casually. They believe the General Contractor who says "Everyone signs my contract with no changes." When projects go well, the contract "stays in the drawer." When challenges arise, the mechanical contractor can lose years of profitability and/or the company because of inequitable contract clauses or ignoring detailed contract requirements. The wise Project Manager will carefully negotiate the contract recognizing that is a key definition for the scope of work.

What Are Contract Documents?

According to AIA Document A201TM-2007 § 1.1.1,

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions),

Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Constructive Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding requirements.

This description is general in nature, and the definition of contract documents your company is bound to should be listed in your contract. It is your responsibility to understand what the contract documents are, and the order of precedence that establishes which document takes priority over the other.

What a Contract Says

Despite the fine print and legal jargon, a construction contract essentially states six simple things:

- Who is responsible for what work
- How the work is to be done
- When the work is to be done
- What the finished product must be
- Who gets paid what and when
- What happens when something goes wrong

Unfortunately, it is the nature of the construction process for these simple things to become very complicated. It is because of these complications, and the thousand and one ways in which either party's profits can be threatened, that contract documents must be so precisely worded and thoroughly detailed.

In the end, though, a contract is still just a confirmation of an agreement, and as the number of contract disputes in the industry attest, each contract is only as good as the people and the companies who execute it.

The Estimate Is Based on Specified Conditions

The cost of performing a contract is significantly controlled by the conditions under which the work must be performed. The most important conditions are time, interference, and construction services. These conditions are substantially established by the contract

documents. Changes in these conditions can have a significant effect on cost. Effective project management will attempt to influence the customer to actually furnish the conditions agreed upon, or to influence changes in such conditions that would be of benefit to the mechanical contractor. The effective Project Manager will see that the work is performed so as to avoid damage to others, or will obtain agreement to excuse damaging performance.

In the event changed conditions cause adverse effects on your costs or damage to others, good Project Managers will find ways to minimize these losses and to preserve the opportunity to recover the damage done to you from the owner, prime contractor, subcontractor, or supplier.

Each set of contract documents sets forth a series of reciprocal obligations of the customer and you as a trade contractor. Contract documents explicitly set forth many of the conditions under which your work will be performed. *Explicit* means that these conditions are clearly stated in an open, unambiguous manner.

Explicit and Implicit Contract Language

Explicit (stated) contract language will override conflicting conditions that would otherwise be implicit (implied). Therefore, the conditions found to be implicit in a contract may vary with the contract documents as well as with the law of the jurisdiction.

Contract documents vary widely from project to project, but most contract documents explicitly cover the following conditions:

- *Time of construction* – Contract documents generally provide that the work is to start within a fixed number of days (usually calendar days) following notice to proceed, or is to start upon execution of the contract.

Public works contracts are usually characterized by both a fixed period of completion, usually expressed in calendar days, and by liquidated damages for failure to complete the work on time. Most private contracts also stipulate fixed completion periods, although liquidated damages are less frequently specified.

The maximum time span allowed for construction will significantly affect estimates of labor productivity, labor rates, material costs, and fixed costs of project administration, supervision, construction equipment, and availability of resources.

- *Sequence of work* – Many contracts require that the work as a whole be scheduled in an orderly manner, so as to efficiently coordinate with the work of many contractors, subcontractors, and suppliers, and also to complete the work as a whole by the scheduled completion date. Contract documents more typically specify scheduling techniques, such as the Critical Path Method (CPM), which must be employed by the contractors. Occasionally, the contract will specify milestone dates when certain interim key phases of the work are to be completed. The prime contractor is usually responsible for the preparation of the overall schedule, but the contract documents frequently impose on the trade contractor a

responsibility to assist in its development and, after having concurred in its logic and feasibility, to be bound by it.

Contract documents that require specific and detailed scheduling contribute to the orderly, efficient performance of the work. The existence of milestone dates aids you, and all other trades, in determining crew sizes and other resources to meet such interim completion requirements.

The schedule and sequence of work are key components in the scope of work. Work done out of sequence or in an accelerated time frame adds to labor cost. The Project Manager must aggressively defend the anticipated schedule and sequence of work by negotiating the best possible contract language.

Scheduling is discussed further in [Section 33: "Scheduling."](#)

- *Construction services* – Contract documents frequently assign obligations to the owner, prime contractor, or other contractors with respect to a number of construction services, such as temporary electricity, temporary heat, temporary toilets, temporary construction and drinking water, material and equipment hoisting, scaffolding, field office space, fuel and energy for testing and for tools, plant air and steam, etc.
- *Occupancy* – Contracts for new construction may provide that the owner can occupy the premises prior to completion of the work. If you have to perform part of the work in occupied areas, costs may be increased by the need to work on a shift basis or to work around the owner's personnel and equipment.

Contracts for reconstruction or remodeling of existing premises may require you to perform your work in spaces occupied by the owner, with a consequent effect upon costs. Alternatively, the contracts may provide that the owner will vacate certain floors, wings, or other areas on a scheduled basis in order for you to perform construction with less interference.

If the premises are to be occupied prior to construction completion, you may incur costs in providing the owner with services such as heat or air conditioning, in providing standby personnel costs if the owner undertakes the operation of the systems, and through having the warranty period extended.

- *Exculpatory clauses* – Under some contracts you are required to excuse the customer of responsibility for the costs attributable to a failure by them to discharge duties implicitly or explicitly assigned to them by the contract documents.

A common example of an exculpatory clause is the provision that, if you are delayed by conditions beyond your control, your only remedy will be an extension of time. Under such a contract provision, you may be held to have forfeited the right to a claim against the

customer for damages done to you by the delay, even though the customer may have acted negligently or in disregard of your interests.

In the negotiation of your contract agreements, seek to avoid the inclusion of exculpatory clauses. Or, as an alternative, attempt to have such exculpatory clauses operate in both directions so as to protect you from comparable claims by the prime contractor and/or the owner.

While exculpatory clauses will often bar you from recovery of damages, the courts in the jurisdiction in which the work is being performed may have either invalidated such clauses as against public policy or may have strictly limited their effect. When confronted with the problem of damages caused by the customer, and the presence of such a contract clause, you should proceed to satisfy the contract's notice requirements and, until advised to the contrary, you should assume that a claim, which establishes fault or negligence on the part of the customer and causally related additional costs to you, will prove to be enforceable.

An additional example of explicit contract language is the indemnity or hold harmless language. This language often requires your company to indemnify (to insure against or reimburse for loss) any acts, negligent or otherwise, of the owner, architect, engineers, or general contractor. Contracts are written with this language as part of the "boiler plate." While most companies do not modify this language, it is important to have it reviewed by your insurance agent to assure your company is not accepting more risk than it should, and to make sure you have adequate insurance coverage for that risk.

More discussion on insurance, indemnity and hold harmless language can be found in [Section 7: "Understanding Bonds and Insurance."](#)

Implicit contract conditions are those that are implied rather than explicitly stated openly and unambiguously. Their force is derived from laws, codes and case law in the jurisdiction in which the work is performed.

The following are implicit conditions generally applicable to your work:

- *Time of construction* – In the absence of any specific requirement to delay the start of the work, the contract implies that the work will be commenced promptly after award and that the workplace will be available. In the absence of an explicit completion period or completion date, the contract documents imply that the construction will proceed expeditiously.
- *Sequence of work, interference and cooperation* – Contract documents imply that the work will proceed in a sequence that is typical of construction work. Except for interference for which adequate notice is given by the contract documents and for interference typical to the construction process, the owner, prime contractor, and trade contractors can be assumed to have agreed that they will avoid hindering one another's orderly, efficient performance of the work. It is a further implicit obligation, binding upon all parties to the

work, that where affirmative cooperation and assistance by one party is essential to the successful performance of the others' work, such cooperation and assistance will be provided.

If the documents do not reserve to the owner specific rights to occupy the building concurrently with your work, then you may assume that the owner will not occupy prior to completion in such a way as to interfere with your efficient performance. A general statement in the contract documents that the owner may occupy the building prior to completion is not a license for the owner to interfere with your normal, orderly work plan.

- *Construction services* – If the contract documents are silent as to which party must provide routine construction services (hoisting, temporary heat, temporary toilets, etc.), it should be assumed that each contractor must provide those services required by it, or purchase them from the prime contractor.
- *Workability of design* – The owner, as the drafter of the contract documents, implicitly warrants that the design is structurally sound, workable, in conformance with applicable laws, and capable of being completed within the contract schedule.

General Types of Contracts

There are two general classifications of contracts used in the construction industry: express contracts and implied contracts.

An *express contract* is one in which all details of agreement are specifically spelled out. It is used in situations where the terms and conditions of agreement between the parties are complex or contain elements where clarity of understanding is important for the protection of both parties. Most plan and specification projects involve express contracts.

The advantages of an express contract are that everything is clearly stated and there is little room for misinterpretation. Among its disadvantages are that items not included can become points of contention and the “letter” of the contract can become more important than the “intent” of the contract.

An *implied contract* is one in which the terms are not expressly stated but are inferred by law, from the acts of the parties, and the surrounding circumstances. It is most practical in situations where the tasks involved in the agreement are generally understood and accepted by both parties. A good example of an implied contract is a case where a Project Manager, faced with an emergency, telephones a local supplier for rush delivery of an item. The Project Manager does not specifically mention to the customer that his company will pay for the item, but the agreement to pay is implied and enforceable.

Implied contracts allow for flexibility and minimize red tape. However, flexibility can lead to abuse, and arbitration or litigation is often required to resolve conflicts that arise.

Pricing of Construction Contracts

In the construction industry, contracts are categorized not only by whether their terms are expressed or implied, but also by the way their dollar value, known as the contract price or contract amount, is calculated. A contract amount can be determined by any of three methods: lump sum, cost-plus-fee or unit price.

In *lump sum pricing*, the mechanical contractor's (or subcontractor's) fee for services is established as a total contract amount. It is the typical pricing method used for plan and specification projects, where the financial goals and details of the work are well established. The advantage of lump sum pricing is that it gives the contractor a set target to shoot for and if through innovation, the contractor can reduce the costs of doing the work and still maintain quality, the contractor realizes the gain in profit. The disadvantage, at least from the contractor's perspective, is that any costs above and beyond the lump sum price will be paid for out of pocket by the contractor. The exception to this rule is if the lump sum price has been increased through a change order. Because the contractor is responsible for any costs above and beyond the lump sum bid, it is generally held that overall cost of the project is borne by the contractor.

In *cost-plus-fee pricing* (often called simply "cost-plus"), payments for services are based on the contractor's expenses plus a set fee, usually a percentage of the expenses. Here the contractor has the advantage. By carefully recording all costs, the contractor is almost certain to make a profit. On the other hand, the enormous amount of paperwork involved can be very time consuming, and if any expenses are not recorded, the cost of those expenses, as well as the profits they would develop, are lost. In this type of contract, the owner is responsible for the overall cost of the project, not the contractor, unless the cost has been limited by a "Guaranteed Not to Exceed" limit on the cost-plus portion. The owner is embracing the risk of the overall project cost, but the contractor still has an implied duty to perform the work as judiciously as possible.

The *unit pricing* method establishes payments based on the number of installed units, each at a fixed price. Here again, the contractor has an advantage. If the pricing of the units is accurate and each unit is installed efficiently, the contractor is almost assured a profit. A single error in estimating unit costs, however, can be disastrous, and slumps in the efficiency of installation crews can eliminate the profits for the entire project.

The Project Manager's Responsibilities

In some companies, the Project Manager is also the project estimator, in which case he is intimately familiar with the plans and specifications or other terms of the contract long before construction begins. In most organizations, however, the roles of estimating, contract negotiation, and project management belong to separate individuals or departments. This could put the Project Manager in the position of starting the project knowing very little or nothing about the contract.

This is an unenviable position, but it is no excuse for failing to study the contract documents thoroughly and developing a clear, practical understanding of what they say. Indeed, all of the Project Manager's responsibilities related to contract documents could be stated in one sentence:

Know, without any doubt, what the contract documents say, and organize and run the project accordingly.

There are two steps in developing the kind of detailed knowledge about the contract that you need:

- Read and reread the contract documents until you understand what is clear and straightforward and have identified what is vague or confusing.
- Meet personally with people who can answer your questions about the vague or confusing parts of the contract documents.

If the answers you need are available from people within your own organization, such as the CEO, the estimator, or the contract negotiator, make a note of the explanation for your own reference during the project. If you or someone else in your company has to go to the other party (the project owner, the prime contractor or, as in the case with a government contractor, the contracting agency) for the answer, *be sure to get that answer in writing so that both parties understand how your question was resolved.*

Scope of Work

The Project Manager's responsibilities regarding the scope of work are to:

- Obtain a copy of the scope of work document and study it carefully before beginning any planning or mobilization. In some cases, the scope of work is outlined in the bid request from the owner or in the bid proposal prepared by your company. In other cases, it must be derived from the contract documents. A ["Scope of Work Checklist" \(Figure 5.1\)](#) may help in determining your company scope and that of subcontractors. Make certain the drawings and specifications used at bid time are listed in the scope of work and in the contract.
- Distribute the scope of work definition to all members of the project team so that everyone clearly understands what the scope of work includes and what it excludes.
- Insist that the job supervisor or foreman consult with you any time there is a question about the scope of work or uncertainty whether a particular activity is within the scope of work.
- Keep a copy of the scope of work document handy and refer to it whenever you have a question about job responsibilities.

A sample ["Letter of Agreement to Proceed without Contract" \(Figure 5.2\)](#) may assist you if you have been issued a Notice to Proceed but have not received a contract.

A Contract Checklist

In general, you will have a good basic understanding of the project contract if you can readily answer the questions below. Many of these questions are discussed in detail in other sections of this manual.

- Who is your contract with?
- Who gives you orders?
- Who pays you?
- What kind of contract is it? (express, implied)
- What pricing method was used? (lump sum, cost-plus-fee, unit price)
- What kind of job is it? (federal government, state government, local government, institutional, public utility, commercial, industrial, overseas: each has its own set of requirements and circumstances)
- Who else is involved in the contract (design professionals, contract managers, subcontractors, suppliers, inspection agencies) and what are their qualifications or your past experiences with them?
- What permits and inspections are required? (in-plant codes, etc.)
- What is the scope of work?
- Does the contract include any special labor requirements?
- How does the current union labor agreement affect labor requirements for the job?
- What are the specific details of construction? (special tool or equipment requirements, potential coordination problems, feasibility of design)
- What is the project schedule?
- What are the important administrative details? (procedures for billing, approving change estimates and substitute materials, accepting work, backcharges, getting compensation for delays, filing claims, etc.)
- Which contract clauses require special review? (indemnity clause, lien release, clean-up, backcharges, site facilities and conditions, contingent payment, etc.)
- Who determines the project schedule and how can that schedule be modified?

- What are the rules regarding payment? (How is work to be billed? Who reviews the bills? Who authorizes payments? How will retainage be paid? What are the conditions for final payment?)
- What is the procedure for changes? (Who has the authority to approve changes? How are changes to be billed? When are changes to be billed? When will payments be made?)
- What happens if something goes wrong? (Who is liable for losses due to accidents, delays, and changes? How will the amounts of claims be calculated?)
- What do other documents say about the original intent of the contract? (the original invitation to bid, the mechanical contractor's proposal letter and bid records)
- What is the procedure for presenting and resolving grievances?
- Which state laws govern the work and the contract? (this should be the state in which the project is located, not the location of the owner or general contractor's offices)
- What are the notification requirements for delay, changes, etc.?
- As Project Manager, what must you do to make a fair profit on the job as described in the documents?

[Figure 5.3 "Subcontract Checklist"](#) may be used to assist you in evaluating contract language.

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin SC 3, "Standard Form of Agreement Between Contractor and Subcontractor"
 - Bulletin LL 11, "Contract Clauses"
 - Bulletin CT 1, "Construction Contract Proposal for Cost of Work Plus a Fee"
 - Bulletin CT 2, "Contract Terms and Conditions"
 - Bulletin CT 4, "Disputes and Arbitration Clauses"
 - Bulletin CT 5, "AIA A201 General Conditions of the Contract for Construction"
 - Bulletin CT6, "Warranty"
 - Bulletin CT 8, "Understanding Manufacturers' Warranties"
 - Bulletin CT 9, "Managing Killer Contract Clauses"

SECTION 6: OTHER DIRECT JOB COSTS AND LABOR BURDEN

Other Direct Job Costs (ODJC)

When contractors built projects using the field forces to lead and plan the projects, job costing was simple. Labor, material, and subcontracts were job cost. The contractor added a percent markup that covered general and administrative expense including the cost of selling the project. In today's market where each project may have a Project Manager, fabrication support, BIM detailing, commissioning, LEED® certification, and other project requirements, the definition of job cost becomes more difficult. In considering what "should" be job costs, the company considers trying to job cost all those expenses that would not be incurred if the project were subcontracted. Capturing these costs as job cost allows the Project Manager to manage them more effectively and include them in change order cost. In some government contracting, if the contractor regularly captures these costs as job cost and estimates them as job cost, they automatically qualify as change order cost.

Direct job costs can be identified as pertaining to the specific project. Some or all of the following may be assigned to a specific project and are therefore easily identified as job cost:

- Equipment to be installed
- Subcontractors
- Materials
- Labor
- Equipment rental from others
- Onsite management staff including Project Manager, project engineer, etc.
- Vehicles assigned to the project
- Communication devices including telephones, computers, cell phones, etc.

Other direct job costs (ODJC) are job costs incurred as part of managing and supporting the job but not necessarily doing actual construction work. They are different from general and administrative (company overhead) expenses, which are costs incurred in operating the company. Many contractors are tracking these ODJC costs in their job cost systems to more accurately reflect actual job costs and reduce variable overhead. Among ODJC are:

- Project Managers, superintendents, nonworking job supervisors, project engineers, drafters, safety director, accountants, paymasters and timekeepers, purchasing agents, warehouse employees, security, jobsite maintenance personnel, etc. When these individuals are not full time on the jobsite, their time is tracked and hours spent on managing/supporting the project are charged on an hourly basis.

- Labor burden (payroll taxes, federal and state unemployment insurance, workers' compensation, liability insurance, small tools and expendable materials, and certain vehicle expenses) – keep in mind that payroll taxes, federal, and state unemployment insurance, and workers' compensation could be included in direct labor costs.
- Project recruiting expenses (this could also be included in direct labor costs)
- Fabrication shop and sheet metal shop expenses
- Equipment rental
- Small tools and consumables
- Project insurance: public liability, builder's risk, property damage, etc.
- Guarantee or warranty reserve
- Vehicles: gas and oil, tires, licenses, insurance, parts and repairs, maintenance, and other transportation expenses
- Temporary facilities and utilities
- Sales tax (may be included in materials or equipment)
- Bonds and permits
- Legal expenses
- Liquidated damages
- Project supplies: construction drawings, photography, letterhead, postage, photocopying, lab tests and X-rays, first aid supplies, ice, water, etc.
- Clean-up and disposal services

The Full Cost of a Labor Hour

The United Association (UA) and the Mechanical Contractors Association of America (MCAA) Joint Strategic Planning Committee began an initiative in the form of an educational program for UA members and leaders. This program is being presented around the country and educates the participants about the Full Cost of a Labor Hour.

An example that could be used for a labor hour follows:

Hourly wage	\$36.21
Union fringe package	15.13
Payroll taxes	4.24

Workers Comp Ins.	3.19
Other Insurance	4.53
Total	\$63.30

This total **does not include** any small tools, consumables, jobsite overhead, and truck expense of a foreman, phones or any other electronics. These costs alone can total at least 20 percent of an hourly wage.

This analysis and program is used to educate the UA field workers of the “full” cost of a journeyman. Too many union craftsman fail to recognize any cost beyond “what is on the check.” Many contractors have become concerned that they are also not recognizing all of the costs associated with field labor. How does the contractor ensure he is recognizing and appropriately costing the true cost of labor?

Labor Burden

Capturing Other Direct Job Costs can be difficult. When using the pipe fabrication shop, how would you charge electricity to a job? The safety director serves many projects so identifying a portion of his time with a particular project is difficult. To address these difficulties, contractors have adopted Labor Burden, sometimes called Allocated Overhead, strategies. ODJC can be separated into the following general categories for convenience.

- Costs for each labor hour
 - Fringe benefits
 - Payroll taxes and insurance
 - Small tools not expected to have a multi-project life
 - Consumable items such as drill bits, rags, flux, saw blades, etc.
 - Safety orientation
 - Drug testing
- Special costs for a labor hour
 - Vehicle costs
 - Safety costs
 - Communication devices such as phones and computers
- Sheet metal and pipe fabrication facilities
 - Facility depreciation
 - Facility utilities and maintenance
 - Supervision
- Drafting, detailing, and BIM coordination
 - Computers and infrastructure

- Facility depreciation or rental
- Facility utilities and maintenance
- Drafting and detailing personnel

Mechanical contractors deciding to initiate a labor burden costing system can assume that the system will be audited in the future either by the government on a contract, or by a frequent customer who does repetitive negotiated contracts. The system must become a part of the accounting process and be administered consistently. Overhead cost accounts can be identified to capture payroll taxes, payroll insurance, small tools, consumables, safety director cost, safety materials, drug testing costs, vehicle costs, communication devices, facility depreciation, utilities, and the labor costs for detailers, draftspersons, shop superintendent, etc. These identified costs can be applied per manhour of field labor, mobile field labor, shop fabrication, drafting, or BIM coordination.

Labor burden for a field manhour is applicable for all contractors. Following is a brief discussion and development for that cost.

- *Fringe benefits* – Usually defined by contract
- *Payroll taxes and insurance* – Usually a percent based on total cost and total manhours
- *Small tools* – The contractor will define the category and apply appropriately
- *Consumables* – The contractor will define the category and apply appropriately
- *Safety orientation* – These costs could be company based or project specific. If company based, the safety director, his materials, and his support would be included.
- *Drug testing* – These costs could be company based or project specific

Using these costs and the total manhours for the plumbers, pipefitters, service technicians, or sheet metal workers, the company can develop a cost to be added to each manhour worked. Some contractors prefer the term Allocated Overhead for certain burdens. Significant costs are associated with each of the above categories. To defend the original targeted gross margin, the Project Manager will identify these costs and manage them. When change orders occur, these costs will be identified and recovered leaving the mark up to cover home office expense and produce a small profit.

Most contractors track these costs using historical data and next year's projections. The historical data can be used for estimating purposes and as a reality check when developing the burdens for the current year and future years. Many contractors estimate using projected shop burdens. If the contractor develops next year's budget and the burdens have increased significantly, he would review his projected revenues and costs. If revenues cannot be increased, costs must be reduced or the shop burdens used in estimating would make him non-

competitive in the market place decreasing potential revenue and creating a company downward spiral.

The following table is an example of one contractor's labor burden calculations.

Cost Codes	Hourly Allocated Overhead (Burden)
All Trades	\$2.25 (small tools /consumables)
Pipe Shop	Add \$8.00 to \$10.25 /hr.
Sheet Metal Shop	Add \$14.00 to \$16.25/hr.
Mobile work force (vehicles)	Add \$13.50 to \$15.25/hr.
BAS techs	Add \$9.00 to \$11.25 /hr.
Engineering Staff	\$8.50/hr.
CAD Group	\$13.50/hr.

Individual contractors may have more or fewer identified burdens. Service contractors regularly use these tools for pricing their work.

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin AF 7, "Other Direct Job Costs (ODJC's) and Indirect Job Costs"
 - Bulletin AF 5, "Service Mark-ups vs. Construction Mark-ups"
 - Bulletin QB 1, "What Is Indirect Job Cost?"

SECTION 7: UNDERSTANDING BONDS AND INSURANCE

Each year, the landscape for the construction industry becomes more complicated. Contractual requirements and litigation are challenges contractors face with more regularity, making risk management a necessity.

What is risk management?

- Risk is the potential or possibility that something, usually negative, will occur.
- Risk management is the evaluation of the probability of a harmful event occurring. It also involves reducing risk, assessing the costs of reducing risk, and determining how to reduce exposure to the costs associated with a harmful event.

This section will serve as a guideline and starting point to answering your questions regarding the risk in surety bonds and insurance. It is not intended to be a complete review of the subject matter. Instead it will provide you with tools to promote discussion and develop questions. Other risks associated with the construction industry are discussed in the appropriate sections elsewhere in this manual.

Each company must consider specific requirements, challenges, and operating areas to tailor solutions that suit its unique circumstances. This process requires input from attorneys, insurance and surety bonding professionals, and other industry resources in order to address the needs of each company.

Surety Bonding

Most everyone in the construction industry is familiar with surety bonds. Surety bonding is an integral part of company business strategy. The ability, or inability, to obtain a surety bond may have a positive or negative effect on your company's chances to obtain work and meet company financial goals

Surety bonds guarantee that specific obligations will be fulfilled. The obligation may involve meeting a contractual commitment, paying a debt, or performing certain duties. There are a number of surety bonds typically available to and used by the construction industry, including:

- *Bid bond* – this type of bond guarantees that the bidder, if awarded the contract will enter into the contract and furnish the required performance and payment bond(s). These bonds carry a penalty of a percentage of the bid (between 5 percent and 20 percent) if the contractor is unable to or wishes to not execute the contract or accept the project. This means that if your company bids a job with a 5 percent bid bond and you withdraw your bid, the surety is obligated to write a check to the obligee (the party for whose benefit the bond is written) in the amount of 5 percent of the total bid as compensation for going to another bidder. While this is a right the obligee has, they can choose to waive that right and let your company withdraw without penalty. Typically, these bonds do not have a premium.

- Performance bonds
 - A *Construction Contract Bond* (also called a *Performance Bond*) is the promise by a third party (the bonding or surety company) to pay – or sometimes perform – if the contractor fails to complete the contract.
 - A *Labor and Material Payment Bond* guarantees that the contractor will pay all bills for labor, materials and subcontractors. It may be a separate bond or made a part of the Performance Bond.
 - *Maintenance or Warranty Bonds* guarantee that the work done by the contractor will be free of defective workmanship and materials. It may be a separate bond or part of the Performance Bond. If it is part of the Performance Bond, it will usually only guarantee maintenance for one year after completion of the contract.
 - *License and Permit Bonds* are those that are required by state law, municipal ordinance, or by regulation and in some cases by the federal government or its agencies. To be licensed, a contractor may be required to have a bond. In practice, the terms “license” and “permit” are used interchangeably. The purpose of these bonds is to safeguard public health, welfare, morals, or assure the public’s safety.
 - Premiums for performance bonds vary by surety, type of bond, and size of bond. If your project has a bond, be sure to include any bond premium on change orders, as bond premium for the project will include any change orders. To neglect including this premium will mean your company must pay the premium for the change order, but will not be able to collect it from the obligee.

Surety is Not Insurance

It is a commonly held belief that a bond is an insurance policy. It is not. An insurance policy has only two parties to the contract—the insurer and the insured. A surety bond identifies three parties to the contract—the principal, who is the party whose faithful performance is being guaranteed; the obligee, who is the party for whose protection the bond is being issued; and the surety or guarantor, who together with the principal, jointly binds itself to the obligee for the faithful performance of the principal’s obligation.

The most important distinction between insurance and a surety bond is the obligation of the principal to indemnify the surety for any damages it pays to the obligee which were caused by the principal. When obtaining a surety bond or establishing a surety bond program, the contractor’s company owners must sign an indemnity agreement with the surety, and if the financial condition of the company is not strong enough to support a bonding program, that same indemnity agreement must be *personally guaranteed* by the owners of the company *and* their spouses.

These indemnity agreements bind the principal and the surety “*jointly and severally*” along with their “*heirs, executors, administrators, and successors*” to the obligations described in the bond. This means that once the bond has been executed and delivered to the obligee, any default gives the obligee the right to seek recovery from the principal and the surety or from either party individually. The primary responsibility falls upon the principal, because no action can be

taken on the bond until default occurs. Once default occurs, damages will have to be paid by the principal and/or the surety. If the surety pays any damages, it acquires the obligee's right of recovery against the principal including personal assets of the indemnitors if the company assets are insufficient.

Why does the surety require the principals to pledge so many assets? It is largely because bonding credit is unsecured. Chances are there are many people or companies ahead of the surety in case of default. A piece of equipment likely has a loan on it, with little or no equity. A building has a mortgage. A personal home may have a first and second mortgage.

What does the surety company ask for when extending bonding credit or a bond? They will require current and past year's financial statements, three years personal and corporate tax returns, work-on-hand reports, personal financial statements of owners, accounts receivable aging, accounts payable aging, and letters of reference from banks. Quite often companies are asked for internal financial statements including a work-on-hand schedule multiple times during the year.

From this list, it is easy to see what role the Project Manager has in establishing or maintaining a bonding program. Surety companies and the bonding agent track not only the financial performance of the company, but of individual projects as well. Your cost-to-complete forecasts not only impact company profitability but when examining project profit, sureties may wonder if project projections vary wildly from period to period.

It is not that the surety does not understand construction companies have bad projects. They do. The surety wants to know your company knows it has a bad project, how bad it will be and what you are doing to minimize losses. This responsibility falls on the Project Manager.

Being able to provide bonds sets your company apart from competition. It is up to you, as the Project Manager, to assure your projects are as efficient and profitable as they can be. This is accomplished by using the tools described elsewhere in this manual. If your projects and the projects of others are profitable, the company may be able to obtain or maintain bonding credit and has a competitive edge in this fiercely competitive industry.

Insurance

Whenever considering the subject of "insurance," companies should always be reminded that "insurance" is simply one of the devices used to reduce or rid the business of unacceptable risks of loss. Insurance is the transfer of this risk to someone better able to handle it, for which a premium is paid.

There are many other ways to reduce risk and insurance should be the one used when others cannot be used. Your company may choose to use the strategy of "spreading the risk" by assigning the risk of subcontracted work to subcontractors, retaining only risk from work your company performs. The strategy of "transferring the risk" is used when the risk is clearly not yours and the risk is transferred to those who do the work. Your company may form other companies to limit risk on certain parts of the business such as equipment and fleet ownership,

real estate holdings, and such. Good companies use these and other strategies to address risk in companies, then use insurance for the unacceptable risks that remain.

While discussing insurance, it is important that the Project Manager has an understanding of what traditional insurance coverages are and what they do and do not cover. This list is not meant to be all-inclusive. If you find yourself confronted with an insurance question, contact your company risk manager or insurance agent for an explanation. Of course, the coverages listed below are general in nature; the specific insurance policies must be consulted for company-specific coverages, inclusions, and exclusions.

To assist you with assessing insurance requirements contract language, [Figure 7.1 “Contractor Insurance Checklist”](#) is included in this manual.

Physical Damage to Assets

Buildings

This coverage is for buildings owned by or leased by the insured (when the lease agreement requires the lessee to cover insurance).

This coverage is typically written on a “risks of direct physical loss” basis and provides coverage for all perils that are not specifically excluded by the policy. Property policies typically exclude earthquake and flood. Earthquake can be added as an endorsement (for a fee) and flood usually has to be a separate policy.

Any loss adjustment begins with determining the cost of replacing the damaged property. If coverage is written on a Replacement Cost basis, the insurance will pay the cost to replace the building with a new one of the same type. If the policy was written on an Actual Cash Value basis, the adjuster will reduce the replacement cost by a reasonable allowance for physical depreciation. Note that this adjustment is not to be confused with depreciation done for tax purposes.

Regardless of the valuation basis, the insurance company will not pay more than the limit of insurance, less any deductible.

Building Ordinance Coverage

Certain building codes require that all new construction be of fire resistant materials. Construction with this type of material may be considerably more expensive than the present building. If the building is significantly damaged, the code in the city or municipality may require the building owners to demolish the building and re-construct to current code. The company property insurance typically covers the damage caused by fire or other named peril, but will not cover the undamaged portion that must be demolished. Coverage for this risk is done by special endorsement to the property policy.

Items that are Not Insured

Property policies exclude items such as underground piping, land, and paved surfaces that would not be affected by a catastrophic loss. The value of these items is typically excluded from the building insurance valuation.

Glass

Building glass is covered for certain perils under the property policy. Typically, the policy provides only limited coverage caused by vandalism. Other perils may also be limited. Glass insurance picks up the additional perils, including vandalism and other losses that are excluded in the property policy.

Boiler Machinery

Specialized coverage is necessary on boilers and other pressure vessels. This coverage is excluded in the property policy.

Personal Property

At owner or leased locations and storage locations, office property and other “on premises” personal property is covered by the same type of property insurance described under Buildings. Periodic update of value of personal property is prudent.

In Storage Trailers and Open Yards

If there is property in storage trailers or in open yards, the property is not covered unless listed in the Property policy or the Contractors Equipment policy.

In Transit

Contractors Equipment insurance covers tools and equipment while they are in transit. A transportation or motor truck cargo policy may be used to cover materials other than property which is being transferred at your risk.

Be aware of a common misconception: when property is being delivered to you, have a definite, written understanding (a Purchase Order) that it is delivered FOB your jobsite or your warehouse. *Do not* assume this is the case. It is a commonly held belief that FOB and freight are the same. They are not. FOB is freight on board. The FOB point is the point at which ownership of the goods are transferred. If you accept a shipment which is FOB origin, the equipment or material belongs to you when it is loaded on the truck. If there is damage in transit your company will be responsible to file the freight claim as well as replace the damaged equipment until the freight claim is settled.

Property Being Installed or Property Under Construction

Loss to property which is being installed or is under construction is subject to Builders Risk insurance or Installation Coverage. Builders Risk insurance is complicated, with many caveats and exclusions, but generally:

- Assure the responsibility for damage during construction, and the responsibility for obtaining property insurance during construction is clearly spelled out in the specifications.
- Be certain that your company is specifically named as a Named Insured on any Builders Risk policy purchased by the owner.
- Assure insurance in force protects you for property before it is installed as well as after.
- If you are working in an existing building, and are relying on the owner's property insurance, be sure to have your company added to the owner's insurance policy as a named insured.
- Deductibles for Builders Risk insurance are typically very high, sometimes more than \$50,000 or \$100,000. If this policy is carried by the owner, assure your company understands what the financial obligation will be if there is a loss to your work under construction.

Owner-Furnished Equipment

If you are installing owner-furnished equipment (OFE), particularly high value equipment, be sure your company Installation Coverage includes coverage for the equipment.

Burglary or Theft of Personal Property

Tools and equipment are generally insured by Contractors Equipment insurance. This type of coverage can be written to cover specified pieces of equipment for specific amounts, or a single amount that applies to all tools and equipment. Because of the cost of this type of insurance and the likelihood of a loss, this coverage, if written at all, has a high deductible.

Office equipment is usually covered by a Property Insurance policy.

Material at jobsites is covered by the Installation Coverage, but theft has to be included. Materials or inventory at your premises that have been purchased for and allocated to a particular job may be insured by Installation Coverage or Builders Risk.

Casualty Insurance

The following commentary describes some of the major features of commercial casualty insurance. Again, perusal of your company insurance policy for specifics is critical.

Workers' Compensation Insurance (WC)

A WC insurance policy provides broad and simple insurance against employee injury and disease. The standard WC policy provides three basic coverages:

- *Workers' Compensation Insurance* – The insurer agrees to pay benefits required of your company by the applicable state WC law. Insurer also promises to defend any claim or suit against you for benefits payable under WC insurance. These benefits include: medical, income (indemnity or lost time wages), death, and dismemberment. The kind and extent of

benefits payable depends on the nature of the disability and upon the state law that controls payments.

- *Employers Liability Insurance* – In this coverage, the insurer agrees to pay all sums you legally must pay as damages because of bodily injury to an employee. This insurance protects against employee injury or disease that do not come under the scope of state WC law. In this type of coverage, there are specific limits of liability. Standard limits for employer liability are \$100,000 bodily injury for accident, \$100,000 per employee for disease and \$500,000 aggregate for disease. Often, owners and general contractors require higher limits, which can be obtained, but will generate additional premium.
- *Other States Coverage* – This provides temporary coverage when employees are working in other states, but the states must be listed in the policy. Be aware that there are some states that require their own state-owned insurance to be in place when working in that State. This temporary coverage does not eliminate your company notifying your agent when you are working in another State.
- Your WC policy may have to be modified to meet contractual requirements. This is typically done by endorsement, and may result in additional premium.

Workers' Compensation Insurance and Workers' Compensation Ratings

The basis of WC premium is per \$100 of payroll. Each classification of employee, based upon their duties, has a different rate which is applied to this payroll. The classification rates are based upon actuarial figures and likelihood of injury. For example, a plumber has a higher likelihood of injury than does an office worker, or even the Project Manager. Shop workers may have a different rate than a field worker. This is why payroll records are kept by work classification. Sometimes this work classification is tied to a phase or activity code. If everyone in the company was recorded as a plumber or pipefitter, the company would pay many times the premium than what should be due.

The second type of rating which applies to many states is the Experience Modification Rate or EMR. This EMR is an adjustment to your manual WC rate (payroll dollars x classification rate). The EMR is based upon actual losses ÷ expected losses. Actual losses are requested from your insurance carrier (number of claims as well as cost of claims) for the previous three-year policy period. In most states the independent agency National Council on Compensation Insurance (NCCI) performs the calculations and in others the State Labor Commission (or similar agency) is responsible. Expected losses are derived from actuaries that calculate what the expected losses (number of claims and cost of claims) are for each work classification the company has. If the actual losses are less than expected losses then a credit is applied to the manual premium. If the actual losses are greater than the expected losses, a debit is applied. Said simply, the fewer accidents your company has, the less workers' compensation premium it will pay.

In addition to a significant reduction in premium, this EMR can be a competitive edge. Frequently, owners, construction managers, and general contractors are pre-qualifying the

contractors they use. Part of this pre-qualification may be a request for your company EMR and/or OSHA logs. If either of these documents does not meet the criteria, your company could get eliminated from a bid list. On the other hand, if these documents meet the criteria, you could find yourself on a select bid list. Owners know that safe companies pay less in premium and therefore, the cost of construction should be less.

Auto Insurance

Auto insurance can be tailored to the needs and exposures of your company.

Auto Liability Insurance

Coverage is provided for sums your company is legally obligated to pay as a result of an auto accident. This coverage also has the right and duty to defend the insured against a claim or suit that could fall within the policy. Defense costs are paid in addition to the liability limit. Generally, a combined single limit of \$300,000 per accident is minimal coverage, but may not meet contractual limits.

Physical Damage

Auto physical damage which pays for damages to covered vehicles is typically covered via collision and comprehensive coverages. Collision coverage pays for a loss on a covered vehicle resulting from overturn or a collision with another object. Comprehensive covers damage to the vehicle caused by any peril except collision, overturn, or a peril specifically excluded.

Collision and comprehensive premiums are based upon vehicle age and cost when new. A company-owned vehicle is typically on the road more frequently than a personal vehicle, has many different drivers, and has a higher risk of loss. This usually results in higher premiums for company vehicles than for the same vehicle if it was personal.

No Fault or Personal Injury Protection (PIP)

Some states have enacted a no fault auto insurance law. There are many misconceptions regarding this law, if applicable in your state.

This law requires your insurance to pay for injuries to persons in your vehicle, regardless of who caused the accident. The law does not address property damage. In theory, these statutes are meant to provide benefits to injured persons without regard to liability. In practice, have these statutes reduced bodily injury claims and legal expenses? Most insurance experts believe not.

Medical Payments

Medical Payments insurance pays, without regard to liability, for medical and funeral expenses arising from an auto accident. Your company will tailor this coverage to their specific needs and the legal status (corporation, partnership, etc.) of the company, with the help of their insurance agent. If this coverage is not properly applied, customers, guests, family members, or others may not be covered.

Commercial General Liability (CGL)

The CGL is designed to provide virtually all of the general liability coverages needed by a typical business.

There are four major groups of CGL coverage:

- Bodily injury and property damage
- Personal injury and advertising injury
- Medical payments
- Supplementary payments (defense costs)

Bodily injury and property damage protects your company against liability for bodily injury to others or damage to the property of others. It covers the following business liability exposures:

- Premises and Operations
- Products and Completed Operations
- Contractual Liability
- Independent Contractors

The *premises exposure* comes from the ownership or occupancy of property. *Operations exposure* comes from business activities undertaken on or away from your business premises. The *products exposure* arises after goods and products manufactured, handled, sold or distributed have left your premises and possession. The *completed operations exposure* arises after your off-premises work is completed.

Contrary to its name, *contractual exposure* has nothing to do with company obligation to complete a project according to the terms of a contract. Rather this type of liability arises when your company assumes any or all job-related liability exposures. Virtually all contracting parties attempt to reduce their liability exposures by transferring potential losses—customers transfer risk to contractors, contractors transfer risk to subcontractors, sellers agree to indemnify buyers from product liability. When it is all said and done, every company should accept liability for the work they do or the goods they sell.

This transfer of liability or risk is done through either hold harmless (or indemnity) agreement in contracts and is backed up by additional insured endorsements (discussed later in this section). The term indemnity agreement refers to an agreement whereby Party A (the indemnitor) promises to reimburse Party B (the indemnitee), for B's liability and associated defense expenses arising out of A's work for B. In an agreement between a general contractor and your company, the general is the indemnitee and your company is the indemnitor. When your

company engages in a hold harmless agreement with a subcontractor, your company becomes the indemnitee and the subcontractor is the indemnitor.

Hold harmless agreements are a valuable risk transfer tool, but in some contracts they are too far-reaching and attempt to pass all risk from all acts, negligent or not. It is important that in any contract your company is asked to sign, your insurance agent is consulted to review the language and an attempt should be made to make the language more equitable.

The *independent contractor* exposure arises when your company contracts with a subcontractor to complete a job for a third party. As a general rule, your company is not liable for the actions of subcontractors but there are exceptions. Certainly any suit brought against one of your subcontractors is likely to name your company as well. Therefore, it is important that the CGL covers liability and defense costs that you incur as a result of work done on your behalf by subcontractors. To minimize your subcontractor liability exposure your subcontractors are required by your contract to carry minimum amounts of insurance, ensure a hold harmless agreement is in the contract, and that all subcontractor insurance certificates name your company as an additional insured.

Personal injury covers offenses such as false arrest, libel, slander, and invasion of privacy.

Advertising injury includes specified offenses such as libel, slander, misappropriation of advertising ideas, infringement of copyright and violating a person's right of privacy committed in the course of advertising your company products or services.

Medical payments coverage pays medical expenses of others resulting from bodily injury caused by an accident on company premises or arising from company operations. This coverage applies without regard to fault.

In addition to paying damages for bodily injury, property damage, personal injury and advertising injury, your company insurer also promises to provide a defense and pay for various legal fees and costs associated with a claim or lawsuit alleging damages that are covered under the CGL policy.

The terms of your company CGL policy will be tailored to the needs and exposures.

Umbrella Liability Insurance

An Umbrella policy is used to provide higher limits of liability and broader coverage than is provided by company primary liability insurance. Literally, this coverage overlays all other coverage and provides payments if primary insurance limits are exhausted from all types of coverage such as CGL, Auto, Workers' Compensation, etc. Generally, this coverage is less expensive than the primary insurance. However, most Umbrella policies have minimum limits that must be maintained in underlying, or primary insurance.

Individual company insurance policy limits vary. In assessing insurance requirements of a project it is up to you, as the Project Manager, to assure your company has at least the limits

stated in the contract. If, at a later time it is discovered that your company carries limits less than those in the contract, the premium generated to increase limits could be substantial and will certainly affect targeted gross margin on the project.

Additional Insured Endorsements

This endorsement is typically called out for in the contract. It protects the named additional insured (owner, general contractor, architect, etc.) against liability for injury or damage caused by work you are doing for them. Your policy will defend all insureds and will pay the amount of any settlement or judgment, up to the policy limits.

Certificates of insurance are discussed below. Be aware that a certificate of insurance is not an additional insured endorsement. This is done by special language on the certificate or by special form endorsement attached to the certificate.

It is good business to request your subcontractors give your company an additional insured endorsement. This requirement should be part of your boiler plate subcontract.

Certificates of Insurance

Your company should require certificates of insurance naming your company as certificate holder from subcontractors *before the work starts*. These certificates provide evidence that your subcontractor's insurance program meets your insurance requirements and that of the contract. They should be reviewed carefully. A certificate of insurance is not a guarantee of continued coverage; it is simply a snapshot of coverage on the date of certificate issue. Therefore, it is important that your company asks for notice (typically 30 days) of any change or cancellation of coverage. This language should appear on the certificate.

Because insurance policies expire and new ones replace them, it is important that your company has a system in place for tracking certificates of insurance, and requesting new certificates when policies expire.

Uninsured or Underinsured Subcontractors

Using an uninsured or underinsured subcontractor reduces the value of the indemnification agreement. If you hire an uninsured or underinsured subcontractor, your company could be responsible for payment for injury or damage that should have been the responsibility of the subcontractor.

In addition, a premium is charged for hiring subcontractors, based upon dollar volume of subcontracted work. If your company hires uninsured subs, your insurer will charge an extra premium at the end of the policy that is based upon the subcontractor's payroll. This extra charge will apply to General Liability policies as well as Workers' compensation policies. Essentially, your company will pay premiums, accept liability, and pay losses as if the subcontractor's employees were on your payroll and their revenues are yours.

When claims are paid under your policy that should have been paid under a subcontractor's policy, your policy limits are unnecessarily reduced, renewal premiums are increased, and could give insurers pause on whether to insure your business or not.

Waivers of Subrogation

The term subrogation means "to put in the place of another." Simply put, this means that if Contractor A incurs a loss and its insurer pays for the loss and it is later determined that Contractor B is responsible for the loss, Contractor A's insurance carrier may bring action against Contractor B's insurance carrier to recover the losses.

This seems fair, however many construction companies are asked to sign a *Waiver of Subrogation* in favor of the owner, general, and/or other contractors on the jobsite. While insurance companies are mixed on whether this is a good idea or not, it is routinely done. There are many reasons, but most believe that subrogation can have negative effects on the job. It can slow the project while the investigation is being done. If the firm does not have adequate insurance or the cash to cover the subrogation amount, it could bankrupt a company, further delaying the project while a substitute contractor is found.

If your contract documents require Waivers of Subrogation, before you sign anything, consult with your insurance agent to assure that your insurance policy(s) allow it and which endorsement to the policy will need to be made.

Subrogation and Waivers of Subrogation are a complicated issue. Every company must evaluate their policy and make the best decision for them and their insurance carrier.

OCIP and CCIP

A "wrap-up" is a centralized and controlled insurance and loss control program, usually for a large single project which covers the owner, general contractor, and all subcontractors and covers various parts of insurance such as General Liability or Workers' compensation.

There are two commonly used types of wrap-ups. One is sponsored by the project owner, and is called an Owner Controlled Insurance Program (OCIP), and the other, sponsored by the general contractor, is called a Contractor Controlled Insurance Program (CCIP).

Each of these programs are essentially operated the same way. For the purposes of this section, programs of these types will be referred to as a CIP or a wrap-up.

Why are wrap-ups or CIPs popular? Usually it is because they offer the possibility of significant cost savings by combining the insurance for all parties or contractors on a project into one policy.

In addition, unlike non-wrap-up projects where the stronger or higher tier parties contractually divert as much liability as possible to subcontractors, the CIP sponsor can control the defense of a liability claim. This is far more efficient and less time consuming than attempting to compel

the insurance carriers of subcontractors to accept a claim and defense of the owner, general contractor, or both.

Typically, all subcontractors and sub-subcontractors are required to enroll in the wrap-up and are not allowed to opt out.

Requirements of the subcontractors working on wrap-up projects differ from project to project, but typically your company will be required to report payroll numbers, claims on the project, injuries, provide updated certificates for insurance not covered by the wrap-up, and off-site activities. The wrap-up also may require project-specific safety orientation for all onsite personnel, drug testing programs, and may even require daily "stretch and flex." These items are meant to reduce accidents on the jobsite, but cost your company money. Be sure you have the costs for these and other items covered in your bid, along with any change orders. In addition, the administration of a CIP is sometimes very time-consuming. These administrative costs should be covered in the bid.

It is important that you understand which coverages are provided under the wrap-up. Some cover general liability, umbrella, builders risk and workers' compensation, and some cover only part of these. This information will need to be transmitted to your insurance carrier as it will affect *your* company insurance premium. For example, if the wrap-up is covering workers' compensation, your company would not pay premium on your WC policy.

Before the project is bid, the wrap-up sponsor will instruct the subcontractors on which method will be used to determine the insurance deductible for the wrap-up. Some projects will bid with the subcontractor's insurance included in the bid and after award a percentage is deducted from the contract amount for insurance. If this is the case, at the end of the project a calculation is made to adjust the initial insurance deduct to what the actual insurance premium would have been on the project if there was no wrap-up.

Many times a contractor will simply give the manual rate without the discounts as the deductible. This can amount to a significant dollar figure when you consider the discounts or credits your company receives. For example:

WC manual premium for 5,000 hours at \$50.00 per hour x 8.80 per \$100 of payroll generates a \$22,000 workers' compensation premium. With an EMR of .80 applied that same premium reduces to \$17,600. It is possible that your company also received a 25 percent credit for having a strong safety program. Application of this credit reduces the premium for the 5,000 hours to \$13,200. If you erroneously gave the full \$22,000 credit, you would have significantly cut the profit margin on the project, by \$8,800.

If the wrap-up covers the umbrella policy, it is possible that your umbrella policy is a fixed amount for a certain amount of coverage. Therefore, no deductible should be given for the umbrella.

In short, if you are not confident that you can calculate the proper deduct, no matter when the deductible occurs, consult with your insurance agent who will assist you in assessing coverage in the wrap-up and also an appropriate deduct. It is also necessary to advise your insurance carrier that you are working on a wrap-up project. This will usually be done when the insurance certificate for off-site operations is issued.

Claims under a wrap-up must be reported to the sponsor's insurance carrier. These claims will appear on *your* company loss runs under the wrap-up policy number, and will affect your EMR as well as your loss history for CGL. When your company is reviewing the loss runs, assure the loss is yours and not one of the other subcontractors on the project.

Additionally, be aware that some wrap-ups have significantly higher deductibles than your company policy carries. For General Liability this could be \$10,000, but on Builders Risk the deductible could be as high as \$100,000. Deductibles should be explained in the wrap-up policy for the project and discussed with your agent. Being at fault for a Builders Risk claim could bankrupt your company. In some cases your agent may be able to put an installation floater in place to buy down part of the deductible.

While wrap-ups are generally good for the sponsor, they are not always good for the subcontractors. Frequently besides high deductibles there are exclusions in the wrap-up that expose your company to unanticipated risk. Your company policy may contain a complete wrap-up exclusion. This means that any claim not covered by the wrap-up is not covered by your policy, an unacceptable situation.

Coverage under a wrap-up usually does not cover professional or pollution liability, coverage for your suppliers, and many others. Scrutinize the contract and the wrap-up documents to assure your company is not unnecessarily exposed.

Once the project has ended, the wrap-up administrator will notify the subcontractors that the wrap-up is cancelled. As of that date, any work your company does on the jobsite becomes subject to your normal insurance policies and premiums. Because premiums are generated by payroll, notify your payroll department of this date so adjustments in the system can be made.

Administering a project under a wrap-up requires different recordkeeping and management methods. Assure you have all of the facts and with the help of your insurance agent, design a system to manage it.

Insurance and surety bonding are complicated matters. Always use the expertise and experience of your insurance or surety agent who can assess risk and help your company decide if the risk is acceptable before making any decisions regarding the risk, insurance, or bonding.

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*

- Bulletin IN 1, "Insurance Punch List"
- Bulletin IN 2, "Risk Management"
- Bulletin IN 3, "Hold Harmless Agreement"
- Bulletin IN 4, "How Large Should Insurance Deductibles Be?"
- Bulletin IN 5, "The Do's and Don'ts of Obtaining Bonding"
- Bulletin IN 6, "Insurance for Catastrophes"
- Bulletin IN 7, "Subrogation Can Spell Trouble"
- Bulletin IN 8, "What Are the Pros and Cons of OCIPs and CCIPs?"
- Bulletin SC 2, "Indemnification Clauses"

SECTION 8: TURNOVER/KICK-OFF AND PRE-CONSTRUCTION PLANNING MEETINGS

The Pre-Construction Planning process begins with the Turnover Meeting. Turnover implies that an estimating group has procured the project and is turning it over to the construction group to build. Kick-off implies that the same group estimates and then builds the project. In this discussion we will use Turnover as the description of choice. The Turnover Meeting may meet the planning needs of the project or the decision may be made to commit to a more thorough Pre-Construction Planning process. Complete Pre-Construction Planning and scheduling are vital to the success and profitability of a construction project. While the size of the contract affects the time required to complete planning, it does not impact the need for a plan. For maximum success, company management must commit the necessary resources to accomplish all planning before the start of construction whenever possible.

Turnover Meeting

A Turnover Meeting is where the company personnel who estimated and bid the project and negotiated the project contract turn over the project to the Project Manager and his team. It is the first major planning function that involves the people who will actually build the job.

In some companies the Project Manager estimates and bids jobs. In such cases, the Turnover Meeting provides the opportunity for you to assign responsibilities to members of the project team and distribute the project documents and details that team members can use to familiarize themselves with before actual planning begins.

Who Should Participate?

Everyone with management responsibilities, authority or detailed knowledge of the project should participate in the turnover meeting. This includes:

- Project Manager
- Estimator
- Sales engineer
- Project engineer
- CEO or other company officer
- Purchasing agent
- Safety officer
- Job supervisor or foreman
- Shop foreman

- Accountant or accounting clerk

In short, everyone who needs to know how the project will be organized and managed should be at the Turnover Meeting. Also keep in mind that the Turnover Meeting is the first opportunity to get the entire project team together in one place. As a result, it is where the Project Manager plants the first seeds of team spirit and cooperation.

Meeting Objectives

There are four objectives of the turnover meeting:

- Give each member of the team an overview of what the project includes (scope of work) and how it will be organized and run (project administration).
- Identify opportunities and challenges offered by the project.
- Assign each member of the team specific responsibilities within the project.
- Give each member of the project team all available project documentation related to his responsibilities.

The Project Manager's Responsibilities

The Project Manager's responsibilities regarding the Turnover Meeting are to:

- Make sure all members of the project team are notified of the meeting and are free to attend.
- Obtain a copy of the original estimate for your files.
- Develop a preliminary schedule of values or billing breakdown.
- Assist the project estimator, the project engineer, the CEO and anyone else who has detailed knowledge of the project to determine the agenda and prepare materials for distribution.
- Visit the jobsite and complete a report, including photographs or videotape, noting:
 - General site conditions
 - Existing utilities: locations and tie-in points
 - Site access
 - Site storage
 - Jobsite security
 - Special problems or considerations

Turnover Meeting Agenda

A Turnover Meeting might last an hour, or it might last an entire day, depending on the size and complexity of the project and the number of people on the project team. The following is a checklist of items often discussed at the Turnover Meeting:

- Project goals and objectives
- Scope of work including value engineering suggestions taken and rejected
- Detailed project estimate and any previous budgets
- Job schedule and completion date
- Subcontractor commitments and their scopes of work
- Work to be done by other trades
- What the project documents say about quality, safety, and special conditions
- Referenced codes and regulations and their requirements as they pertain to the work
- Billing schedule and billing breakdown
- Profit targets
- Results of the initial jobsite inspection
- Identification of unusual risks and opportunities

Once the basic facts of the project have been discussed, the meeting should consider how the project effort will be organized and managed. Topics should include:

- Personnel qualifications and certifications (welding, brazing, medical certs, etc.)
- Project organization and chain of command
- Responsibilities for communications with general contractor, project owner, subcontractors, other trades, suppliers, inspection agencies, etc.
- Strategies for procuring and managing job resources (materials, equipment to be installed, labor, construction equipment, subcontractors)
- Requirements for shop and coordination drawings
- Fabrication strategy and requirements

- Scheduling of work activities and deliveries of equipment and materials
- Coordination of efforts with other trades on the job
- Handling of change orders, claims, emergency situations, and special requests to the general contractor or other project authority

The individual project planning requirements may be met in this Turnover Meeting. When necessary the company may choose to initiate a more thorough Pre-Construction Planning effort. When that decision is made, the following actions will be taken at the conclusion of the Turnover Meeting:

- Set a date or dates for the Pre-Construction Planning meetings
- Assign responsibilities for gathering additional planning information from the various suppliers, vendors, contractors, subcontractors, engineers, and the owner

A sample ["Turnover Meeting Agenda" \(Figure 8.1\)](#) is provided.

Pre-Construction Planning Meetings

Next to careful staffing, Pre-Construction Planning is the most important pre-construction activity of the project. It gives everyone a clear and detailed idea of what is involved, offers the opportunity for questioning and brainstorming, deepens the spirit of team commitment initiated at the Turnover Meeting and produces a step-by-step strategy for approaching the project.

Practically all of the most successful mechanical contracting companies in the country insist on Pre-Construction Planning for every project, regardless of the project's size. Whether it is a few hours spent mapping out a small project or several days spent on a large one, they find that the time and effort invested pays off not only in increased profits, but in team morale as well.

So important is Pre-Construction Planning in many companies that the meetings are routinely held at a location away from the office, ensuring that the planning effort is free from the daily distractions of the office. The Pre-Construction Planning meeting is where all the members of the project team, as well as other people directly involved in the mechanical construction activities of a project, get together before construction begins to develop a detailed strategy for completing the work specified in the contract documents.

Objectives of the Meeting

The objectives of the Pre-Construction Planning meeting are:

- Identify and introduce key players in the project.
- Review the project's scope of work and special requirements.

- Assign management responsibilities, authority, and accountability.
- Implement administrative policies and procedures for safety, quality control, resource management, and project documentation.
- Design a comprehensive and practical project schedule.
- Devise a workable scheme for short interval planning throughout the life of the project.

Who Should Attend

The list of people who should attend the Pre-Construction Planning Meeting depends on several factors, including the size and complexity of the project and the level of involvement of people such as suppliers and subcontractors. The Project Manager should consider these factors in preparing the list of attendees.

Among the project team members who should be at every pre-construction planning meeting are:

- Project Manager
- CEO or other company officer
- Estimator
- Purchasing agent
- Job supervisor or foreman
- Shop foreman
- Head of drafting department
- Project Manager's administrative assistant
- Scheduler
- Accounting department manager or job cost analyst
- Warehouse manager
- Safety director
- Service and start-up manager
- LEED professional

- Commissioning manager

Depending on the size and structure of the project, you may find it necessary to include the following people in the Pre-Construction Planning effort:

- EEO director
- Office manager
- Subcontractors
- Vendors

These lists are not exhaustive. You may find it necessary to add people to them. Also, in many companies, two or more of the positions listed are held by one individual. The important thing to keep in mind is that all of the *functions* listed above must be represented at the Pre-Construction Planning Meeting.

A major factor in scheduling a Pre-Construction Planning Meeting is the availability of the people involved. It can be difficult in a busy company to get everyone together for a one-day meeting, let alone a series of meetings that, for massive projects, might last several days. In light of this, the Project Manager should arrange the meeting agenda so that only the core project team need be present for the entire meeting. Other necessary personnel can attend for a few hours or a single day in order to make their contributions to the planning effort.

The Meeting Agenda

The Project Manager should conduct the meeting by following a prepared agenda and giving everyone involved a copy of the agenda well in advance of the meeting. Advance notice of the topics to be covered, as well as *repeated notices* of the meeting's date, time and location, help ensure that everyone will attend and arrive prepared.

A job information sheet tells everyone who is who on the project and provides contact information for each of the principals. Every member of the project team should receive a job information sheet at the Pre-Construction Planning Meeting and revised copies of the sheet as necessary during the course of the project. A sample ["Project Contact Sheet" \(Figure 8.2\)](#) is included in this manual.

Focus on Scheduling and Material Handling

The two most important items to consider during Pre-Construction Planning are scheduling and material handling. The project team must not only schedule the job activities listed in the scope of work, but schedule and coordinate the resources and support activities that make construction possible, such as:

- Labor

- Equipment and material purchases and deliveries
- Shop drawings and coordination drawings
- Construction equipment
- Subcontractors
- Fabrication

Minimizing double-handling and onsite storage of materials is essential to efficiency at every stage of the project. For this reason, material handling must be a major focus of the planning effort. Before the Pre-Construction Planning Meeting, the Project Manager and the job supervisor or foreman should do two things in preparation for the planning discussion:

- Inspect the jobsite for situations requiring special material handling procedures.
- Meet with the prime contractor's project supervisor to discuss material handling and storage facilities that will be available during the project.

Meeting Minutes and Communications

Assign someone the responsibility of recording the minutes of the Pre-Construction Planning Meeting so that the project team has a complete record of its decisions, planned actions, and assigned responsibilities. Have these minutes typed and distributed to all members of the project team as soon as possible after the meeting, and encourage everyone to review them. Invite questions or comments, and issue updates and addenda as necessary.

Distributing complete sets of Pre-Construction Planning Meeting minutes demonstrates your commitment to keeping everyone on the project team informed and channels of communication open. It also gives everyone a ready reference to use in answering questions that might arise later.

Focus on Challenges and Opportunities

All projects have certain things in common. Also each project is unique with its own particular challenges and opportunities. These special elements should be the focus of planning and project management because they present the greatest potential for creativity and profitability.

Encourage everyone on the team to identify opportunities and challenges and discover ways to exploit or resolve them profitably. Among common opportunities for increasing profitability are:

- Design errors and omissions
- Unique fabrication or installation techniques

- Value engineering changes
- Identifying particular customer needs and developing strategies to exceed expectations
- Opportunities for expanding or reducing the scope of work
- Innovations in material handling

Among the challenges that, depending on the way they are handled, become either problems or advantages are:

- Errors in the original estimate
- Troublesome contract clauses
- Identifying notice provisions for delay and changes to the contract
- Scheduling problems such as:
 - Poor sequencing of events
 - Unreasonable lead times for processing submittal data and taking deliveries of equipment
 - Conflicts with other company projects
 - Conflicts with the activities of other trades on the job
 - Inadequate time for obtaining permits
 - Unavailability of sufficient labor or specific subcontractors at given times
- Quality requirements
- Safety requirements
- Governmental rules and regulations

There are several advantages to identifying and discussing these items in the Pre-Construction Planning process. First, it clears as many obstacles as possible out of the way before construction begins so that the jobsite team starts with a well-prepared plan for success. Second, it forces everyone on the team to really think about the project and its potential for profitability. Third, it gets everyone working together and creates a “we can do it” attitude—a spirit of enthusiasm and confidence that practically ensures success.

Pre-Construction Planning done properly ensures success on the project. Some companies do little or no Pre-Construction Planning, throwing the project team into a “sink or swim” situation and depriving them of the time they need to develop teamwork and a plan for success. The team is in a defensive posture constantly challenged with no clear plan for response. Successful companies have found that corporate commitment to the Pre-Construction Planning process

significantly improves corporate profitability, avoids margin fade, and identifies problems early in the project when actions can be taken to avoid claims and litigation.

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin JM 4, "Pre-Job Conference"
- *Planning for Profitability: Your Guide to Successful Pre-Construction Planning*

SECTION 9: MATERIAL AND EQUIPMENT ACQUISITION

Purchasing material and equipment to be installed usually means money spent, something directly opposed to profits. As any experienced Project Manager will tell you, however, purchases can be a source of profit, if they are handled consistently and according to a set strategy.

The purchasing strategy for any project should be organized before the first purchase order is filled out. This strategy should provide for:

- The best possible expenditure of project funds
- Assignment of purchasing responsibilities
- Accurate and complete recordkeeping
- Timely delivery of materials and equipment to be installed
- Regular review of invoices to verify they are in accordance with purchase orders
- Understanding of what is being purchased

Spending Wisely

The project estimate gives a budget for purchasing everything you need to complete the project. Like any budget, however, it doesn't tell what has to be spent. It only sets a limit on what can be spent and still make a profit.

Having the latest information on the best available prices and terms does not guarantee profitable purchases. Equally important in profitable purchasing is avoiding costly errors.

The most common errors occur in the preparation of purchase orders. To avoid these pitfalls, do the following:

- *Use standardized purchase order forms* – Whether generic or custom-designed by your company, standard purchase orders help eliminate omissions and mistakes by getting everyone in the habit of submitting orders the same way every time.
- *Prepare each purchase order carefully* – Be accurate in the description of each item and order at one time the full quantity of each item needed, thereby avoiding reorders and partial orders. This requires careful planning and close coordination of purchasing and scheduling. Be sure to include a statement that the material and/or equipment must be in accordance with plans and specifications and is subject to engineer approval.
- *Give complete and clear instructions for shipment and delivery* – Tailor the packaging requests to the type of material handling methods that will be used on the project. Use of bag and tag or a similar custom packaging system will reduce onsite material handling costs.

- *Follow up* – Make sure the purchase order is received, the information on it is clearly understood, and the delivery will be made when specified on the purchase order. Unless it is company policy, use caution when having deliveries made to the shop. This increases material handling costs, a cost most projects cannot withstand.

Responsibilities

Once the project team has identified what must be purchased, the next step is to assign specific responsibilities for making sure each item is properly ordered, expedited, inspected upon delivery, and properly stored and handled.

In some companies, a purchasing agent oversees purchasing for projects. He gathers quotes on prices of equipment and materials, maintains current records on prices and availability of items, nurtures good working relationships with suppliers, and holds final authority for reviewing and approving purchase orders and approving purchases. In a company where there is no designated purchasing agent, these duties must be assigned to one or more specific individuals on the project team.

Expediting, or making certain that ordered materials and equipment are delivered on time and in the manner required for efficient handling, is another major responsibility. Here again, some organizations have one person specifically assigned to expediting purchases for all of the company's projects. Other organizations leave this responsibility to be handled by someone assigned by the Project Manager.

On the jobsite, someone must have the responsibility for inspecting purchased items as they are delivered, checking that quantities and types of items match what was ordered, making sure the items are in good condition, and reporting all receiving information to the Project Manager or the company office. The Project Manager usually assigns a job supervisor or foreman to either handle this responsibility or to assign a reliable crew member to do it. Either way, final responsibility for making sure incoming materials and equipment are inspected ultimately lies with the Project Manager.

Few purchasing strategies are perfect. There are times during a project when a job supervisor or foreman discovers that something was not ordered or that he needs an item not anticipated in the original take-off. Such situations can delay the entire construction process unless someone on the jobsite has the authority to make necessary purchases. Some companies hesitate to give this authority to job supervisors or foremen, fearing that they will abuse the privilege. Others grant only limited purchasing authority, up to a few hundred dollars or so. The fact is, however, that if a company trusts a job supervisor or foreman with the supervision of hundreds of thousands of dollars of materials, equipment and labor, then it should trust his judgment regarding necessary purchases.

Purchasing Documentation

Paperwork is the only tool a Project Manager has to monitor and control purchasing expenses and be sure that receipts match orders. Don't rely on anyone's word or memory; there is simply

too much at stake. To avoid errors, confusion and other costly surprises, establish a strict method of recordkeeping for all project purchases. The basis of this record-keeping system is the documentation and documents themselves, and the most important of these is the purchase order.

The Purchase Order

A purchase order is not just an order form. It is a *contract* that binds your company to paying for delivered materials, equipment or services. At the same time, it is a control document, used in the office to track the order and in the field to verify receipt of the proper items and quantities. It is also a set of instructions that tells the supplier not only what is wanted but how it should be packaged and shipped and when it should be delivered. Finally, the purchase order is the basis for payment.

Because it plays so many roles in the purchasing system, the purchase order must contain a great deal of information, and that information must be complete and accurate if the system is to work well. Some of the information that should be on each purchase order includes:

- A *complete* description of each item, including quantities and prices
- The company's job number, order number, and other necessary control codes
- Plan and specification references
- Specific delivery date(s)
- Packaging and shipping specifications as dictated by the material handling requirements of the job
- Notation of who pays for freight and when your company is responsible for the shipment (FOB). Most companies have a standard for FOB and freight terms. Make sure you understand the terms you put on the purchase order. *MCAA Management Methods Manual* Bulletin PC 3, "FOB Terms," describes the term FOB in more detail.
- Requirements for notification of delivery.
- A list of documents needed from the supplier, including invoices, delivery and packing slips, warranty information, and operation and maintenance manuals.

The Supplier's Acknowledgement

Another important document in the purchasing process is the supplier's written acknowledgement that the purchase order was received and that the terms (prices, delivery dates, shipping methods, packaging requirements, documentation requirements, warranty periods, etc.) it contains are accepted. This acknowledgement *binds the supplier to the terms of the purchase order*. Therefore, the Project Manager should insist that every supplier reply to

each purchase order with an acknowledgement, and that each acknowledgement specifically states the terms agreed to and any modifications to the original purchase order.

Some suppliers consistently refuse to accept various terms of contractor purchase orders. One proven way to eliminate the time-consuming process of negotiating purchase order terms for each job is to negotiate, one time only, a standard modification for each vendor. This is preferable to accepting the terms contained in a vendor's acknowledgements.

Bills of Lading, Packing Lists and Suppliers' Invoices

When a shipment arrives, the person charged with inspecting deliveries should immediately check the contents of the delivery against the carrier's bill of lading and the packing list. Note any discrepancies, such as missing items, incorrect quantities and back orders, on the appropriate report form and immediately send the report to the Project Manager. When the supplier's invoice arrives, it should be checked item by item against the bill of lading, packing list and field report regarding the delivery, with any discrepancies resolved immediately.

Types of Purchasing for Projects

There are two different forms of purchasing for projects: *definitive scope purchases* and *blanket scope purchases*.

- *Definitive scope purchases* – Generally, but not always, equipment purchase orders and the subcontracts involve definitive scope purchases. The purchase take-off, if one is done, provides the support to define the proper scope for the definitive scope purchases.
- In theory, if properly written/produced and barring any changes by the customer, the dollar amount of the issued equipment purchase order or subcontract should be the exact dollar amount required to perform the work of that cost code to the completion of the project.
- *Blanket scope purchases* – Blanket orders for miscellaneous materials and/or subcontractor services can be issued on the basis of the quantities contained in the estimate. The blanket scope order must be written to permit flexibility in the quantity of materials and/or services to be provided without any penalty or premium in the price to be paid.

As with definitive scope purchases, the Project Manager must review the terms and conditions of the construction contract for the project in order to determine whether the standard form requires any modifications.

No purchase order or subcontract should be issued unless the Project Manager has adequately determined:

- The bill of material/scope of work
- The time frame required by contract schedule for the production of shop drawings, submittal review, fabrication, and delivery to jobsite

- Terms and conditions required to be in the purchase order or subcontract to protect the company from undue liability

A sample [**"Purchase Order Terms and Conditions" \(Figure 9.1\)**](#) can be found in this manual.

Equipment Purchasing

Installed equipment is a big-ticket item on most construction projects. Although the cost of each piece of equipment is established at the beginning of the project and therefore not considered a variable, the costs of obtaining and installing that equipment can prove volatile. The process for specifying, purchasing, and handling installed equipment is often complex and can result in costly errors.

One way to avoid excess expense related to installed equipment is to control equipment documentation. This includes control of:

- Submittal sheets
- Shop drawings
- Installation instructions
- Test reports
- Air and water balance reports
- As-built drawings
- Start-up notices
- Operation and maintenance manuals
- Warranty letters
- Maintenance contract proposals

A Tracking System

To assist the project team in monitoring the progress of submittals, purchase orders and deliveries, the Project Manager should institute a system that tracks the paperwork for each piece of equipment to be installed on the job. The Project Manager should assign one person on the project team to update each form daily, if necessary, and distribute updated forms weekly.

A [**"Purchase Order Log" \(Figure 9.2\)**](#) may assist you in tracking purchase orders for a certain project.

An [**"Equipment Tracking Form" \(Figure 9.3\)**](#) could be used to track not only Purchase Orders but also submittals and shop drawings.

An [**"Equipment and Material Release Form" \(Figure 9.4\)**](#) could be used to transmit submittals and release equipment or material for shipment. This form also has an acknowledgement portion for the vendor to sign and return.

The [**"Equipment Delivery Schedule" \(Figure 9.5\)**](#) is a log showing all pertinent information for each piece of equipment needed, including vendor name and contact information, purchase order number, dates of submittals, shipping date and verification of delivery. During Pre-Construction Planning, a master equipment schedule should be prepared and copies issued to the purchasing agent, the job supervisor or foreman, the fabrication shop foreman, and others involved in the purchase or handling of the equipment. The schedule should be updated as needed and updated copies issued immediately so that everyone has the most current information at all times.

Additional resources available through MCAA's online [**Resource Center**](#):

- *MCAA Management Methods Manual*
 - Bulletin LL 2, "Purchases and Sales Under the Uniform Commercial Code"
 - Bulletin MK 2, "Why Mechanical Contractors Should Furnish Equipment"
 - Bulletin PC 1, "Purchasing for Profit"
 - Bulletin PC 3, "FOB Terms"
 - Bulletin CT 8, "Understanding Manufacturers' Warranties"

SECTION 10: SUBMITTALS

A *submittal* is a request for review and approval for a portion of the construction project. The submittal can be a set of data sheets compiled by the vendor for a particular piece of equipment. The submittal could also be the welding procedure for the piping and fittings or information on the pipe and fittings themselves. The submittal could also be the proposed LEED validation process or a commissioning procedure. Any item or process that is part of the construction could be the subject of a “submittal.”

The contractor forwards the submittal data to the architect/engineer, most often through the prime contractor, who reviews it to make sure the submittal complies with the project's plans and specification. The architect/engineer's approval of the submittal authorizes the contractor to proceed with the purchasing or the construction process submitted.

Fabrication and Building Information Modeling have increased the importance of timely submittal approval. Not only does the contractor need detailed information for the approved equipment, effective modeling requires detailed information for all system components including valves, fittings, and any devices in the system (for example flow measuring devices). Without timely approval of submittals, the fabrication/BIM effort cannot proceed effectively.

The Project Manager's Responsibilities

You have the following responsibilities regarding submittal and rough-in data:

- Maintain a file on each submittal and put *all* information on that submittal in its proper file folder (this may take either digital or paper form) *as soon as you receive it*.
- Obtain copies of all approved submittals.
- Use *approved* submittal data to plan all equipment installations and fabrication. If you must use unapproved submittal data to plan and install rough-ins, *be careful*. If the unapproved submittal is rejected, you could end up removing and reinstalling the rough-ins again. Accurate submittal information may be necessary to properly plan and execute any of the following:
 - Fabrication
 - Building Information Modeling
 - Commissioning
 - LEED certification
 - Execution of welding and testing
 - Coordination with other trades
 - Receiving, unloading, and storage of equipment
 - Material handling

- Provide necessary submittal information to subcontractors involved in the installation of equipment (e.g., drywall, masonry, structural steel, sheet metal, electrical, temperature control, testing and balancing contractors, etc.) so they can plan their work accordingly.
- When the equipment arrives, verify that the equipment received matches the description on the submittal. If you find any discrepancies, notify the supplier or manufacturer immediately.
- When the equipment arrives, find the manufacturer's installation instructions (a set of instruction sheets usually packaged with the equipment) and add them to the file folder for the equipment. Follow the instructions *carefully* during installation. (See [Section 38: "Start-Up"](#) for more information.)
- Be sure that all operation and maintenance data is received with the equipment and is filed for later inclusion in the project operation and maintenance manual. Provide the project supervisor/foreman with:
 - Copies of all approved submittals
 - A set of manufacturer's instructions for each piece of equipment received at the jobsite
 - Operation and maintenance data for each piece of equipment received

Submittal Log

The ["Submittal Log" \(Figure 10.1\)](#) can be used to chart the flow of submittal data. An updated submittal log should be taken to all project meetings.

Forwarding of Submittal Data

Submittal data is sent to the prime contractor, architect/engineer or owner by means of a transmittal letter. The number of copies required is determined by the project specifications.

Approved Submittals

Submittal data that is returned stamped "approved" or "approved as noted" should be reviewed for any comments. The approved submittal should then be forwarded to the appropriate vendor or subcontractor.

Rejected Submittals

Submittals that are returned "rejected" should be returned to the vendor or subcontractor for corrections and then be resubmitted. Your copy should be filed in your resubmittal file and entered on the submittal log until the corrected submittals have been received.

SECTION 11: LEED PLANNING AND CERTIFICATION

Fueled by the growing popularity of the LEED rating system, more owners have chosen to build greater efficiencies into their buildings. But what is LEED and how does it change the role of Project Managers in the planning and execution of their job? In this section we will cover the following:

- The basics of LEED
- The LEED AP accreditation program for individuals
- The certification process for buildings
- The responsibility Project Managers have in a LEED project
- Added documentation for which plumbing and mechanical contractors have responsibility

The Basics of LEED

What is LEED?

LEED is a building rating system that stands for Leadership in Energy and Environmental Design. It was developed in 1998 by the U.S. Green Building Council (USGBC) in an effort to mitigate the environmental impact of buildings. In its initial design, it provided guidelines for architects and engineers to design new buildings to efficient standards. As its popularity has grown, it has added rating systems to address existing buildings, commercial interiors, core and shell, schools, healthcare, retail, neighborhood development and homes. These improved rating systems have created a more streamlined process, but have also made LEED ratings more difficult to achieve.

LEED's rating systems have become a 100 point credit system (with the exception of homes) with these five categories:

- Sustainable Sites (SS)
- Water Efficiency (WE)
- Energy and Atmosphere (EA)
- Materials and Resources (Materials and Resources)
- Indoor Environmental Quality (IEQ)

In the 2009 update¹, two additional bonus categories were created for an additional 10 bonus points in:

- Innovation in Design (ID)
- Regional Priorities (RP)

The new bonus categories give ID points for projects that either go above and beyond the credit's threshold or create a new solution to earning that credit that is easily replicable.

To earn RP points, each project must look up the credits that its local region has selected as important to that part of the country; for example water use reduction in Arizona. So in addition to the points you would earn for the water use reeducation credit, you would earn an additional point for the Regional Priority points as well.

Each rating system is different. Gauging the efficiencies for different types of buildings requires different types of credits and different weightings for the credits. Between all of the rating systems, there are different credits, weightings and prerequisites. For example, a measurement and verification credit is required if you are building a new construction project, but not if you are building just the core and shell for a commercial property. This is because building owners that are providing interior space to be occupied by tenants have no decision making power to control the tenant's fit-out.

Also, between the rating systems, there are drastic changes in credits and their weightings. For example, in new construction, reducing potable water need for landscaping by 50 percent earns you two points, but for the operations and maintenance it earns only one point.

Before starting any LEED project, make sure of the type of rating system that is involved and purchase a LEED Reference Guide for that rating system. Talk to the general contractor to determine which rating system is being used and which credits are being applied for.

Performance Categories in LEED

So how do you tell how green a LEED building is? When the USGBC created the LEED rating system, it also created tiers to showcase the building's efficiency. It is one thing have built a LEED building, but to build a LEED *platinum* building showcases the environmental dedication you made to the project. The USGBC takes the 100 possible points (plus the 10 additional) and grades each project to determine a score. The tiers break down as follows:

¹ For further detail on the LEED rating system, visit the MCAA Green website (www.mcaa.green.org). Archives of webinars on the LEED 2009 update and the October 2012 update of the LEED 2012 Rating system are available at http://www.mcaagreen.org/educ_archived_webinars.html.

- Certified 40-49 points
- Silver 50-59 points
- Gold 60-79 points
- Platinum 80 points and above

When you saw this scale, you probably noticed that the credit point threshold for the Certified rating is quite low. You may also have noticed that there is a wide point range for the Gold rating.

The difficulty with certifying any building in the LEED 2009 version comes more from meeting the prerequisites than from getting enough credits. Many of the prerequisites are based on exceeding the existing building codes, which are very difficult in their own right. For example, to meet the prerequisite on *Fundamental Energy Performance*, you have to exceed the ASHRAE 90.7-2007 by 10 percent, a difficult task as ASHRAE has also made a concerted effort to increase efficiency in their codes. While meeting all credit requirements is important, meeting prerequisites is essential. If a project doesn't meet *all* of the prerequisites, the number of credits it could possibly earn doesn't matter as it will not receive a LEED rating at all.

As you can see, the LEED Gold certification has a 20-point window from 60-79 points. The simple reasoning here is that the USGBC wanted to make it even harder for buildings to be rated as Platinum. By adding an additional 10 points to Gold, it raises the bar for the highest level of certification by 10 points.

The GBCI

In 2009, the USGBC created the Green Building Certification Institute (GBCI), a third party organization to certify buildings and manage the accreditation process for individuals. The distinction to understand is that people become *accredited* while buildings become *certified*. This third-party organization was established to meet the requirements for ANSI certification for LEED rating systems and accreditation programs. To do so, third party certification and accreditation needed to be administered. Thus, the GBCI was formed. The USGBC continues to manage the qualifications for both of these programs, but not the day-to-day testing and administration.

LEED Accreditation

LEED AP Program

The USGBC also developed an accreditation program for individuals to earn professional credentials in their knowledge of the LEED process. The credential that they created is called the LEED AP², which stands for Accredited Professional.

In 2009 a second, lower level of accreditation was added called the LEED Green Associate (LEED GA). The LEED GA recognizes that although everyone working on a LEED project should have some knowledge of LEED practices, not everyone needed to be a LEED AP. The LEED AP was upgraded to demonstrate knowledge in a specific rating system and the LEED GA was introduced to demonstrate a general knowledge of LEED concepts and practices.

To earn a LEED AP credential, you must first pass the LEED GA exam. To qualify to take the LEED GA exam, you must meet a set of prerequisites. Currently, to take the exam you must meet one of the following requirements:

- You have worked on a LEED project
- You have taken a preparation course
- You work within the industry (architects and engineers only)

Once you have proven that these prerequisites have been met, you can pay the requisite fees and sit for the LEED GA³ exam. Testing is administered by the GBCI and locations can be found in every major city in the US.

Once the LEED GA exam has been passed, you have earned your first credential and you can prepare to take the LEED AP exam. Since 2009, people who take the LEED AP exam must choose a specialty rating. For example, if you pass the LEED AP exam for Green Building Operations and Maintenance, you would earn a LEED AP + EBOM accreditation.

The difference between the LEED GA and the LEED AP+ exams are striking. The LEED AP+ exams are much more difficult. They require a thorough knowledge of each LEED credit, various methods to achieve the credit, and the calculations involved. There is a very low pass rate on these exams and an exam preparation course is recommended.

² For more information on the LEED AP program, visit the MCAA Green website (www.mcaagreen.org) to download the latest LEED AP update or view a webinar on the subject.

³ In 2010, MCAA created the LEED Green Associate Test Preparation module to help MCAA members prepare for the LEED GA Exam.

With the new process, continuing education is required. If you are a LEED GA, you are required to earn and submit 15 hours of accreditation every two years. For LEED AP+, 30 hours of continuing education is required every two years.

Which Accreditation is Right for You?

As a Project Manager, the answer to this question might simply be neither. At the height of popularity of the LEED AP process, many people saw the LEED AP as a way to get new business or prove to owners or general contractors that you know what you are doing on LEED projects. Many people earned their LEED AP because the process was simpler and there were no additional fees or continuing education requirements.

MCAA recommends that Project Managers obtain the LEED GA if they are either working on LEED projects or preparing for one. The LEED AP+ is only recommended for Project Managers who consistently work on LEED projects or when it is required for bidding on a LEED project. LEED accreditation may be more important for Project Managers on service jobs because their role will often be more at the forefront. It is further recommended that you wait to take the LEED AP+ exam after you have earned your LEED GA. You might find that the LEED GA accreditation will provide a perfect amount of knowledge for your work on projects.

Working on a LEED Project

Working on a LEED project can be unfamiliar territory. There are added steps for documentation and different building practices may be required. Additional costs will need to be considered when estimating bids for LEED projects.

Responsibilities

The first thing to identify on a LEED project is which rating system is being used and what the owner and/or general contractor believe are your company's responsibilities. On each LEED project, Project Managers can have the following responsibilities:

- Documenting all paperwork required for the LEED credit
- Submitting credit information online to earn credits
- Researching all credit information to learn how to properly earn credit points
- Understanding your onsite responsibilities and how your construction methods can affect other credits being earned
- Coordinating with the estimator to verify additional responsibilities and specific materials required

Knowing Your Rating System

Never assume which rating system applies to the project. Currently, LEED is on a three-year code cycle, but you are likely working with a non-current rating system. Architects typically

register the project with LEED as soon as the process begins to get the most favorable⁴ LEED rating system. There can be drastic changes within the same rating system between updates. Make sure you know which LEED rating system you are using⁵ and the credits you are responsible for attaining.

Knowing the credits for which you are responsible greatly impacts the number of hours you will need to do on research, documentation, and training. Be sure to verify with the general contractor or LEED coordinator⁶ all the credits and prerequisites for which you have direct and indirect responsibility, as well as the methods that they intend to meet these requirements. There are often multiple paths to earning LEED credits.

Indirect credits can often be lost on a job by insufficient documentation. The most dangerous situations are prerequisites such as *Construction Activity Pollution Prevention* and *Minimum Energy Performance*. Before starting every project be sure to ask the LEED coordinator or general contractor to look at the list of intended credits that they are hoping to earn and verify their plan as well as your responsibilities for each credit, even if it is something that you would not consider to be within your role.

Common indirect credits include:

- Construction Activity Pollution
- Water Use Reduction
- Measurement and Verification
- Minimum Energy Performance
- Enhanced Commissioning
- Construction Waste Management

⁴ The older the rating system, usually the more favorable it is. Every new version of LEED requires greater efficiencies to make the LEED certification relevant.

⁵ In some cases, if the project or the certification process takes a very long time you may be forced into the next version. Also, the LEED Coordinator might voluntarily switch to the newest version to take advantage of some perceived gain.

⁶ A LEED Coordinator is usually a third party consultant who helps organize documentation and guide subcontractors through the LEED process. If the owner or general contractor has hired one for the job, this will be the person you want to consult with any LEED specific questions.

The best way to assure you are working towards the right rating is to have *at least* one person from your company assigned to the project through the LEED Online system. The LEED Project Team Administrator makes all LEED Online assignments. Having access to the LEED Online system will show you who is responsible for each point as far as LEED is concerned.

Directly Responsible Credits

Once the credit responsibility has been determined, it is imperative to research them immediately. The best way to do this is to purchase the LEED reference guide for that rating system. The USGBC sells all reference guides online⁷. They are available in PDF format and in paper copy. Both have advantages, but having paper copies allows you to copy sections you need and make notes.

Bring a paper copy of each credit explanation from the Reference Guide for every credit you are directly or indirectly responsible for to meetings. Even LEED APs are sometimes fuzzy about the details of the requirements among all the rating systems. Having this information on hand will enable you to answer questions about requirements and voice concerns about other parts of the project when your credits are impacted.

Determining as much detail as possible before going into a bid can be the real difference between working on a profitable job and a disaster. If the estimator doesn't take into consideration many of these details, financial risk is increased. Materials might have to be re-purchased, additional time could be needed for adhesives to cure, and documentation could be severely underestimated. The simple fact that LEED adds complexity and added coordination slowly adds up as well⁸.

Responsibilities and Documentation

Your company, usually through you the Project Manager, will have various additional responsibilities on a LEED project⁹. These will be specific responsibilities that must be documented in a certain way. Most of the time it will be much easier to do this as the project goes along instead of after it is finished. In some cases if you wait until the project is finished you may have completely missed the ability to properly document the project. This can be catastrophic. The following are examples, of typical mechanical, plumbing, and sheet metal

⁷ www.usgbc.org

⁸ The MCAA's green building website (www.mcaagreen.org) has many online webinars that cover impacts for MCAA contractors, and documentation for specific credits and rating systems. Look into both archives and scheduled webinars for more helpful hints and education.

⁹ A webinar that goes through responsibilities and documentation for each LEED credit is available for download from the webinar archives at www.mcaagreen.org.

contractor responsibilities by category and point. Remember to clearly document everything especially when specific documentation is specified.

Sustainable Sites

At first look, many contractors would not think that they would be responsible for any of the credits within this category. Although there are few areas of direct responsibility, there are many indirect responsibilities for contractors.

- *Site Selection* – Although this credit rarely impacts contractors, it may be a rare instance in which a sediment basin is constructed that would require mechanical piping systems for controlled release of storm water. If so, be aware that design calculations are very complicated.
- *Development Density* – Typically has no impact on contractor responsibilities.
- *Light Pollution Reduction* – Typically has no impact on contractor responsibilities.
- *Brownfield Redevelopment* – This credit occurs when a project is planned for a site that is considered contaminated by a federal, state, or local agency or jurisdiction. The site must then be cleaned up before the project is built. For contractors, if the project includes cleaning up old piping or tanks this could be in your scope of work. If you become responsible for this and are not familiar with this type of work, you may need to hire an expert in this field. Also, the remediation of the contamination might require some type of temporary or permanent piping system to clean it up. Be aware of this extra responsibility and take appropriate action. The same authority that deemed the project contaminated will need to certify it as clean before you get the point or even before occupancy is given. This could also be an issue if asbestos removal on piping is put in your scope of work. Be very conscientious of documentation in this credit area.
- *Alternative Transportation* – The mechanical contractor may be impacted in rare cases when a natural gas or hydrogen fueling station is called for. The plumbing contractor could be involved when a shower is required for the bicycle credit.
- *Site Protection* – This credit involves preserving or creating open space and/or native vegetation. In some cases this may require moving existing buildings, roads, parking lots, etc. and their associated above or underground piping systems. Also, there may be geographic areas that are marked off limits to equipment. If so, these areas will be unavailable for access routes or storage of materials and could affect these strategies on your project.
- *Stormwater Design* – This credit can have a lot of impact on mechanical contractors in the form of piping and storage systems associated with storm water control as well as piping and storage associated with storm water retention tanks (cisterns) that will reuse the storm water. There also may be code issues associated with the cisterns and how the water can be

reused (also addressed in the “Water Efficiency” section). This is another area where design calculations are very complicated.

- *Heat Island Effect* – This refers to the artificial rise in ambient temperature due to low reflective surfaces such as black asphalt and dark shingles. The points are actually separated into roof and non-roof. In non-roof, the mechanical contractor could be affected if underground piping needs to be moved, relocated, or protected due to changes made in hardscape. In the roof sections, the contractor could be affected if the roof is being retrofitted or if a vegetative roof is involved. A vegetative roof requires a drainage system. Beware of local jurisdictional issues here. Also, you need to be careful when working on rooftop equipment that mechanical roof systems are not damaged.

Water Efficiency

The first prerequisite requires a 20 percent reduction from the Energy Policy Act of 1992 (EPAct 92) in LEED 2009. Earlier versions of LEED have no water efficiency prerequisite. A general warning for the plumbing contractor is needed here. Due to the low water systems installed, the waste side needs to be properly designed and installed. If pipes are too large or the pitch is off even a small amount, the systems will clog and back-up regularly! Even minor dips can cause a big problem.

The first credit section here is “water efficient landscaping.” This will typically be designed by a landscape architect or designer. If the mechanical contractor is in charge of design, they will need knowledge of new underground drip and mist irrigation systems. If the second point is attempted, knowledge is required of calculations regarding the landscape factor of all vegetation in the landscape within the LEED boundary even if no potable water is used for irrigation!

“Innovative wastewater technology” is the second credit in this category. In addition to the warnings given above for the prerequisite section, contractors must be aware of proper FTE (full time equivalent) calculations and especially the local codes regarding use of graywater and low water fixtures. For example, some allow graywater systems and some don’t. Some allow waterless urinals and some don’t. Another thing to watch out for is “onsite treatment” of wastewater. While this is possible, it is expensive and requires specialized biological treatment and lots of land for the necessary constructed wetlands used for removing impurities.

Last is the general “Water use reduction” which gives points for additional reductions beyond EPAct 92. A point is awarded for a 30 percent reduction (an additional 10 percent beyond the prerequisite) and an additional point for a 40 percent reduction. These are very difficult to achieve without going to composting toilets and storm water reuse.

Energy and Atmosphere

This section has three prerequisites, more than any other section. The first is “Fundamental Commissioning.” Fundamental Commissioning covers at a minimum HVAC systems, controls, domestic hot water heating, and renewable energy systems. The owner can add systems to this

such as rainwater harvesting, fire suppression, smoke control, and others. The first thing you want to get is a copy of the specification to see what is expected of you. If it doesn't include copies of the checklists that will be used in the pre-functional and functional tests you want to get that as soon as possible. The key to commissioning is the level of competence of the commissioning agent (CxA). An early team meeting with the CxA and the controls contractor is essential. Things to be wary of here: the expertise of the CxA, documentation, and extra time involved. If it is clear in the beginning that the CxA is not extremely competent you are going to need to be ready for some extra attention. This person can make or break the whole project. Commissioning is very much about documentation. Make sure everyone understands this. Depending on the sophistication of the CxA and your own documents there could be much more time required of both your management and labor employees so beware of this in bidding. There is an additional commissioning category that goes beyond the prerequisite and is good for points. If your project is going for "Enhanced Commissioning" you will also be contributing to a commissioning manual, be responsible for training the owner on the operation of the HVAC equipment, and all submittals will be reviewed by the commissioning agent. This will all add to your project costs.

Prerequisite 2 is "Minimum Energy Performance." Most of the points in this section are dependent on the baseline created by this prerequisite. The baseline is set by applying ASHRAE 90.1 to your project and beating it by a percent. For example for New Construction in LEED 2009 you need to beat ASHRAE by 10 percent just to meet the prerequisite. This number will be based in kilowatts and will be the energy consumption for HVAC, water heating, and lighting. While this is the most comprehensive credit category, if the contractor is not involved in design/build or value engineering then the main issues for the contractor will be in the commissioning category and not in this category. If the contractor is involved in design, then much expertise and time will be required since you will pretty much be guaranteeing the energy performance of the building.

Prerequisite 3 is "Fundamental Refrigerant Management." This simply means no CFCs. However there are a few exceptions. If it is an existing building, then a phase out may be permitted for five years. Also, if you can't cover the cost of new equipment with a simple payback in 10 years, it doesn't have to be replaced. Never assume these exceptions will be approved as they are not guaranteed! Also, if you have a district cooling system this will likely be out of your control.

The first credit group in this category is "Optimize Energy Performance." This section represents the most points available in any section. Again, this affects the contractor only in the commissioning section unless the contractor is involved in the design. If you are involved in the design in any way, remember that any problems will likely be the problem of the entity with the deepest pockets than the one with the most fault so be wary of your partners in the design process.

Credit 2 is "Onsite Renewable Energy." Things to watch out for here are: space requirements for these various systems, long lead times for equipment, extra training required for labor, special mounting considerations, extra coordination with other trades, structural review for

roof mounted systems, and warranty issues. If the project is counting on grants or incentives related to renewable energy, there may be special requirements you need to meet to get them. If not, you might end up being responsible for that money they didn't receive.

Enhanced Commissioning is the next credit, which was already discussed in the prerequisite.

Credit 4 is "Enhanced Refrigerant Management." This is an extension of the refrigerant management prerequisite. It adds a prohibition for using halons, CFCs and HCFCs for fire suppression. It doesn't outright prohibit anything else for other uses but does apply a formula to refrigerants used. Make sure you keep all equipment and refrigerant documentation. Also, be aware that you may need to replace/substitute refrigerants if they are not in compliance.

Credit 5 is "Measurement and Verification." This is all about controls, metering, sub-metering, and energy modeling. It is very complex and usually done by a third party contractor. Be prepared for possible disputes with this contractor.

Credit 6 is "Green Power," which is renewable energy that is purchased from a third party. The MEP contractor is typically not involved.

Materials and Resources

Prerequisite 1 is the "Storage & Collection of Recyclables." The MEP contractor is not typically involved.

Credits 1, is "Building Reuse." The major concern here is that if old structures are being reused then a structural engineer will need to evaluate suitability for placement of rooftop equipment, cooling towers, etc.

Credit 2 is "Construction Waste". Make sure to follow rules carefully on where to dispose of construction waste. This is done by weight or volume but usually by weight. There are projects where points were missed because recyclables went in the landfill pile and the threshold was missed by one half percent!

Credits 3 through 7 are about material and fixture reuse. Although the rule is no MEP materials are eligible for this section, there are some obscure exceptions for plumbing equipment in the older versions of LEED. So unless you are reusing some old plumbing fixtures you do not need to track recycled content on any MEP equipment.

Indoor Environmental Quality

Prerequisite 1 is "Minimum IAQ Performance." Ventilation must meet ASHRAE 62.1. The year of the standard is dependent on which version of LEED you are being held to. This is another area where the mechanical contractor's liability will be mainly in the commissioning process unless they are involved in design in some way.

The second Prerequisite is regarding "Tobacco Smoke Control." There are two different areas of impact here. First, if there are designated smoking areas they must be tested for negative

pressure and that could be in your contract. Second, it is likely that there will be no smoking for any construction workers at any time within 25 feet of the building. This creates issues for field workers who smoke and may create productivity issues.

Credit 1 is "Outdoor Air Delivery Monitoring." The main thing to know here is that the monitors are relatively expensive (about \$5,000 each) and you need one for each air handler/rooftop unit. Other problem areas are: control system integration and placement of CO₂ monitors. Monitors must be placed within a certain height range and cannot be placed in ducts. This is another area where design time and liability increase when you are involved in the design of the system.

Credit 2 is "Increased Ventilation." While it may not be your responsibility, be aware that this will significantly increase energy usage since it requires a 30 percent increase in outdoor air.

Credit 3 is about "IAQ Management during Construction." The contractor has several responsibilities here. First, you must comply with a written IAQ management plan for construction and preoccupancy. This must meet or exceed Chapter 3 of SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," November 2007. Someone on the project team should be appointed as the coordinator for this. Since there are some very specific mechanical requirements, you may want to appoint your own coordinator. The elements of the plan include HVAC protection, source control, pathway interruption, housekeeping, and scheduling. The HVAC protection requirement is very specific. You need to have at least 18 photos, taken during three different phases, of the HVAC system showing how all duct work openings have been covered with plastic to protect the ducts from dust and odors and other steps mandated by the SMACNA standard. If you operate the system these covers must be replaced after operation and you also need to have MERV 8 filter media on all return openings. If an unducted plenum is used all ceiling tiles must be in place. A log must be kept of installation and replacement of the filter media. Additionally, the ductwork should be checked for leaks, and repairs made quickly. You will likely be the contractor that signs off on this credit.

Credit 3.2 is "IAQ before Occupancy." There are two options here: a pre- or post-occupancy flush-out or an air quality baseline test. The first two options are very time consuming as the amount of air you need to flush is enormous (14,000 cfm per square feet of floor area) while a certain temperature and humidity are maintained. The second option must be done pre-occupancy with all finishes in place, and if there are multiple floors must be done on each floor.

The grouping in Credit 4 is all about VOCs (volatile organic compounds). The best way to handle this is to start a log at the very beginning of the project for every adhesive, sealant, coating, etc. that is used on the project. You need to make sure they are all under the USGBC limit (the USGBC Reference Guide has a chart). You should also take care to keep all MSDS sheets, product information, and original containers of those products.

Credit 5 is "Indoor Chemical & Pollutant Source Control." It covers pollutants during construction, and this credit is about systems to control pollutants after occupancy. This requires direct exhaust for garages, laundry rooms, and copy rooms. Most importantly it

requires MERV 13 filter media in place prior to occupancy. So, first you have to make sure the MERV 8 material is replaced with MERV 13 and you should log its installation. Next, even if you weren't the designer, make sure the design took into account the right filters. Often the filter racks aren't wide enough to hold the right filter media. Check this before you order the equipment!

Credit 6 is about controllability of lighting and thermal comfort. While lighting is not your concern, thermal comfort is. There are several strategies that can be used. Operable windows count within certain parameters. 50 percent of workstations must be able to control air temperature, radiant temperature, air speed, or humidity. The mechanical contractor will most likely be required to sign off on this requirement.

Credit 7.1 is "Thermal Comfort – Design." If you are the designer, you have to comply with ASHRAE 55 and address project space and use, climate zones, and provide a system description and strategy. Even if you are not the designer, you will be responsible for the system manual, which will document to the owner/occupants how to maintain and adjust the system to achieve thermal comfort. This includes set points, control sequences, recommended corrective actions, schedules, and procedures for recalibrating sensors, etc.

Credit 7.2 is "Thermal Comfort – Verification." This requires there to be a survey of all building occupants between six and 18 months after occupancy. The kicker is that if 20 percent of occupants are dissatisfied, then something must be done to make it more comfortable! You will need to have a pre-written plan for what to do in case this happens. A permanent monitoring system for temperature and humidity is also required to achieve this point.

The final credit category is "Daylight & Views" and does not affect the mechanical contractor.

In conclusion, the LEED system is very complicated and there are lots of opportunities for slip-ups. Assure you or someone in your company is qualified to take on one of these projects, and that money has been put in the bid for doing the documentation and research a LEED building requires.

Additional resources related to this section:

- MCAA's Green website, www.mcaagreen.org
- MCAA's *Green Associate Training Module*
- LEED® Reference Guide, available from the USGBC

SECTION 12: PROJECT COMMISSIONING

Project commissioning in the construction industry is an evolving process. In the early 1990s, mechanical contractors started to commission their own projects. When the United States Green Building Council (USGBC) began to require independent commissioning agents for Leadership in Engineering and Environmental Design (LEED) certification, independent commissioning agents started companies. To better standardize and quantify the process, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the National Institute of Building Sciences (NIBS) worked together to develop ASHRAE Guideline 0-2005 which defines the commissioning process. ASHRAE also developed Guideline 1-200x, "The HVAC&R Commissioning Process." NIBS developed Guidelines 2-200x through 14-200x for other building systems such as roofing, lighting, fire, life safety, etc. In parallel, the National Environmental Balancing Bureau (NEBB) also developed a commissioning and accreditation process. Some engineers, campuses, and government agencies developed their own standards. Because of these sometimes competing systems, the Project Manager will need to research and identify the standards under which he is to commission or assist in commissioning the project.

What is Project Commissioning?

According to Wikipedia,¹⁰

Project commissioning is the process of assuring that all systems and components of a building or industrial plant are designed, installed, tested, operated, and maintained according to the operational requirements of the owner or final client. A commissioning process may be applied not only to new projects but also to existing units and systems subject to expansion, renovation, or revamping.

In practice, the commissioning process comprises the integrated application of a set of engineering techniques and procedures to check, inspect, and test every operational component of the project, from individual functions, such as instruments and equipment, up to complex amalgamations such as modules, subsystems and systems.

Commissioning activities, in the broader sense, are applicable to all phases of the project, from the basic and detailed design, procurement, construction and assembly, until the final handover of the unit to the owner, including sometimes an assisted operation phase.

¹⁰ Wikipedia, the free encyclopedia (www.wikipedia.org)

Fundamental Objectives of the Commissioning Process

ASHRAE Guideline 0-2005 is an excellent tool to define and manage the commissioning process. Even when the ASHRAE Guideline is not used as the basis of performance on a particular project, familiarity with the guideline will assist the contractor in planning and execution for their project. According to Guideline 0-2005, the fundamental objectives of the Commissioning Process are:

- Clearly document owner's project requirements
- Provide documentation and tools to improve the quality of deliverables
- Verify and document that systems and assemblies perform according to the owner's project requirements
- Verify that adequate and accurate system and assembly documentation is provided to the owner
- Verify that operation and maintenance personnel and occupants are properly trained
- Provide a uniform and effective process for delivery of construction projects
- Deliver buildings and construction projects that meet the owner's needs, at the time of completion
- Utilize quality-based sampling techniques to detect systemic problems, as such sampling provides high value, efficient verification, accurate results, and reduced project costs
- Verify proper coordination among systems and assemblies, and among all contractors, subcontractors, vendors, and manufacturers of furnished equipment and assemblies

Due to the integration and interdependency of facility systems, a performance deficiency in one system can result in less than optimal performance by other systems. Implementing the commissioning process is intended to reduce the project capital cost through the first year of operation and also reduce the life-cycle cost of the facility. Using this integrated process results in a fully functional, fine-tuned facility, with complete documentation of its systems and assemblies and trained operating and maintenance personnel.”¹¹

The contractor's role may be to lead the commissioning effort or to support a third party.

¹¹ ASHRAE Guideline 0-2005

Often the Commissioning Agent (CxA) is not selected in the design phase of the project missing the opportunity to benefit from the complete commissioning process and input from the CxA. The project team must be prepared to manage the commissioning process from the point in time they become involved. By proactively managing the CxA and the process, start-up and validation of the systems will be expedited. A specific and detailed plan is necessary or the commissioning process will be disorganized and expensive.

Commissioning Principles

The National Institute of Building Sciences (NIBS) notes that, “regardless of the extent of commissioning that is determined as appropriate for a project (number or complexity of systems commissioned) and the approach utilized (Independent Commissioning Authority (CxA), A-E/CA, or Owner/CA), there are three overarching principles in the Commissioning Process that begin at project inception and continue through Occupancy and Operations.

Determine Project Performance Requirements

Every project goes through Pre-Design and Design Stages that establish an owner's needs, goals, scope, and design solutions for a proposed project. Proposed designs and constructed work can only be evaluated against objective criteria and measures that are embodied in well-documented project requirements. Project development is a learning process where building performance decisions are refined to successive levels of detail over the course of a project's life cycle. Key commissioning activities supporting this principle include:

- Understand Needs of Special Building Types
- Define Threats, Risks, and Consequences
- Determine Key Program Goals and Objectives
- Recognize Systems Criticality to Achieving Goals
- Conduct Key Commissioning Programming Activities

Plan the Commissioning Process

Commissioning involves the systematic process of planning delivery team member roles and responsibilities and tasks for all project phases and activities, including review and acceptance procedures, documentation requirements, development and approval of Commissioning Plans, Commissioning Schedules, and Testing and Inspection Plans. Planning the Commissioning Process includes identification of special testing needs for unique or innovative assemblies and measures that will assure adequate O&M Training. Key commissioning activities supporting this principle include:

- Establish Goals for Quality, Efficiency, and Functionality
- Establish a Commissioning Approach and Scope

- Establish Commissioning Budgets
- Establish Commissioning Plans
- Establish Commissioning Schedules
- Establish Testing and Inspection Plans
- Develop Commissioning Specifications
- Determine Special Testing Needs
- Establish Re-Commissioning Plans

Document Compliance and Acceptance

Commissioning serves as the historical record of an owner's expectation for project performance throughout the project delivery process. The purpose of commissioning documentation is to record the "why, how, and what" of key delivery team decisions throughout the planning and delivery process. Commissioning documents the establishment of standards of performance for building systems and verifies that designed and constructed work meet those standards. Key commissioning activities supporting Document Compliance and Acceptance include:

- Document All Levels of Project Development and Acceptance
- Emphasize Inspection, Testing, and Training on Commissioned Systems
- Compile Key Commissioning Documentation"¹²

Commissioning Objectives for each Phase of Construction

ASHRAE Guideline 0-2005 breaks the project into the following phases and identifies objectives for each phase.

Pre-Design Phase

Pre-Design Phase Commissioning Process objectives include the following:

- Developing the Owner's Project Requirements
- Identifying a scope and budget for the Commissioning Process

¹² National Institute of Building Sciences (NIBS)

- Developing the initial Commissioning Plan
- Acceptance of Pre-Design Phase Commissioning Process activities
- Review and use of lessons-learned information from previous projects

Design Phase

Design Phase Commissioning Process objectives include the following:

- Verifying the Basis of Design document with the Owner's Project Requirements document
- Updating the Commissioning Plan to include Construction and Occupancy and Operations Phase Commissioning Process activities
- Developing Commissioning Process requirements for inclusion in the Construction Documents
- Developing draft Construction Checklists
- Updating the scope and format of the project Systems Manual
- Defining training requirements
- Performing commissioning-focused design review
- Acceptance of Design Phase Commissioning Process activities

Construction Phase

Construction Phase Commissioning Process objectives include the following:

- Updating the Owner's Project Requirements
- Updating the Commissioning Plan
- Verifying that submittals meet the Owner's Project Requirements
- Developing detailed test procedures and data forms
- Verifying that systems and assemblies comply with the Owner's Project Requirements
- Delivering the Systems Manual
- Verifying training of the Owner's operation and maintenance personnel and occupants
- Acceptance of Construction Phase Commissioning Process Activities

Occupancy and Operations Phase

Occupancy and Operations Phase Commissioning Process objectives include the following:

- Using the Commissioning Authority's project knowledge and experience to minimize contractor callbacks
- Providing ongoing guidance on operations and maintenance to achieve the Owner's Project Requirements
- Completing seasonal testing of facility systems and assemblies
- Documenting lessons learned from applying the Commissioning Process for application to the next project
- Acceptance of Occupancy and Operations Phase Commissioning Process activities."¹³

Execution of the Commissioning Process

The project team will be driven by the specifications of their project. Often there is a detailed specification including testing forms for the equipment and point-to-point validation procedures for the automatic control system. Other times the specifications may only say "In accordance with ASHRAE Guideline 0-2005." Total cost of the commissioning process can vary dramatically. Contractors have found that commissioning agents often have little practical experience with mechanical systems. Their testing protocols are unnecessarily complex and time-consuming. To control cost and expedite project completion and payment, contractors must proactively manage the process including meetings, documentation, inspections, criteria, problem resolution, scheduling, etc. Often the best solution is for the contractor to produce a detailed commissioning plan and submit that plan for approval. Often acceptance of the plan will involve a difficult negotiation. The team must recognize that if the negotiation is difficult before the process starts, it will be difficult and much more expensive if the commissioning process is poorly defined, unscheduled, and open-ended.

Many resources are available to assist the project team. Forms, processes, and procedures are constantly being developed and improved. The NIBS discussion lists a form website that offers forms which are regularly revised. MCAA, ASHRAE, NIBS, NEBB, and others offer a wealth of information. The first excellent commissioning plan produced by the company will be difficult and expensive. Each successive project using the plan will be more successful and profitable by effectively managing the commissioning process.

¹³ ASHRAE Guideline 0-2005

A recent survey of contractors yielded the following lessons learned which are helpful in managing the commissioning process.

- Think of commissioning as an integral part of the design and construction process, not a separate activity that starts once construction is complete.
- Agree early on the forms that will be used by all parties for installation check, start-up, point-to-point, and functional performance testing. Too often contractors are told that internal forms are acceptable, only to have another party later demand that alternative forms be used.
- Use a web-based service, such as Dropbox, to upload all of the pertinent current documentation for all parties, including submittals, shop drawings, O&M manuals, forms, and completion lists.
- Get agreement from all parties performing installation inspections to use a common consolidated list broken out by area and/or system. This will save time managing multiple lists, and cut down on the number of repetitive items.
- If there are multiple similar systems, such as variable volume air handling units, plan to test one of them as early as possible in the construction process to uncover any design, equipment, controls, and/or installation issues. This will minimize the cost and schedule impact of any required modifications .

Additional resources available on this subject:

- ASHRAE Guideline 0-2005: The Commissioning Process
- NIBS Guideline 3-2006: Exterior Enclosure Technical Requirements for the Commissioning Process
- The Building Commissioning Guide: U.S. General Services Administration
- SMACNA HVAC Systems Commissioning Manual

SECTION 13: FABRICATION AND SHOP DRAWINGS

Why Fabrication?

Fabrication, the construction method in which assemblies are designed and built in the shop for installation in the field, is one of the Project Manager's most effective tools for increasing productivity and job profits. The commitment to fabrication is a commitment to planning and office/field cooperation. The Project Manager must drive the office staff to perform on a timely basis producing accurate shop drawings and fabrication planning. To then ensure success, the Project Manager needs commitment from the field to accept the shop drawings and install the fabrication without modification. Too many fabrication efforts fail because the field labor does not accept the advantages of fabrication or lacks confidence in the planning effort. The many advantages of fabrication include:

- Owners perceive contractors who fabricate as being better skilled and more professional.
- Work is done under close supervision and at the same location as the detailers.
- Safety in the field is improved with better material handling.
- Shop safety records are usually excellent.
- Onsite installation crews can be kept smaller and more productive.
- Onsite quality control is more predictable because fabrication work is better planned and is executed in controlled conditions.
- Properly planned and detailed fabrication makes material purchasing more accurate, reducing the number of shorts and returns.
- Material deliveries to jobsites often include back orders that disrupt the flow of work. Jobsite backorders can be avoided with shop fabrication.
- Assemblies can be delivered to the jobsite as needed, improving material handling practices, and minimizing onsite storage requirements.
- Assemblies may not be as attractive to thieves as loose material.
- Regular employment in the fabrication shop promotes company loyalty and can provide fill-in work for jobsite crews when weather prevents work onsite.
- Because of the controlled environment and their specialization in fabrication work, shop employees quickly become skilled, innovative, and very productive.
- Work can be done when weather conditions are not ideal.

- Fabrication shops consistently use better tools (forklifts, electric hoists, positioners, panagraphs, welding machines, chop saws, etc.) than the jobsite.
- The company's specialized tools can be concentrated in one spot, eliminating the need for a full complement of expensive power tools on every jobsite.
- Custom fabricated jigs can be improvised in the shop with minimal cost and then used effectively on other projects.
- The planning required for fabrication makes coordination of efforts with other trades easier.
- Constructability problems and compatibility issues are identified before field installation, which avoids re-work and field labor disruption.
- Depending upon your local labor agreement, apprentices or unskilled labor classifications may be able to work in the fabrication shop, thereby reducing costs.

Manufacturing the Project

Fabrication brings to the construction industry the same type of production techniques that are used in practically all other industries. With fabrication come many cost- and time-saving advantages. Realizing those advantages, however, requires planning and follow-through. To significantly reduce cost, contractors must continuously improve their construction process and fabrication is a key component in driving continuous improvement.

The simple strategy of fabrication is:

- Fabricate components and assemble them in the shop
- Erect and install complete assemblies in the field
- Ensure the assemblies and necessary field installation materials are delivered to the point of installation at the same moment in time

The process of fabrication has many features that help make that strategy effective:

- Repetitive operations
- Efficient work area arrangement in the shop
- Progressive station-to-station (assembly line) fabrication of components
- The capacity to manufacture components, subassemblies, and then large assemblies
- The ability to reliably schedule the delivery of assemblies and necessary field installation material

Planning for Fabrication

Planning for fabrication demands good organization and careful attention to scheduling and material handling. The Project Manager's first step is to organize the fabrication team so that he can identify opportunities for fabrication in the project and assign specific responsibilities for taking advantage of those opportunities.

Among the project team members who should be involved in both the planning and implementation of fabrication are the:

- Project Manager
- Shop foreman
- Job supervisor or foreman
- Draftsman/designer
- Field superintendent
- Purchasing agent

Other members of the team may be added as needed. Once the team is assembled, planning is usually done in three stages. If the project uses Building Information Modeling (BIM), refer to [Section 14: "Building Information Modeling"](#) for a thorough discussion of BIM and its utilization.

Review project plans for situations where fabrication will reduce double-handling of materials in the field, minimize onsite storage requirements, speed field installation, and/or increase overall productivity.

Use the job breakdown and the overall project schedule to schedule fabrication design and production with sufficient lead time to accommodate the job schedule.

Assign each member of the team specific responsibilities, being certain to cover items such as:

- Who determines what to draw?
- Is a mock-up necessary?
- Who internally approves drawings before production begins?
- Who externally approves drawings before production can begin so that if changes are made by the owner or others, the contractor is not at risk for re-work?
- Who coordinates purchasing of materials with the production schedule?

- Who coordinates deliveries between the shop and the field?

See ["Sample Job Fabrication and Drawing Requirements Form" \(Figure 13.1\)](#) and ["Schedule of Fabrication Drawings" \(Figure 13.2\)](#).

How Should Shop Drawing Preparation Be Scheduled?

The shop drawing schedule is driven by the date the fabricated items are needed at the jobsite. The Project Manager, knowing the needed dates for construction, will provide drawing start dates that allow adequate time for drawing preparation, internal and external review and approval, delivery of material and equipment (if required), shop fabrication time, and delivery to the site. It is good practice to begin preparing the shop drawings as early as possible. Job schedules are often compressed, requiring the Project Manager to expedite submittals and approvals so the shop drawing process can proceed rapidly. Even when quick approval is accomplished, the Project Manager will often have to prioritize shop drawings and fabrication to minimize impact to job schedules.

Manual vs. CADD Drawing Preparation

The decision to use manual preparation, Computer-Aided Design and Drafting (CADD) preparation, or Building Information Modeling (BIM) will vary from project to project and should be based on economics, schedule, specifications, electronic data available, and the type and scope of the contract work to be done. Usually, it is not advisable to use CADD systems on retrofit type projects due to the absence of an electronic database of the facility being modified.

Shop drawings should be prepared with sufficient detail to meet the needs of the shop for fabrication and the field for installation and erection. Some CADD systems and BIM models will produce fabrication/spool drawings that will improve the effectiveness of the drawing effort and reduce the cost of fabrication.

Availability of CADD Background Drawings

Most Architectural/Engineering (A/E) design firms now prepare drawings utilizing CADD systems and may supply digital drawings to you. Utilizing these drawings should reduce your cost for shop drawing preparation. The project documents and your relationship with the other members of the construction team will affect access to the electronic files. The use of technology in the planning/drawing phase of construction projects is evolving, and will vary dramatically from project to project.

Availability of Equipment Submittals

Shop drawings cannot be prepared without the final approved equipment submittal drawings. These submittals must be expedited by the Project Manager to be sure they are available to meet the shop drawing schedule. Often in the early stages of the project, the entire team will focus on expediting approvals so the chance for jobsite success is not compromised.

Managing the Shop Drawing, Fabrication, and Delivery Process

Any possible cost reductions through use of shop fabrication will be lost if the routing and approval systems fail. Often the weakest link in the shop fabrication system is timely fabrication and delivery. The Project Manager must set up an expedited tracking system, to be handled by the Project Manager or an administrative support team member. The process must be managed to produce timely shop drawings, effective fabrication, and timely delivery to the jobsite. This expediting must be done regularly to ensure the most effective jobsite performance.

Some General Considerations

Designing and producing fabricated assemblies is only half the story of fabrication. You also have to adjust jobsite procedures and the thinking of the entire project team to get the most of your fabrication/planning program. Among the necessary steps to take are:

- Be innovative in your approach to fabrication, keeping an eye out for better, quicker, less expensive ways to get the job done.
- Be receptive to suggestions from everyone on the project team, including journeymen and apprentices.
- Have your job supervisors or foremen insist on detailed drawings of all assemblies to be fabricated.
- Make sure fabricators know exactly what is expected of them regarding method, technique, and, whenever possible, production level (diameter inches/man/day, joints/day, hanger assemblies/day, etc.).
- Avoid *assuming* that a fabrication job is being done as originally planned.
- Create a jobsite culture that only accepts “one pass” construction. Work is completed each time a crew is mobilized in an area and there are no loose ends or required second mobilizations.
- Coordinate deliveries of fabricated components with job tasks, the availability of onsite storage space, and all necessary tools and material so each work activity can be completed the first time.
- Plan the jobsite for efficient receiving, storage, and distribution of fabricated materials.
- Provide a secure area for storage of fabricated components.

A Precaution

Among experienced Project Managers, few nightmares equal that of carefully designing and fabricating a few hundred assemblies only to have the plans or requirements change at the last

minute, turning weeks of work into an expensive pile of scrap. To avoid such a situation, be sure to have the customer's project authority sign off on your fabrication drawings *before* you start production. That way, if he later makes a change that affects the fabrication work, you have in hand a signed document that makes the customer responsible for the cost of modifying already manufactured assemblies.

Additional resource available through MCAA:

- *Online Piping and Usage Specification (OPUS)*, www.opuspipng.org

SECTION 14: BUILDING INFORMATION MODELING

The growing use of Building Information Modeling (BIM) in the construction industry presents many unique challenges and opportunities to today's Project Manager. Owners, architects, engineers, and prime contractors are becoming increasingly knowledgeable and sophisticated in their application of the BIM process in order to further their needs and goals. It is essential to properly manage the BIM process within your company in order to satisfy those expectations while ensuring your own ability to harvest the opportunities BIM presents and preventing cost overruns and increased risk associated with lax BIM management. When managed properly the BIM process can provide multiple opportunities for:

- Higher quality installations and overall product
- Efficient execution and optimal equipment layout and component routing resulting in lower material and labor costs and increased profit margins
- Fabrication and component module assembly
- Efficient, logical, sequenced material handling and highly accurate purchasing
- Reduced waste
- Improved safety

Once viewed as a revolutionary new process, BIM is now an established, required method of spatially coordinating mechanical, electrical, and plumbing (MEP) systems in the healthcare, commercial, and institutional settings. Accordingly, some contractors view BIM as just one more requirement they are now obligated to fulfill in order to win major projects, while others have recognized the opportunities BIM presents and as such have completely reworked their business plans around the process.

Successful use of the BIM process must be seen as a function of Project Management. BIM allows you to build a virtual representation of exactly what you are going to build, exactly where you are going to build it, what sequence you are going to build it in, and exactly what and how much material you are going to build it from. When you use the model to plan the work, nearly all project planning can and should be centered on the model.

Understanding BIM and Spatial Coordination

Building Information Modeling is a collaborative building process between the architect, engineer, prime contractor, owner, and building trades contractors collectively known as stakeholders, to generate geometrically accurate, intelligent digital information to be used for the design, construction, and maintenance of a facility.

Simply put, BIM can be defined in two parts:

- *Building Information Modeling*, which is an activity or process that results in a

- *Building Information Model*, which is an assembly of three-dimensional geometric objects which form a digital *model* that exists in cyberspace.

The BIM Process is a method of integrating, sharing, and communicating details of the building's design, layout, and construction. The primary goal of the process is to develop a fully coordinated, fully constructible, integrated virtual model of the building project.

The BIM Model is comprised of intelligent 3D objects whose data resides in the building model's digital database. The database maintains the objects' exact 3D geometry as well as additional appropriate information such as size, weight, volume, part number, description, and/or costs. This information can be quickly extracted into tables or bills of material using software formats such as Microsoft® Excel® or Adobe Acrobat® PDF.

Spatial Coordination is the major element of the BIM process for MEP contractors. This is the process whereby building contractors, using contract design documents, establish the exact location and routing of their components in relation to the building structure and other contractors' components. The primary goal of spatial coordination is to resolve interferences between trades and equitably establish the spatial boundaries of each trade's installation, including access required for installation and maintenance of their respective components.

BIM execution plans and/or project specifications will generally establish the roles and responsibilities of an MEP Coordinator, usually a representative of the prime contractor, who will facilitate coordination meetings and will assemble each trade's model into a single "Integrated" or "Federated Model" that represents the complete project. Utilizing automated clash detection software, the MEP coordinator will identify outstanding coordination issues or interferences. When interferences occur, the MEP trades will, ideally, resolve the situation by negotiating and collaborating for the most equitable and generally most cost effective solution. Resolution of interferences should be a team effort, making adjustments for the overall benefit of all parties. This requires a certain level of give and take by the participating parties. Project Managers should be alert, however, to resolutions that involve substantial system rerouting or relocation resulting in added materials and labor. When resolution cannot be accomplished within the parameters provided by the design documents and project specifications, the project's design team must be involved.

Integrating BIM into Your Project

Successfully utilizing BIM to lower costs and increase profits requires the full integration of the BIM process into nearly all facets of your company's structure. Of prime importance to the Project Manager is managing the integration of BIM technology into the field processes and workflow. Full and complete buy-in to the process by job supervisors or foremen, journeymen, and apprentices is necessary for its success. Primary methods used to realize this objective can be accomplished through:

- *BIM Project Planning* – Planning a project, as described throughout this manual, takes on an added dimension when BIM processes are to be utilized. Virtually every function of planning

is impacted by the BIM process. It is often said that the most critical period of any project are the first two weeks. Numerous decisions and choices are made that will affect the project throughout its entire life. This is the time for the project team to develop a plan to build the project, and determine how the BIM process integrates into the plan. Methods utilized to build the project virtually in cyberspace and in the real world on the project site need to be determined. Some of the most critical elements of integrating BIM into the planning process are:

- *Identify spatial design deficiencies* – Ongoing, unresolved spatial design issues often become major obstacles to the BIM/Coordination process. BIM planning should include a review of the contract drawings to look for problems where they typically exist such as convergent points where all the MEP systems come together in restricted or limited space. When systems cannot be installed as per design the “red flag” is raised as early as possible in the process so that the design team may become involved and work towards a timely resolution, which is essential to a successful project.
- *Formulate strategies* – Truly the sky’s the limit for utilizing BIM to formulate strategies for increasing productivity. Fully involving job supervisors or foremen is a must! Strategies centered on optimal methods for laying out, hanging, and supporting components, component fabrication, and efficient material handling schemes prove to be the most beneficial. Good strategies often focus on utilizing CAD/BIM deliverables to allow field installers to be able to get in and out of an area quickly and efficiently before the hindrance of construction congestion develops.
- *Identify opportunities* – In formulating strategies, opportunities for increased productivity and lower costs will become apparent, some examples are:
 - Optimized equipment layout and system routing – optimizing layout reduces material and labor cost.
 - Hanger support methods – BIM allows for every hanger support size, length, and location to be predetermined prior to installation.
 - Downloads to robotic laser survey equipment – download layout to total station equipment to be quickly and accurately laid out in the field.
 - Fabrication and module assemblies – fabricated spools and assemblies can be generated directly from the model.
 - Efficient material handling – BIM allows for extraction of material by any area or breakdown desired, allowing for grouping, bag and tag or color coding of materials by any selection set desired.
 - Means and methods for field installation – a fully coordinated model allows looking beyond “how will this fit” to new, innovative ways to execute more quickly and efficiently.
- *Determine CAD/BIM deliverables* – The ultimate goal of BIM project planning should be a joint determination of CAD/BIM deliverables the project team will use to build the project. In order to schedule manpower, purchase materials, and schedule fabrication and deliveries, the Project Manager and job supervisor or foreman must know exactly

what deliverables will be delivered, how they are to be used, and when they can expect to receive them. Deliverables should be tracked with a deliverables log.

- *Weekly team status and update meetings* – Conducting weekly status meetings throughout the coordination process will ensure that the coordination plan developed for the project is being followed and schedules for coordination and deliverables are being maintained. The meetings should be a method for keeping both the Project Manager and the field fully apprised of the progress of the coordination effort and any spatial coordination issues or changes that have the potential to impact cost or schedule. The meeting also becomes a “look ahead” for items or deliverables that are needed by the field for upcoming construction activities. Additional guidance for structuring and conducting these meetings can be found in [Section 17: “Conferences and Meetings.”](#)

Utilization of inexpensive, user-friendly web conferencing software for status meetings as well as daily communications between detailers, Project Managers, field supervisors, and any other party deemed appropriate is a cost-effective and efficient method of communicating and sharing information among team members.

BIM Documentation Management

The very nature of the BIM process results in numerous documents with multiple revisions. If not carefully managed, installations can be easily installed using out-of-date or voided drawings. A means for tracking documents delivered and current revision must be established and maintained. This can be in the form of hand-maintained logs or more sophisticated methods such as utilizing accessible digital storage via a web-based FTP site to store all current deliverables in digital form. The structure of digital storage locations should be standardized and contain only current documents. Void documents should be moved to an archive file. Regardless of the means, a method should be employed and enforced to reduce the risk associated with lax document management.

Taking the Lead

Some prime contractors look to MEP contractors to lead the BIM process. For qualified MEP contractors, this provides an opportunity to not only establish your reputation as a BIM-savvy MEP Contractor but also lets you to have a major influence on the factors that enable you to use BIM opportunities to their full potential. A word of caution—do not oversell yourself, be sure you are confident and that you have the level of expertise needed to take on such responsibilities. A BIM execution plan that sets guidelines, defines the process, establishes who is in charge, and provides means for dispute resolution should be part of the project. As your BIM experience and expertise improve, you will most certainly find advantages to identifying situations where you can take control of and lead the coordination effort. By doing so in a fair and equitable manner you can benefit not only yourself but the entire project.

Outsourcing

BIM subcontractors must be managed much more closely than the typical subcontractor. When outsourcing is utilized, methods described above for managing BIM in-house should be applied to subcontracting BIM as well. A clear understanding of exactly what is expected, what is to be delivered, and a schedule for same should be established in writing. BIM subcontractors should have suitable references and a proven track record. Utilization of peer group companies or other trusted MEP contractors may provide the best option.

BIM is a complex process. Several books, numerous trade magazine articles, and trade seminars are available on the subject. Do your research. The more you know about BIM the more informed and beneficial decisions you can make when managing it.

Spatial Coordination

Standard and acceptable industry practice for spatial coordination performed under the contract documents is a collaborative process executed between the primary installation contractors and overseen by the general contractor or construction manager. This practice for spatial coordination seeks to integrate objects, systems, and components into spaces allocated in the contract documents. Standard and acceptable industry practice for coordination does not include adding pipe, ductwork, fittings, conduits, cable tray, junction boxes, or other appurtenances to remedy spatial constraints. Such work falls beyond the scope of what is considered standard and acceptable industry practice for coordination, and will be performed as expressly directed pursuant to the terms of the contract. Standard and acceptable industry practices for achieving spatial coordination under the contract documents assume:

- The contract drawings have been fully designed and coordinated by the owner and/or its design professionals such that, if installed as shown on the contract drawings, the finished product will result in systems operating as designed by the owner and/or its design professionals.
- Systems fit within the spaces allocated on the contract drawings as qualified below.

MCAA, in partnership with SMACNA and NECA, was successful in developing and placing a landmark definition into the new national BIM standard that provides a well-defined and repeatable framework for installation-level spatial coordination of mechanical, electrical, plumbing (MEP) and fire protection systems. This definition, under *5.5.1 Scope of the National BIM Standard – US v2 (NBIMS-US v2)*, is available for download at www.mcaa.org. The complete section under which *5.5.1 Scope* falls is *Section 5.5 Mechanical, Electrical, Plumbing, and Fire Protection Systems (MEP) Spatial Coordination Requirements for Construction Installation Models and Deliverables – November 2009, Revised May 2012*. By prescribing and defining this consistent framework for spatial coordination, *5.5.1 Scope* can help ensure the savings in time and change order costs that can occur only with a clear interpretation of where coordination ends and new or redesign begins. NBIMS-US v2 is an initiative of the National Institute of Building Sciences buildingSMART alliance.

SECTION 15: JOB COST AND LABOR CONTROL

Costs and Profits

Job costs and labor affect far more than just the project itself. These two things are the basis of financial planning for the entire company. The company gauges its financial health on the profitability of each project it undertakes. Cash flow planning flows from the job cost analysis and billing projections. If the information provided by the system is reliable, the benefits it brings to the project are shared throughout the company. If errors slip through, however, they can lead the company's financial planners to decisions that can have a devastating impact on the company's future.

Every project has a budget based on the project estimate. The budget specifies how much the project team can spend for everything it needs to complete work: mechanical equipment, materials, subcontractors, labor and other direct job costs such as rental of tools and construction equipment, jobsite trailers, security equipment, utilities, etc. A budget is an indispensable tool. Unfortunately, most Project Managers use only half of its potential. They use it to track how much they spend. They forget that it can be used to manage losses and track how much profit they make. This is a serious mistake, because *earning the maximum fair profit on every project is a critical objective*, and not fully using the proper financial tools puts a Project Manager at a disadvantage right from the start.

The Objectives of Job Cost Control

There are four objectives of job cost control:

- Monitor planned, incurred, and anticipated project expenditures.
- Control the cost of construction.
- Provide ongoing forecasts of the project's financial outcome.
- Maintain effective records that identify the results of good and bad estimates so that adjustments can be made in labor productivity factors and methodology.

Notice that all of the above are management objectives. None aims at simply "documenting" costs, although that is certainly a part of job cost control. Instead they form a *system* that tells the project team where the project stands financially at any given moment and provides an early warning system for identifying and correcting profit-threatening situations before they can become crises. It is a mistake to only manage the gross profit margin on a project. You must manage each line item to maximize profit and minimize loss.

["How to Make Money on Projects" \(Figure 15.1\)](#) and ["Why Projects Go Wrong" \(Figure 15.2\)](#) provide a snapshot of why job cost control is critical.

Designing a Job Cost Control System

The design objective is to create a job cost control system that:

- Provides the Project Manager with the information needed to manage the project profitably.
- Maintains effective records to feed back results of good or bad estimates to estimating and allow for adjustments in labor productivity factors and methodology.
- Provides company executives with the information they need to manage the company profitably.

To meet its design objectives, a job cost control system must view everything related to the project as contributing to project profits or taking away from project profits.

The job cost control system would also have these four characteristics:

- *Uniformity* – It follows the format of the original project estimate so that it reflects the basis of that estimate. It also conforms to your company's accounting system so that the flow of information is reliable, accurate, and predictable.
- *Practicality* – It provides all required information in usable form and is easy for all project and company personnel to use.
- *Completeness* – It tracks all project costs, including those incurred, planned, and anticipated, and is detailed enough to identify project trends.
- *Timeliness* – The information it provides accurately reflects the *current* status of the project.

It is more difficult to list those who are not involved in job cost control than those who are. The fact is everyone on the project affects project profitability. However, certain members of the project team have particularly important roles, namely the:

- *Estimator* – Responsible for the material and equipment take-offs and the calculation of budget increases and decreases due to changed work and other factors.
- *Project Manager* – Responsible for converting the project estimate into a project cost control tool, enforcing job cost control procedures, monitoring project status reports, and acting on trends detected in those reports.
- *Job supervisor or foreman* – Responsible for tracking project progress and worker productivity as well as forecasting job costs.

- *Accountant or business manager* – Responsible for designing and maintaining an account code structure for the project and ensuring that it fits in with the company's overall accounting system.
- *Accounting clerk(s)* – Responsible for accurate data entry, bookkeeping, and generation of project status reports.
- *Purchasing agent* – Responsible for issuing properly coded purchase orders and requisitions and tracking their status.

Other members of the team are also important. For example, the fabrication shop foreman is responsible for maintaining a production and delivery schedule that meets project requirements and devising methods for cutting material and construction costs wherever possible. The company's CEO is responsible for actively supporting the job cost control system by insisting on compliance and guiding the Project Manager in its implementation.

An Overall Strategy

The overall job cost control strategy for any project should have four basic elements:

- Clear definition of the scope of work as determined by the contract documents including request for proposal, quotations, plans, specifications, contracts, etc.
- Agreement within the company on a target gross margin for the project.
- A coding system that identifies all direct and indirect job costs and will provide the information needed for effective project management.
- Job cost accounting so that the flow of information conforms to the flow of construction, allowing the project team to have confidence in the data and be able to accurately project final job cost.

Reviewing Project Documents

The project documents set the ground rules for every aspect of the project, and job cost control is no exception. To make sure the job cost control system has a solid foundation, the Project Manager should review each document prior to the pre-construction planning sessions and then educate the project team so that everyone understands the contracted scope of work.

The bid documents should be reviewed carefully for information related to job costs, specifically:

- *Scope of work* – How accurate is it? Are there areas in it that are likely to change over the course of the project?

- *Original estimate* – Do the schedule and plan of execution used to prepare the estimate still hold? Are the original assumptions still true regarding major vendors, codes, wage rates, production rates, contingencies, inclusions, and exclusions?
- *Contracts* – Is the total contract amount accurate? Does the contract allow for sales tax and other taxes? What billing procedures and dates are specified? Will the project owner inform the Project Manager promptly if a payment request is rejected or delayed? What provisions are made for collecting retention? How are change orders to be handled and billed? What documentation is required for billing, such as lien waivers, labor reports or cost-plus documentation? Is there a pre-approved project schedule? For a complete discussion of contracts, refer to [Section 5: "Contracts and Contract Documents."](#)
- *Plans and specifications* – Are they accurately reflected in the project estimate?

The Importance of Gross Margin

Gross margin is the difference between the dollar amount of the contract and the direct and indirect cost of doing the work. Gross margin is not net profit. Net profit, or the company's actual profit on a project, is calculated by deducting a proportional amount of all indirect costs such as company administration costs, interest on company loans, general insurance premiums, company income tax and property tax, capital investment in equipment, business license fees, contingency funds and company office expenses (building and equipment rental, office personnel salaries, etc.) from the gross margin.

Although it is not an accurate gauge of net profit, target gross margin is an important tool for project management for three reasons:

- It sets a financial goal for the project that everyone can understand and influence.
- It provides a baseline for setting a financial goal for each task, a goal the project team and especially the job supervisor or foreman can use to gauge crew performance and productivity.
- It offers a means for identifying variances from the project estimate as they occur so they can be corrected before they cause serious damage to project profitability. Some companies hesitate to let Project Managers, job supervisors or foremen know their financial goals for the project. This not only deprives members of the project team of an important motivator; namely, pride in meeting or beating achievable goals, but it can also demonstrate a company's distrust of its employees. It puts the project team at a distinct disadvantage by asking them to perform efficiently without telling them how their performance is actually measured.

Sharing profit information gives the project team a sense of added responsibility, assures it of the company's trust, and sets financial performance objectives that reflect the real nature of the construction business.

Calculating target gross margin is a straightforward procedure. The Project Manager starts with the total amount of the project contract and deducts all estimated direct and indirect job costs from it. The result is the project's target gross margin.

Job Costs

When contractors built projects using the field forces to lead and plan the projects, direct job cost was simple. Labor, material, and subcontracts were job cost. The mark-up covered general and administrative expense, including the cost of selling the project. In today's market where each project may have a Project Manager, fabrication support, BIM detailing, commissioning, LEED certification, and other project requirements, the definition of job cost becomes more difficult. In considering what "should" be job costs, the company considers trying to job cost any expenses that would not be incurred if the project were subcontracted. Capturing these costs as job cost allows the contractor to often include them in change order cost. In some government contracting, if the contractor regularly captures these costs as job cost and estimates them as job cost, they are automatically included in change order cost.

Direct job costs can be identified as pertaining to the specific project. Some or all of the following may be assigned to a specific project and are therefore easily identified as job cost:

- Equipment to be installed
- Subcontractors
- Materials
- Labor
- Equipment rental
- Onsite management staff, including the Project Manager, jobsite engineer, etc.
- Vehicles assigned to the project
- Communication devices including telephones, computers, cell phones, and T1 lines

Other direct job costs (ODJC) are job costs incurred as part of managing and supporting the project but not necessarily doing actual construction work. They are different from general and administrative (company overhead) expenses, which are costs incurred in operating the company. Many contractors are tracking these ODJC costs in their job cost systems to more accurately reflect actual job costs and reduce variable overhead. Among ODJC are:

- Project Managers, superintendents, nonworking job supervisors or foremen, project engineers, drafters, safety director, accountants, paymasters and timekeepers, purchasing agents, warehouse employees, security, jobsite maintenance personnel, etc. When these

individuals are not full time on the jobsite, their time is tracked and hours spent on managing/supporting the project are charged on an hourly basis.

- Labor burden, including payroll taxes, federal and state unemployment insurance, workers' compensation, liability insurance, small tools and expendable materials, and certain vehicle expenses. Keep in mind that payroll taxes, federal and state unemployment insurance, and workers' compensation could be included in direct labor costs.
- Project recruiting expenses (this could also be included in direct labor costs)
- Fabrication shop and sheet metal shop expenses
- Equipment rental
- Small tools and consumables
- Project insurance (public liability, builder's risk, property damage, etc.)
- Guarantee or warranty reserve
- Vehicles (gas and oil, tires, licenses, insurance, parts and repairs, maintenance and other transportation expenses)
- Temporary facilities and utilities
- Sales tax (may be included in materials or equipment)
- Bonds and permits
- Legal expenses
- Liquidated damages
- Project supplies, including construction drawings, photography, letterhead, postage, photocopying, lab tests and x-rays, first aid supplies, ice, water, etc.
- Clean-up and disposal services

The target gross margin must also take into account allowances and contingencies, such as reserve funds used to cover unexpected costs resulting from estimating errors, omissions, and uncertainties. *Allowances* are funds for added costs that are traceable and predictable. *Contingencies* are funds used to cover labor variations and unexpected costs.

Establishing a Coding System

An accounting and reporting system that assigns a specific code to each task on the project is the only reliable way to track job costs, especially the highly volatile cost of labor. Once

established, the codes are used in all project reports so that everyone is using the same format and there is no room for misinterpretation. When possible, the job cost breakdown will follow the same breakdown used in the estimate to facilitate the final project review and allow comparison of estimated and actual labor productivity. There are two steps to establishing a coding system: doing a job breakdown and doing labor coding breakdowns.

Job Breakdown

The goal of a job breakdown is to identify the major activities involved in the project. This is accomplished by:

- Reviewing the scope of work and the plans and specifications to determine a logical construction sequence.
- Doing a material and equipment take-off that establishes material and equipment needs for each step in the construction sequence.
- Creating a workforce loading chart that establishes the labor requirements for each step in the construction sequence.

The result is an overview of the project that specifies the equipment, material, and labor requirements of each stage of construction. Whenever possible, include the job supervisor or foreman when doing the job breakdown so that he understands the logic and can influence the detail that the company will hold him or her responsible for reporting. The job supervisor or foreman is the first level of management on every project.

Labor Coding Breakdowns

A labor coding breakdown takes the construction stages identified in the job breakdown and reduces them to a sequence of tasks. These tasks should be:

- Clearly definable.
- Capable of being reported separately.
- Follow the logical sequence of construction.
- Capable of being completed within a short time period (usually 10 or fewer working days).
- Broken down by trade, craft, system, and/or physical area of the project.

When this detailed breakdown is complete, each task is assigned a labor control code that conforms to the original project estimate and the general ledger of the company's accounting system. Because the company's existing accounting structure serves as a format for the coding system, there is no need for the project team to devise its own account codes.

“Labor Report (Labor Hours and Dollars)” (Figure 15.3) illustrates how the information from the labor coding process is combined in a reporting format. The first three columns show the labor code for each task, the task description, and the estimated labor hours and amount for that task. The remaining columns are used throughout the project to report:

- Additions and deletions of hours due to change orders (Column 4)
- Revised estimated labor hours based on the effect of change orders (Column 5)
- Estimated percentage of completion for each task (Column 6)
- The number of estimated labor hours used to date (Column 7)
- The actual number of labor hours and dollars used to date (Column 8)
- The number of labor hours still available for the task or the number of hours the task has used over and above the estimate (Column 9)

In assigning labor codes to various tasks, the project team should be sure that:

- The tasks in the breakdown are small enough that the reporting system provides necessary detail, but is not overly detailed. An overly detailed system is cumbersome and complicates the reporting procedure. In general, each labor code should cover a clearly defined task that a crew can complete within 10 working days.
- No coded task should involve more than 15 percent of the total hours on the project, no matter how small the project.
- All codes and estimate information are entered in the company's accounting system before work on the project begins.
- Everyone and every operation in the project, including field supervision, planning, purchasing, accounting, reporting, prefabricating and more, uses the same coding system.

Material Control Sheets

The same coding system can be used for controlling materials as well as labor. This is particularly important on cost-plus (time and material) projects where every item used must be tracked.

A material control sheet similar to the labor reports can be designed using the dollar amounts from the estimate and the material and equipment take-offs, and task codes similar to those in the labor coding breakdown. The resulting data should be integrated with the project's purchasing and field reporting systems, and the reports generated should include information on:

- Variances between quoted and actual prices
- Delivery status
- Invoice and payment status

Tracking Profitability and Volatile Costs

The project team can keep track of project profitability by:

- Regularly comparing costs, especially costs of labor and materials, to estimates.
- Revising cost estimates and contract amounts as changing project situations warrant.

Labor is the most volatile cost on any project, and tracking it requires:

- An accurate and reliable reporting system based on the labor coding breakdown.
- The project team's commitment to the accuracy and timeliness of the reporting system.

The job supervisor or foreman plays an important role in this reporting system. It is his responsibility to:

- Submit weekly labor reports accurately listing the number of hours each worker performed on each task and the proper code number of each task.
- Report percentages of completion for each task on the project, as part of his short interval planning duties.

Fortunately, having the project broken down into small tasks makes it relatively easy for the job cost controls to accurately report project progress, since it is much easier to determine whether a 10-day task is 25 percent, 50 percent or 75 percent complete than it is to determine the same thing for an entire three-month stage of construction. Statistical theory (as well as practical experience) indicates that small errors in a large number of small categories tend to offset each other, providing a far more accurate overall result than the practice of basing estimates on a few large categories.

The labor report discussed earlier combines the data from the job supervisor or foreman's weekly labor reports (coded time sheets) and estimates of task completion, adds them to previously recorded data, and compares the totals to the labor hours estimated for each task. The result summarizes two things:

- The status of labor usage on individual project tasks
- The status of labor usage on the project

This labor summary provides everyone on the project with feedback on performance and information for planning further labor usage and modifying the labor strategy. It also provides company executives with information for planning the financial strategy of the company.

Dealing with Variances

One of the most valuable aspects of a detailed labor reporting system is that it tells the Project Manager at a glance which tasks are under, on, or over the estimate, allowing the project team to make adjustments so that a gain on one task balances the loss on another. It is a system that is based on the identification and resolution of variances.

A variance is a difference between what is expected (estimated) and what actually occurs. There are two types of variances:

- *Isolated variances* – due to a single event or a temporary situation on the project and have a minimal effect on the project outcome
- *Variant trends* – due to ongoing events or permanent situations on the project and can have a drastic effect on the project outcome

“Results of Isolated Variance and Variant Trend” (Figure 15.4) illustrates the difference between isolated variances and variant trends. The upper chart shows the outcome of an isolated variance, such as several days of bad weather or a missed equipment delivery date that occurred when the project was 10 percent complete. Although the variance threw the budget off by 30 percent at this early stage (estimated cost: \$10,000; actual cost: \$13,000), the \$3,000 discrepancy never grew beyond that. As a result, at the end of the project, it amounted to only 3 percent of the total contract amount.

The lower chart tells quite a different story. The variant trend began at the same point when the project was 10 percent complete. However, because it was a trend and not just an isolated incident (such as an unproductive work method or an estimate error that was left uncorrected) its effect persisted. At the end of the project, the discrepancy was 30 percent of the total contract amount.

Obviously, it is essential that the Project Manager learn to distinguish between isolated variances and variant trends and focus primary attention on the latter. Regardless of whether a variance is isolated or part of a trend, the Project Manager and job supervisor or foreman must take immediate action to correct it by:

- Redirecting efforts on the task affected by the variance
- Trimming costs on other project tasks to compensate for the loss of profits

What to Do if Labor Codes Are Going Over

As always, there are no set rules in this business: in most cases, common sense works the best. First, you must decide if just a few codes are going over and by how much. If some are over and

others are under, you must do a thorough onsite inspection. At this point you will evaluate the progress being made on the activities and what factors affected the codes that are over or under. If the trend continues with labor overruns, make no mistake: you have a problem on your hands.

Depending on your company culture and the project, you may need to get the superintendent, labor manager, your supervisor or even the company owner involved. Is the relationship between labor and management one of trust, or is it adversarial? If it is one of trust and mutual gain, the job supervisor or foreman will be an integral part of the solution. If the relationship is adversarial, the job supervisor or foreman and crew may be the problem. The company will have to evaluate the project and seek solutions.

What are the reasons given by the job supervisor or foreman? What do you need to do to remedy these issues? If you do not address concerns, the job supervisor or foreman may exploit them until you do. Some examples are:

- “The work area is not clean.” Have your laborers clean the work area.
- “We cannot work in that room because the drywall is not done.” Proceed with your work until you receive a written stop work order.
- “I cannot get my material distributed. The prime contractor has everything blocked.” Work on Saturday or after hours to stock the work areas.
- “The sheetrock contractor is getting out in front of me.” Work a few extra hours a day to stay in front of the sheetrock contractor. If he is violating the approved schedule, insist he follow the schedule.
- “I am waiting on the electrician.” Make sure you are first; the others will find a way to get their work done.
- Make sure the tools and materials are organized and in the proper work space and adequate tools are on the project.
- Make sure the estimate is right for the project conditions.
- Make sure you have the right people doing each task. Few workers are the best at everything. Everyone has their own strengths and weaknesses.
- Make sure you have the right job supervisor or foreman for the project.

Remember that it takes more than the Project Manager to look at the project when things are rough. The workforce is your eyes and ears too. Once a situation is identified, your team should be a resource in finding a timely, cost-effective solution. Ignoring the situation will result in bigger problems later. It's better to be proactive.

Revising the Project Estimate

As the project progresses, some tasks exceed their budget and others come in under. Change orders add to and deduct from the contract amount. The result is that the original estimate can lose its meaning and value as a scorekeeping tool. The solution is to update the estimate continually so that it always reflects current and anticipated expenditures and changes to the contract amount. In this way, the estimate remains an accurate baseline for monitoring gross margin.

The procedure for revising the project estimate is simple:

- Modify the contract amount and the estimated direct job costs according to the latest data on contract changes reflecting incurred and anticipated costs.
- Recalculate the target gross margin by deducting all updated direct job costs from the updated contract amount.

Be sure everyone on the project team is informed about all changes to the target gross margin so that they can plan their strategies accordingly.

Monthly Project Status Report

The Monthly Project Status Report is a summary of all current and available project financial information, prepared by the Project Manager with the cooperation of the accounting department. It portrays current trends in project profitability and forecasts the project outcome based on those trends, giving the project team essential information on all financial aspects of the project and giving company management essential information on the project's contribution to overall company profitability.

A ["Monthly Project Status Report" \(Figure 15.5\)](#) includes:

- An accounting of all categories of direct job costs (equipment, subcontractors, materials, labor, and ODJC)
- A comparison of actual and estimated costs in each category
- A forecast of final costs in each category
- A calculation of the revised contract amount
- Statistics on gross margin and billing

To be accurate, the Monthly Project Status Report must take into account all project costs, including paid invoices, committed costs, and anticipated costs. To be useful, its results should be communicated to all project personnel to give them feedback on project progress and a current basis for planning the remainder of the project.

Labor costs are *the* major variable in construction work, and accurate labor reporting is the only way of tracking and controlling them. Without labor reports, your company has no way of knowing whether the labor hours being used on the project are within the original estimate and, therefore, whether the project is profitable.

The Labor Reporting Process

The labor reporting process should follow the same basic procedure regardless of the size of the project, including:

- The company estimator or the Project Manager estimates the number of labor hours required for each task in the project.
- During Pre-Construction Planning, the project team decides how the project is to be built, scheduled and controlled, and breaks down the estimate into appropriate tasks.
- Change work codes are assigned as major change orders are received and approved, and are used to track the costs of change work.
- The Project Manager, job supervisor or foreman, and/or superintendent prepare a list of estimated labor hours, by code, for each task, based on the material and equipment take-off. The project team reviews these estimates during pre-construction planning and modifies them as necessary.
- The job supervisor or foreman uses the list of estimated labor hours to direct labor efforts.
- The job supervisor or foreman keeps a daily record of labor hours used, by code.
- Every worker has a time card for each pay period, listing the number of hours worked on each task. The job supervisor or foreman verifies the tasks and hours on each time card, fills in the code number of each task and submits the cards to the company office, together with the record of the labor hours used during the period. These records become the basis of the period's payroll and labor cost evaluation. See [“Labor Tracking Sample” \(Figure 15.6\)](#).
- The company should regularly issue a project labor report that compares the number of labor hours actually used on each project task with the original and revised labor estimates for that task.
- As part of the short interval planning process, the project team uses the labor breakdown to plan their weekly activities. By using the labor codes in the planning, tracking in the accounting system is reliable. Labor is tracked by *general* categories of activities within definitive project areas. The selection of labor activities should support the billing breakdown and be of such a grouping that the field supervision can easily visualize and report the activities. General categories of labor activities could be:
 - Underground plumbing

- Layout, hanger installation
- Risers
- Rough-in by system by area
- Equipment setting or mechanical equipment rooms
- Waste and vent by area
- Storm drains
- Fit-out, equipment connection
- Start-up, testing, and commissioning
- Punch list
- Supervision

These general categories may be subdivided per “easily” identified materials and/or systems. The above-established categories of labor activities should be tracked per a limited physical project area. The contract drawings often provide a convenient means of subdividing the project into discrete, identifiable areas. Generally, the subdivision is by floor level and by floor segment such as a wing or quadrant. The usual guideline is to select areas that can be easily visualized and reported by the field supervision. But these areas must not be so large as to present such a large quantity of labor that the field supervision and Project Manager cannot easily determine the percentage of completion. Areas of high labor concentrations, such as equipment rooms, should be tracked using individual systems reflecting the actual construction plan.

Labor reports are the basis of the job cost control system that the Project Manager uses to make major management decisions. If the reports turned in by the job supervisor or foreman are incorrect or incomplete or if the accounting department makes errors in recording the reported information, the entire job cost control system is inaccurate. The results can be costly, especially if the mistakes go unnoticed until the end of the project, when it is too late to take corrective action.

The Project Manager's primary responsibility, then, is to make sure all labor information that comes in from the field is accurate and complete and that it is entered properly into the accounting system. To do this:

- Be certain that everyone on the project team, particularly the job supervisor or foreman, is familiar with the tasks and labor codes for the project.
- Insist that the job supervisor or foreman keep his own record of labor hours by code. He should record labor hours used *daily* on a standard form provided by the company and use personal records to verify the codes and hours on each worker's time card. *He must not rely on memory and wait until the end of the pay period to create the labor record!*
- Ensure that the job supervisor or foreman gets each worker to record labor hours *daily* on the time card and not wait until the last day of the pay period to “remember” what was done each day.

- Review (or assign someone to review) all labor reports and time cards as they arrive from the field to make sure the project's name and number appear on each of them.
- Require the job supervisor or foreman to inform you *immediately* when he knows that the labor hours on a particular task will exceed the original estimate.
- Request that the job supervisor or foreman get instructions from you when he feels that a certain task does not fit any of the codes assigned to the project.
- Require the job supervisor or foreman to check and recheck each time card and labor report before submitting it to ensure that each code and number of hours is correct and to avoid errors.
- Insist that labor hours spent on cost-plus (time and material) change work be recorded separately, using the appropriate codes.
- Make sure the job supervisor or foreman does not try to avoid "looking bad" by diverting some of the hours from a cost code going over estimate to a code which may otherwise come in under estimate.

The Importance of Accurate Reporting

Some job supervisors or foremen tend to hide when a particular activity falls behind the schedule, hoping to compensate during the next interval and therefore avoid questions or criticisms of their performance. This behavior is often a symptom of lack of trust among members of the project team, and it can have a devastating effect on cost reporting.

The Project Manager must know at any given time exactly where each task stands. One inaccurate report of project progress can throw an entire project off balance further down the line, upsetting the sequence of activities and the coordination of trades and crews and creating inaccurate data for the planning of other intervals and projects. To avoid this, the Project Manager can, from the very first day of the project:

- Encourage each job supervisor or foreman to report honestly the crew's progress on each activity.
- Avoid criticizing or reprimanding a supervisor for using more labor hours than anticipated to complete a project.
- Treat overruns (and under-runs) on labor hours as situations to be analyzed, not personal mistakes.
- As part of the analysis of each overrun, explore the reasons that the overrun occurred, what effect it will have on other project activities, and how to avoid similar overruns in upcoming intervals.

By creating a “safe environment” for everyone on the project team in which no one fears reporting negative project developments or voicing their ideas or recommendations, the Project Manager ensures that the information received is accurate and complete.

SECTION 16: LABOR RELATIONS

The United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada celebrated its one hundred and twentieth birthday in 2009. The national leadership, recognizing that the union segment of the construction marketplace continues to lose market share, has worked with the Mechanical Contractors Association of America and other national associations to write the *UA Standard for Excellence*. This standard may be included in your local agreement now or in the future. The following is the *Standard for Excellence* that was published in the *UA Foreman Training Manual*. It is a good discussion of the contractor/labor management relationship.

UA Standard for Excellence

Member and Local Union Responsibilities

To ensure the *UA Standard for Excellence* platform meets and maintains its goals, the Local Union Business Manager, in partnership with his implementation team, including shop stewards and the local membership, shall ensure all members:

- Meet their responsibilities to their employer and their fellow workers by arriving on the job ready to work, every day on time (Absenteeism and tardiness will not be tolerated.)
- Adhere to the contractual starting and quitting times, including lunch and break periods (Personal cell phones will not be used during the work day with the exception of lunch and break periods.)
- Meet their responsibility as highly skilled craftworkers by providing the required tools as stipulated under the local Collective Bargaining Agreement while respecting those tools and equipment supplied by the employer
- Use and promote the local union and international training and certification systems to the membership so they may continue on the road of lifelong learning, thus ensuring UA craftworkers are the most highly trained and sought after workers
- Meet their responsibility to be fit for duty, ensuring a zero tolerance policy for substance abuse is strictly met
- Be productive and keep inactive time to a minimum
- Meet their contractual responsibility to eliminate disruptions on the job and safely work towards the on-time completion of the project in an auspicious manner
- Respect the customers' property (Waste and property destruction, such as graffiti, will not be tolerated.)

- Respect the UA, the customer, client and contractor by dressing in a manner appropriate for our highly skilled and professional craft (Offensive words and symbols on clothing and buttons are not acceptable.)
- Respect and obey employer and customer rules and policies
- Follow safe, reasonable and legitimate management directives

Employer and Management Responsibilities

MCAA/MSCA, PFI, NCPWB, PCA, UAC and NFSA and their signatory contractors have the responsibility to manage their jobs effectively, and as such have the following responsibilities under the *UA Standard for Excellence*:

- Replace and return to the referral hall ineffective superintendents, general foremen, foremen, journeymen, and apprentices
- Provide worker recognition for a job well done
- Ensure that all necessary tools and equipment are readily available to employees
- Minimize workers' downtime by ensuring blueprints, specifications, job layout instructions, and material are readily available in a timely manner
- Provide proper storage for contractor and employee tools
- Provide the necessary leadership and problem-solving skills to jobsite supervision
- Ensure jobsite leadership takes the necessary ownership of mistakes created by management decisions
- Encourage employees, but if necessary, be fair and consistent with discipline
- Create and maintain a safe work environment by providing site specific training, proper equipment and following occupational health and safety guidelines
- Promote and support continued education and training for employees while encouraging career building skills
- Employ an adequate number of properly trained employees to efficiently perform the work in a safe manner, while limiting the number of employees to the work at hand, thereby providing the customer with a key performance indicator of the value of the *UA Standard for Excellence*.
- Treat all employees in a respectful and dignified manner, acknowledging their contributions to a successful project

- Cooperate and communicate with the job steward

Problem Resolution through the UA Standard for Excellence Policy

Under the *UA Standard for Excellence* it is understood, that all members through the local union, and management through the signatory contractors, have duties and are accountable in achieving successful resolutions.

Member and Local Union Responsibilities:

- The local union and steward will work with members to correct and solve problems related to job performance.
- Job stewards shall be provided with steward training and receive specialized training with regard to the *UA Standard for Excellence*.
- Regular meetings will be held where the job steward along with UA supervision will communicate with the management team regarding job progress, work schedules, and other issues affecting work processes.
- The job steward shall communicate with the members about issues affecting work progress.
- The business manager or his delegate will conduct regularly scheduled meetings to discuss and resolve issues affecting compliance with the *UA Standard for Excellence* policy.
- The steward and management will attempt to correct such problems with individual members in the workplace.
- Individual members not complying with membership responsibility shall be brought before the Local Union Executive Board, which will address such members' failure to meet their obligation to the local and the UA, up to and including filing charges. The local union's role is to use all available means to correct the compliance problem.

Employer and Management Responsibilities:

- Regular meetings will be held where the management team and UA supervision will communicate with the job steward regarding job progress, work schedules, and other issues affecting the work process.
- Management will address concerns brought forth by the steward or UA supervision in a professional and timely manner.
- A course of action shall be established to allow the job steward and/or UA supervision to communicate with higher levels of management in the event there is a breakdown with the responsible manager.
- In the event that the employee is unwilling or unable to make the necessary changes, management must make the decision whether the employee is detrimental to the UA

Standard for Excellence platform and make a decision regarding his/her further employment.

Additional Jointly Supported Methods of Problem Resolution

- In the event an issue is irresolvable at this level, the local or the contractor may call for a contractually established labor/management meeting to resolve the issues.
- Weekly job progress meetings should be conducted with job stewards, UA supervision, and management.
- The UA Local or the contractor may involve the customer when their input is prudent in finding a solution.
- Foremen, general foremen, superintendents and other management should be educated and certified as leaders in the *UA Standard for Excellence* policy.

A Framework for Working Together

The labor agreements negotiated in your area and the personnel policies established by your company may be different from the *UA Standard for Excellence*; however, they are the framework for cooperation between management and labor in your area. Together these agreements will provide:

- A clear approach to getting jobs completed
- Specific work goals and conditions
- Standards for job performance

The Project Manager's leadership is an important key to creating and maintaining an atmosphere of positive management-labor relations that foster trust, respect, and mutual concern for doing the job well. Local unions and local contractors will either succeed together or fail together.

Know the Rules

Labor agreements and personnel policies can work for or against the project effort. To ensure that they work in your favor, you have to be sure that the members of the project team have a working knowledge of the following:

- *Labor agreements* – Particularly those sections related to:
 - Work hours, starting time, and quitting time
 - Wages, including rules governing shift time and overtime and how they affect the project schedule
 - Crew composition, especially as it affects productivity

- Supervision

The Project Manager may find it beneficial to post particular work rules as they relate to the project, including:

- *Project agreements* – If the project is covered by a specific project agreement, the project team will review it thoroughly during Pre-Construction Planning. The Project Manager should hold a meeting with the prime contractor to discuss the impact of the agreement on the project.
- *Jurisdiction procedures* – Understand the two ways of establishing trade line jurisdictions:
 - “Area practice,” which is normally clear-cut and can be settled by labor representatives
 - Arbitration through the Impartial Jurisdictional Dispute Board
- *Company policies* – Be especially familiar with these areas of your company's personnel policy:
 - Safety, particularly OSHA guidelines that pertain to the job
 - Equal Employment Opportunity and Affirmative Action
 - Hiring procedures
 - Drug/alcohol testing policies and procedures
 - Termination procedures, especially as they relate to firing. Be certain your company policy has provisions for:
 - Firing employees for just cause such as excessive absenteeism, theft, insubordination, vandalism, or violation of company policies.
 - Issuing at least one warning to an employee, as appropriate, before firing him or her.
 - The job supervisor or foreman's issuing of warnings and notifying the office of such warnings on a daily basis.
 - A review by the Project Manager of all firing decisions made by the job supervisor or foreman.
 - Explaining the cause of termination to the fired employee at the time of firing.
 - Recording the reason for which an employee is terminated. An employee who is terminated for unsatisfactory work or an infraction of a rule should have this fact noted on the termination slip to prevent him or her from collecting unemployment benefits paid for by the company.
 - Reductions in workforce and how they are handled.
 - See [Figure 16.1: “Sample Separation Notice”](#)

Maintain Communications with Labor Leaders

As appropriate for your project, establish good relationships with labor leaders from the start of the project. If necessary hold a Pre-Construction Planning Meeting with your company's labor liaison and union representatives to:

- Agree on ground rules for the project
- Ensure compliance with trade jurisdictions
- Determine a schedule for regular meetings and special meetings, when necessary

Make sure that a member of the company or project staff is assigned to act as the sole liaison with the union business manager. Make sure your assignee keeps the union business manager informed about all situations regarding labor and solicits his recommendations and cooperation for the project's labor relations effort.

Work to develop a project environment where management and labor view the project as a mutual venture with potential rewards for both. Learn to see problems as challenges to the creativity and problem-solving abilities of both sides.

Handle Layoffs Properly

Layoffs occur when a project's schedule dictates changes in the work crew. In some cases, they are a result of poor scheduling or excessive hiring. The Project Manager can control layoffs through good planning and wise workforce scheduling. When a layoff is required, inform the union business manager in advance and make every effort to send the affected employee(s) to another project.

A divided team cannot easily do good work. If the Project Manager wants to ensure the profitability of the project, he has to take steps to unify management and labor in a cooperative effort.

SECTION 17: CONFERENCES AND MEETINGS

The Purpose of Meetings

Meetings before, during, and after the construction project help create and maintain good communication. Attendees convey information for the use of others and receive information they themselves can utilize.

Meetings also allow people to get to know others who are working on the job. This personal contact is important to building and maintaining good working relationships. Establishing contact in person makes it easier to conduct business over the phone, which is an integral part of work in the construction industry.

Other than the occasional special or emergency gathering, all meetings should be scheduled regularly and consistently. Weekly meetings should be held on the same day of the week, at the same time and in the same location. In this way, those connected to the project know when and where to be without excess coordination. More than likely, project personnel will know what to prepare for as well.

The worst “meeting killers” are:

- Absence of key personnel involved in the subject to be discussed.
- Unprepared personnel.
- Confusion about where to meet (resulting in late arrivals), or about the purpose of the meeting.
- Discussion of other items that are not the intended subject of the meeting.
- Meetings that last too long, lack appropriate focus, or do not involve most of the participants.

Any of these circumstances can hamper a meeting and often an entire project. Enforcing regular, reliable meetings is the first step in eliminating these common meeting killers.

Regularly scheduled meetings with a published agenda and minutes can reduce the volume of telephone calls, e-mails, text messages, letters, and other communication required. If all entities connected with the project know that every Tuesday at 9:00 a.m. there is a meeting with the architect, Project Manager, job supervisor or foreman, subcontractors, and possibly the owner, they will know that this is the proper place to raise job-related problems.

Projecting an Image

The way a Project Manager conducts him- or herself at a project meeting can have tremendous impact on the way he is perceived by everyone else on the project. You should always strive to project an image of confidence and leadership.

Among the ways to establish and maintain that image are:

- Dress conservatively
- Maintain an appearance of authority
- Be certain of your facts and express your opinions with conviction
- Avoid being overbearing
- Avoid begging or patronizing

Where you sit at a meeting or conference is also important. Arrive at each gathering early enough to choose a seat where you can comfortably listen to and engage the facilitator while being receptive to and able to interact with the rest of the participants.

Chairing a Meeting

The person who chairs the meeting should be responsible for preparing the minutes and the agenda. This individual should direct the meeting and not allow it to stray too far from the agenda. If the meeting starts to fixate on certain issues, schedule a separate meeting at another time to discuss the special items. Generally, the person in constant contact with all field personnel should chair the meetings.

The meeting leader must:

- Follow the agenda
- Start the meeting on time
- End the meeting as soon as possible
- Keep the discussion to the topic for which the meeting is intended
- Cut the meeting short, if required
- Prepare and distribute the minutes

If the meeting is too long, people may not attend the next one, which is often a hint of decay in jobsite organization. Meetings can be an efficient means to disseminate information, raise issues, and resolve concerns, as long as they are properly managed.

The primary task of the meeting leader is to handle the mechanics of the meeting and mediate the personalities involved so that the meeting remains a productive instrument for solving problems. Never harass, embarrass, or reprimand anyone at a meeting.

Meeting Agendas

All meetings proceed more smoothly if they have an agenda and the agenda is followed. Even single-purpose meetings will proceed in a more logical manner if they have definite, guided direction. The primary purpose of an agenda is to let meeting attendees know what will be discussed and in what order. For jobsite meetings, the minutes of the prior meeting can usually serve as an agenda. Discuss the oldest items first and, if possible, put them to rest.

Keep Meetings Short

Meetings should be as short as possible. The following is a guideline for meeting length:

- Working design meetings: 4 hours
- Special meetings: 30 minutes to 1 hour
- Jobsite meetings: 30 minutes to 1 hour

Any meeting that lasts longer than these guidelines tends to become ineffective and boring, and will decrease productivity. Long meetings are usually caused by the following:

- The leader of the meeting does not distribute a written agenda.
- The leader of the meeting lets discussion tangents get out of control.
- The participants in the meeting have not done their homework.

Attendees who come uninformed or unprepared to discuss items on the agenda can cause a meeting to be excessively long. Sometimes there is good reason for taking time to inform people. However, if this happens when it could have been avoided, the meeting leader may choose to stop the meeting and reschedule it for another time in order to give everyone the opportunity to prepare properly. *There is no reason to waste everyone's time.*

Meetings Should Be Specific

Meetings should be held for a specific purpose. If there is a problem over the landscape plans, then a specific meeting should be held to discuss the landscape plans. To avoid nonparticipating members or those expounding outside their areas of expertise, only include people who can contribute to the resolution of the problem for which the meeting was called.

Do not allow the jobsite construction meeting to deteriorate into a design meeting. Call a separate meeting to discuss issues if the need arises. Arrange for the concerned parties to hold a separate meeting at another time.

It is common courtesy to other participants in the meeting to avoid off-topic discussion and to concentrate on areas that relate to their work. Many times someone who does not regularly attend meetings will attend one meeting for a single purpose. If it is not a complicated matter, it should be addressed first and the person leaves the meeting. The length of a meeting has a

tendency to increase exponentially based on the number of persons attending. Therefore, it pays to:

- Review the list of attendees and weed out those who need not attend.
- Not allow attendees to discuss matters with which they are not directly involved.

Meeting Minutes

However tedious the process, keeping and distributing minutes of all meetings is an important task. The format of the meeting minutes is less significant than the minutes being published and distributed. Because information is critical to the success of a construction project, every communication vehicle available must be used. The minutes of the various meetings provide an excellent way to inform not only the people who attended the meeting, but everyone involved in the project.

The minutes of construction meetings provide substance and accountability for the items discussed. They should be considered a construction document and are considered a legal document, which should be noted to the participants. Well-documented minutes can greatly benefit the management of the project.

It is difficult to chair a meeting and keep accurate minutes at the same time. It is much better to have someone else in your company keep the minutes. However, you must assign the task to someone who will understand the conversations that occur. Minutes prepared by a clerk, project engineer, or someone else should be reviewed in draft form before they are issued.

Although difficult to manage, in some cases it is advantageous for the meeting organizer to keep the minutes for the following reasons:

- The minutes from prior meetings can be used as the agenda. This makes it easier to keep notes in the proper order.
- If the record of the meeting needs interpretation, the organizer (or chair) maintains control of that interpretation.
- The organizer becomes better prepared for the upcoming meeting while preparing the agenda and reviewing the minutes from the past meeting.

Although preparation and circulation of the minutes takes time, distribution must be reasonably prompt. If there is a jobsite meeting every week, then the minutes of each meeting should be prepared and distributed before the next meeting is held.

Veracity in Reporting

All reporting is, to some degree, biased. Everyone sees the item in question from a different perspective. If the person preparing the minutes leaves out some important items that were discussed, the veracity of the minutes is compromised. In this case, the validity of the minutes

as a contract or construction document is jeopardized. Presenting the complete facts is essential, even if it means that some individuals may be seen in a negative light. It is in the best interests of all for the minutes to maintain objectivity and therefore credibility.

Construction Conferences

Construction conferences are meetings called by the project owner or the prime contractor to discuss aspects or phases of work of interest to all trades on the job. Some meetings, like pre-bid, pre-construction and regular job conferences, are standard practice on almost all projects. Others are called to discuss items or resolve problems such as:

- Substitution of materials or products
- Change orders and extra work
- Unforeseen work
- Corrective work
- Scheduling changes
- Mediation of construction difficulties
- Protests and disputes
- Conflicts in plans and specifications
- Value engineering proposals
- Safety hazards
- Punch lists
- Project acceptance and transfer of responsibility

Pre-Construction Planning Meetings

The Pre-Construction Planning Meeting is a general meeting of all the major parties on the project. It is held after the major subcontracts have been awarded and prior to beginning actual construction. The participants are the:

- Project owner
- Architect/engineer
- Prime contractor
- Subcontractors and their superintendents

- Key suppliers
- Public agency representatives, if necessary

The purpose of the Pre-Construction Planning Meeting is to establish acceptable ground rules for all parties on the project so that everyone knows ahead of time what is expected of them. It is an effort that requires several hours or several days, depending on the size and complexity of the project.

A typical agenda for a Pre-Construction Planning Meeting includes the following items:

- How progress payments will be made
- Format of payment requests
- Payroll reports (Davis-Bacon Act provisions)
- Shop drawing and submittal data requirements
- Required insurance and permits
- Project schedule
- Temporary facilities
- Temporary utilities
- Storage facilities
- Clean-up and trash removal
- Material handling equipment and facilities
- Change order procedures
- Employment practices
- Listing and identification of subcontractors
- Punch list procedures
- As-built drawings
- Final payment and retainage
- Scheduling of regular job meetings

For the Pre-Construction Planning Meeting and all other conferences held during the course of the job, you as the Project Manager are responsible for:

- Being prepared to discuss your company's requirements and opinions regarding everything on the agenda.
- Conducting yourself in a way that enhances your image and that of your company and wins the project team advantages in the project effort.

Pre-Construction Planning Meetings are discussed in further depth in [Section 8: "Turnover/Kickoff and Pre-Construction Planning Meetings."](#)

It cannot be stressed enough how important it is for the Project Manager to be fully informed about his company's positions on specific items and to be able to report accurately on the progress of the mechanical work. Your command of the facts demonstrates professionalism and helps assert leadership at each conference.

SECTION 18: STAFFING

The Importance of People

A construction project is a thoroughly human activity. It is designed by people, built by people, and managed by people. It provides employment for individuals and profits for companies, and in the end, gives the people of the community a facility to use in their daily lives.

At every step, the success of a project lies with the people involved in it. Nothing happens by sheer accident. If something goes right, it is because the people responsible made it right. If something goes wrong, it is because somewhere along the line someone or some group made a mistake.

Consequently, for the contractor to perform their part in a construction project and earn the maximum fair profit, senior management have to fill the company with people who have the knowledge, skills, tools, and attitudes to make things go right. When it comes to staffing a project, the Project Manager has the same requirements. It is the starting point for success.

The Goals of Staffing

The goals of staffing a project team are identical to the goals involved in creating a successful sports team:

- Assign the right number of players to the job so that every position is filled.
- Assign each player to the position he plays best.
- Assign responsibilities to each person on the basis of combined knowledge, skills, abilities, and attitude.
- Design the team so that each person's weakness is balanced by another's strength; aim for a group whose individual skills complement one another.
- Create a real team where people think and work well together; avoid a group where one superstar dominates and everyone else is secondary.

If a Project Manager had a blank check and the freedom to choose his team members from anywhere in the construction industry, he would have little problem putting together a team that fulfilled these criteria. An all-star team could be assembled specifically for each project. Unfortunately, this is the real world, and like a professional sports coach, the Project Manager must create the best team possible given the resources and people who are available. This sometimes makes staffing a difficult job.

Staffing In the Real World

Take, for example, a situation where the company is about to start a \$400,000 job in a local hospital. The project includes working in active areas of the building—near operating rooms

and an intensive care unit—so strict control of dust, fumes, noise, and traffic is essential. Hospital utility service cannot be interrupted except for short periods at odd hours. Access to many areas is restricted. The hospital had a bad experience with the mechanical contractor on the last construction project, and the general contractor has a reputation as difficult to get along with.

The company has a terrific foreman with lots of hospital experience, but he is tied up on another project for the next eight months. There is another person who is fairly well qualified for this kind of job and had a proven track record. However he and the general contractor do not get along. The only other available foreman is a new person who has supervised only two small jobs. However she is a quick study, she listens, and gets along well with everyone—except the company's purchasing agent.

This example probably is not too far from the type of staffing decisions you and your company face regularly, and it points out the kinds of dilemmas that can make staffing so difficult—a dilemma complicated by the fact that \$400,000 and months of work hang on your decision.

Keep in mind that staffing goes far beyond the job supervisor or foreman positions. In some cases it includes warehouse supervisors, shop foremen, onsite administrative personnel, and home office support to manage scheduling, estimating, payroll, accounting, correspondence, and purchasing.

A Set of Proven Procedures

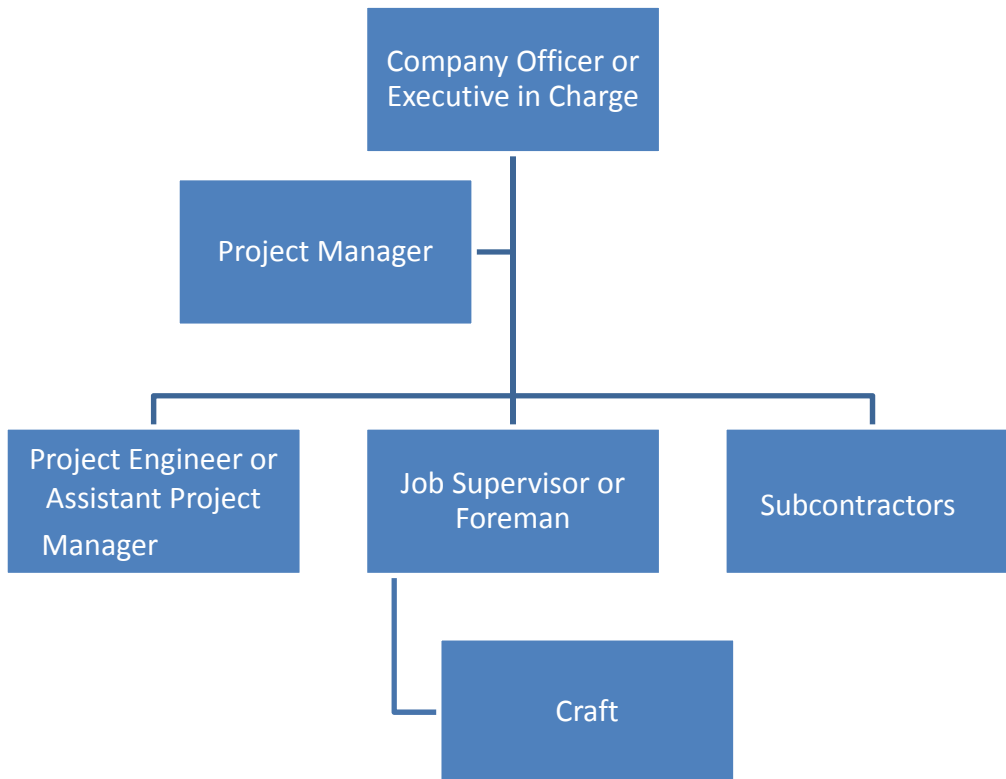
The best approach to staffing is to establish and follow a set procedure. Among many contracting companies, the procedure, that has brought the most success to staffing project teams looks like this:

- Create a chart that shows all of the functions the project team must perform in order to manage the job successfully.
- Using the chart as a guideline, develop a project team organization chart that assigns specific functions to individual team members.
- Review a combination of the knowledge, skills, abilities and attitudes of the individual team members and assign responsibilities that match capabilities.
- If necessary, modify the organization chart. Assure all functions are covered by the most capable person.
- Assign specific responsibilities and authority to each team member.

You will notice that the above procedure starts by identifying functions to be performed and then assigns those functions to people. This process assures all responsibilities will be covered with the most competent person available performing those duties. This process is best done as part of Pre-Construction Planning.

Project Organization

Once you understand who is going to do what, you should consider how the hierarchy of the project will be established. This chain of command may be different for each project and will certainly be different for each company. However, it is important that people know who they are accountable to and who is accountable to them. This hierarchy also establishes necessary lines of communication. Even if very informal, this chain of command must be communicated and understood by everyone on the project team. The chart below is just one of the many ways a project chain of command could be organized. It is not meant to be the only answer, but to give you an idea of how your project chain of command chart *may* look. For some companies the job supervisor or foreman reports to a superintendent and the subcontractors report to the foreman. What is important is that everyone understands their specific responsibilities and authority.



Job Descriptions

On larger projects where many company personnel are involved, it may be of some advantage for the Project Manager to design job descriptions for each position in the project team. Some individuals and companies resist writing job descriptions because they fear employees may hide behind them, refusing or resisting work that is not in the description. Common practice proves otherwise. Job descriptions give people parameters and guidelines. They understand what they are accountable for. If your company has people you think may hide behind a job description, perhaps they are the wrong person for your organization. Anyone who works in the

construction business understands that everyone must do things that are “not their job” on occasion. This is because of the dynamic nature of the business.

Job descriptions also give management and owners of companies a tool for performance evaluations, provide a description of the position in the event it needs to be filled, and gives potential candidates a clear picture of the expectations of the position.

What makes up a good job description?

- Specific task(s) to be performed
- Detailed work procedures
- A statement of who the position reports to
- A statement of subordinates, if any
- A list of personnel from whom the person will receive directions
- A definition of job responsibilities

Making Adjustments

After all of the staffing assignments have been completed, you will likely find that some adjustments need to be made. Some people will just not fit where you put them. Some people will show capacity for more responsibility, and some will show they are not capable of doing what you thought they could. Just like everything in life, making adjustments is part of what you do.

If you find yourself redistributing responsibilities, be sure that functions are not left out and that the new arrangement is communicated to everyone on the team.

Responsibility and Authority

Responsibility and authority go hand-in-hand. Responsibility gives an individual a goal; authority gives him or her means for achieving that goal. There is nothing more frustrating than having responsibilities and lacking the authority to get those tasks done. A team member may be unable to do the job or could be forced to go through so much red tape to get authorization to act that enthusiasm quickly goes away and frustration sets in.

A company's performance is only as good as the people working together to achieve success. As a Project Manager, one of your responsibilities is to lead and motivate individuals and teams to high performance. This is accomplished by clear communication, setting of expectations, and accountability. Once you have laid that groundwork, all you need do is make sure your people have the resources to do their job and get out of the way so they can do it!

SECTION 19: VEHICLES

Managing Company Vehicles

The project team must control the use of company vehicles to assure that each vehicle is available when needed, maintained in good condition, protected from abuse and operated only by authorized personnel. Vehicle liability and damage insurance policies specifically state the conditions for use of company vehicles, which are aimed at preventing personal injury and vehicle or property damage. Your company's policies should be designed to enforce those conditions.

It is your responsibility to enforce your company's policies pertaining to vehicles assigned to your project, particularly those regarding personal use of company vehicles and use restrictions due to insurance concerns. To do this, you must be familiar with those policies. You should also make them clear to everyone on the project and make sure that the project team enforces them.

You should implement the following control policies:

- Develop a training log and sign-off sheet for each company vehicle that requires special training or operating procedures.
- Maintain copies of insurance coverage for each vehicle assigned to the project.
- Document vehicles used on time and material or cost-plus projects.
- Ensure that vehicles are regularly cleaned and made ready for work.

Finally, insist that everyone responsible for company vehicles follows proper maintenance procedures. Vehicle maintenance is easy to overlook on a project where so many other details demand attention. However, vehicles are valuable company assets, and caring for them properly helps minimize operating costs and can prolong the life of those vehicles. In addition, a clean, well-maintained fleet projects a positive image of your company.

SECTION 20: PRODUCTIVITY

Productivity is, “The degree of effectiveness of industrial management in utilizing ...labor and equipment.”¹⁴ This definition pins responsibility for productivity squarely on management. Many contractors do not realize the first level of management is the field foreman. Without the commitment and understanding of the field foreman, productivity cannot be significantly improved. Productivity is a direct expression of the effectiveness of the management team. It is a resource just as capable of being managed effectively (or ineffectively) as are materials, equipment, schedules, subcontractors, and all the other resources of the project.

Productivity and Profits

To be consistently profitable, contractors must manage labor productivity. Labor is the primary risk on almost every project. The high cost of each labor hour (see [Section 6: “Other Direct Job Costs and Labor Burden”](#) for a detailed discussion of the labor hour cost) requires that the jobsite team focus on maximizing the effectiveness of each jobsite worker. The only difference between productivity and profitability is the way they are spelled.

Basic Elements of Productivity Management

Most of what is involved in good productivity management is common sense. It all comes down to your ability to manage and coordinate the basic resources of the project, namely:

- People
- Materials
- Facilities
- Tools and equipment
- Energy and motivation
- Information

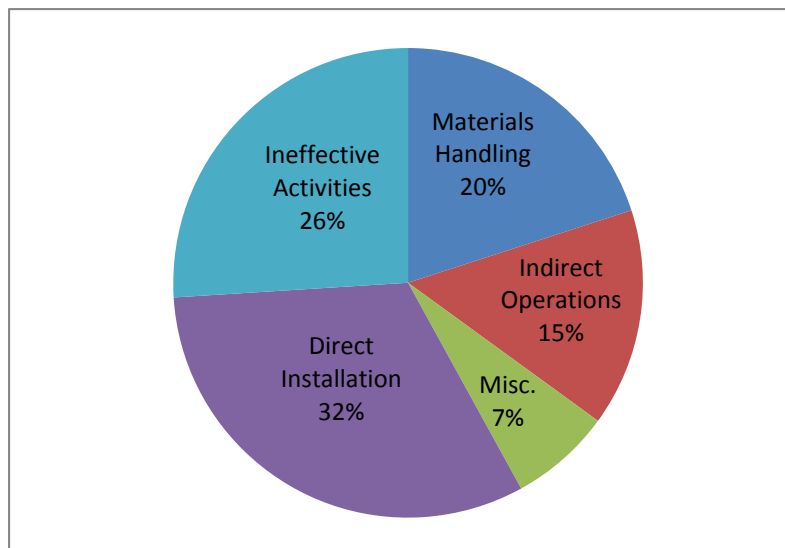
Breakdown of Daily Work Activities

Contractors and owners seeking to improve jobsite productivity have done many studies defining activities and measuring jobsite outputs and inputs. The following table breaks the typical jobsite into specific categories.

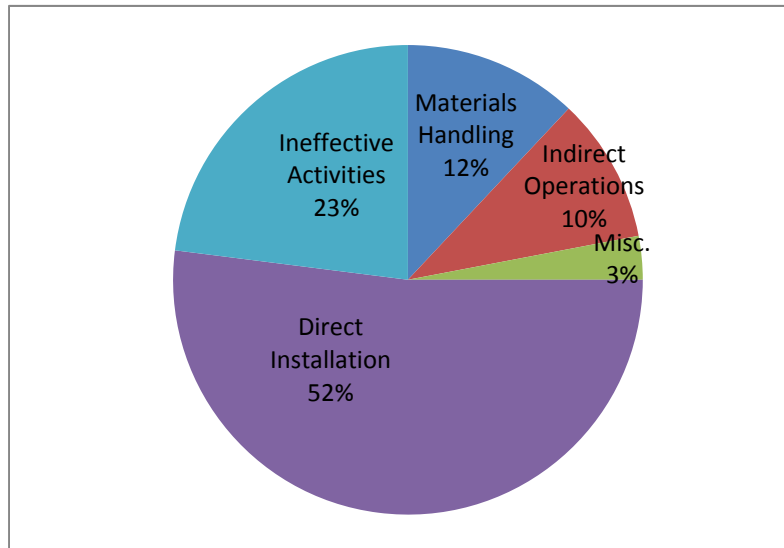
¹⁴ Webster's Third New International Dictionary.

DIRECT INSTALLATION	<ul style="list-style-type: none">• Actual Direct Installation• Onsite Fabrication• Testing Operations
INDIRECT OPERATIONS	<ul style="list-style-type: none">• Set-Up Operations• Talk About Project• Receive Instructions• Planning Project• Tools – Get Out, Set Up, Put Away
MATERIALS HANDLING	<ul style="list-style-type: none">• Unload Truck• Hoisting• Move Materials and Tools to Installation Area
INEFFECTIVE ACTIVITIES	<ul style="list-style-type: none">• Late Start, Early Finish• Early Lunch, Late Return• Coffee Breaks• Other Rest Periods
MISCELLANEOUS	<ul style="list-style-type: none">• Get Coffee for Crew• Other

Studies on industrial, commercial, and institutional projects indicate that productivity is similar on each. The following pie chart graphically shows productivity for the typical day.



Recognizing the need for improved productivity, some contractors have implemented aggressive fabrication policies, improved jobsite logistics, logically sequenced construction schedules, jobsite incentive programs, and productivity feedback systems. Significant jobsite productivity is the result as shown on the following pie chart.



Direct installation increased from an average of 32 percent to an average of 52 percent—a 63 percent improvement in productivity.

A significant improvement in productivity can be achieved when management takes responsibility for making that improvement possible. Leadership of the field foreman is imperative. Recognizing the possible improvement also helps the contractor understand how jobsite labor productivity can be so significantly impacted. On the typical jobsite where 2.5 hours of direct operations are done each day, a 30 minute impact to productivity becomes a $0.5/2.5=20$ percent impact to production. Such an impact results in a 20 percent labor cost increase which may exceed the contractor's gross margin on the project.

Measuring Productivity

There are many techniques for measuring productivity on the jobsite. Contractors and owners have used time-and-motion studies, work sampling, videotape analysis, units/day, etc. All of these techniques require independent observation and quantification. Some contractors have used these techniques successfully and are disciplined to use them on their challenging projects. Acceptance of these methods by the field forces has often been problematic.

Other contractors have adopted field productivity measurement systems that depend on labor loaded jobsite activities. The system is put in place so that the data is collected when the foreman fills out jobsite time tickets. Characteristics of these labor-loaded jobsite activities include the following:

- The activity is a logical part of the construction sequence

- The foreman understands the activity and the scope of work
- Time duration is ideally 3 – 22 days
- Crew size can be controlled by one foreman
- The activity is defined by specific geographic or contract boundaries
- Where appropriate, the activity is defined by mechanical system
- The job activity is consistent with the accounting system
- The same coding system is used on each jobsite to permit comparisons between jobs and to minimize confusion for the foreman
- Activities are compatible with the labor scheduling software
- The same labor coding is used in estimating, planning, Short Interval Planning, manpower loading charts, and the job cost system

Using labor loaded jobsite activities allows the team to gather productivity measurements in the accounting system. Is the activity indicating an accurate estimate, performance below estimate, or that the activity will exceed the estimated cost? When this system is consistently used it allows the following:

- Feedback to estimating in a form they established and understand
- More accurate labor reporting since the activities are a logical part of the construction sequence and foreman thus understand them and are able to accurately input the labor data
- Activities become the basis for the manpower loading chart
- Activities are used and identified in the short-interval planning process
- By establishing change order cost codes, the contractor can often track the cost of individual change orders and field directives
- The contractor can track and document labor impacts by individual areas of the project
- The data can be used as the basis for a Measured Mile Analysis (see [Section 36: "Claims"](#) for a more detailed discussion)

Tracking field productivity is imperative if the contractor is to manage the risks of contracting. Using the mantra "What gets measured, gets improved" will drive the jobsite team to collect accurate data and manage the project to a successful completion.

Factors that Affect Productivity

Enhancing the team's productivity relies on the Project Manager's ability to recognize factors that contribute to and factors that hinder productive work. The most successful contractors develop a culture that expects to make every estimate. The attitude becomes a self-fulfilling prophecy. The company sells the project at market price and the project team, through creativity and commitment, performs the work and redeems the estimate.

Factors that Improve Productivity

Among the factors that stimulate productivity are:

- Short Interval Planning
- Innovative materials and equipment
- Fabrication of all possible components
- Good, effective supervision
- Good relationship among members of the team
- Computerization/standardization of business and engineering activities
- Worker motivation programs (including feedback, recognition, and rewards)
- Constructability review of design
- Positive morale on the jobsite
- Effective pre-construction planning of activities
- Safety programs and incentives
- Standard purchasing practices
- Competition between crews, areas, or shifts
- Incentives in the contract
- Effective utilization of subcontractors
- Challenge of maintaining job schedule and job budget
- Optimizing site facilities
- Favorable working conditions

- Clear, understandable project requirements and drawings
- Availability of tools, materials, and equipment
- Good communication and reliable information
- Participation of all workers in decision-making
- Aggressive but realistic project schedule
- Pride in workmanship
- Opportunities to learn

Some of these factors are within the control of the jobsite team. All of them can be affected by a proactive team.

Factors that Adversely Impact Productivity

Among the factors that hinder productivity are:

- Overtime and/or fatigue
- Errors and/or omissions in plans and specifications
- Multitude of change orders
- Management/labor relations problems
- Lack of design completeness
- Stacking of trades
- Dilution of supervision
- Reassignment of workers from task to task
- Material location (i.e., height above work level, tight tunnel, deep ditch, etc.)
- Adverse temperature or weather
- Learning curve
- Morale and attitude
- High absenteeism or high turnover rate
- Material, tools, and equipment shortages

- High accident rate/unsafe working conditions
- Jurisdictional disputes
- Work rules and restrictive work practices
- Unavailability of skilled labor
- Crew size and composition
- Economic conditions and level of unemployment or employment
- Size and duration of project
- Timeliness of decision making
- Impractical Quality Assurance/Quality Control (QA/QC) tolerances
- Uncontrolled breaks
- Beneficial and/or joint occupancy
- Inadequate temporary facilities (lighting, parking, changing rooms, restrooms, etc.)
- Weak leadership
- Weak support system (warehouse, tool room, personnel department, etc.)
- Unreasonable schedule
- Suppression of innovation
- Lack of reliable information
- Poor communications
- Unnecessary paperwork
- Poor planning and scheduling
- Inaccurate feedback
- Personality conflicts
- Sloppy workmanship
- Repetitious and uninteresting work

- Dirty, cluttered work area
- Poor coordination of trades by prime contractor

As with the list of positive factors, this list is incomplete. There are other factors that positively and negatively affect productivity.

Identifying Productivity Opportunities

Improving productivity requires the project team to identify project operations and activities that offer opportunities for improvement and then focus the necessary resources to drive improvement. Two general guidelines can be used to identify opportunities:

- It is easiest to implement improvements in operations that are already ahead of schedule and under budget.
- It is easiest to identify areas for improvement in operations that are based on short cycles and small crews and involve many repetitious tasks.

The Short Interval Planning process has been proven to significantly improve productivity because it provides an ongoing structure for identifying short-cycle tasks, brainstorming approaches to current problems, implementing experimental solutions for brief periods, quickly evaluating results, and providing positive feedback to the team. The Lean¹⁵ construction process builds on Short Interval Planning by changing the typical jobsite push process to a foreman- driven pull process.

Once you've identified productivity opportunities, put the project team to work on exploring ways to take advantage of them. This involves a cooperative effort to:

- Acknowledge that opportunities exist
- Gather facts related to each opportunity
- Interpret the facts
- State the objective you want to accomplish
- List your alternatives for accomplishing your objective
- Select the best alternative

¹⁵ Lean Construction is a relatively new "management system" that focuses on the foreman "pulling" the material to the job on an as-needed basis as opposed to a more traditional system of the project manager "pushing" the materials to the job.

- Develop and initiate a step-by-step plan of action
- Follow up to gather data and evaluate how successfully your project team took advantage of the opportunity

Here again, the short interval planning process is the ideal forum for discussing ways to improve productivity. It regularly brings together all the key players on the project team and provides short-cycle planning and evaluation.

Dealing with Resistance to Change

Improving productivity usually requires changing policies, procedures, and/or work methods. Naturally, this stirs resistance, especially among workers who are accustomed to a particular way of working. Fabrication and computers are cases in point. Both offer tremendous advantages, yet their initial introduction into the construction industry bred tremendous resistance.

To overcome worker resistance, the Project Manager and foreman must understand what fuels the resistance. Primarily, there are five reasons that a person resists change:

- *Rational opposition* – a valid, logical reason for believing that the proposed change is either unnecessary or will be ineffective
- *Emotional reaction* – an unfounded but deeply felt aversion to change
- *Selfish desires* – motives that conflict with the objective of the proposed change
- *Insecurity (fear)* – the basis of most resistance to change
- *Economic impact* – a belief that the change will adversely influence earnings or job security

If the proposed change is clearly thought out, the Project Manager and foreman can overcome resistance to change by:

- Deciding from the start what is to change and what is *not* to change
- Anticipating the most probable causes of resistance
- Planning a strategy to remove the most probable causes of resistance
- Explaining to everyone involved what will change, what will not change, and why the change is needed
- Providing the training necessary to make everyone comfortable with the change
- Testing the change on a small scale before fully implementing it

- Encouraging worker comments, criticisms, and suggestions (feedback)
- Being sensitive to feedback and using it to modify the change as necessary

Keep in mind that people adopt new ideas all the time. The ideas they adopt tend to be those which they understand, which hold personal interest for them, and which enhance their lives in some way. These facts should be considered when designing or explaining any change aimed at improving productivity.

Specific Steps for Productivity Improvement

There are certain steps the Project Manager and foreman can take to improve productivity on almost any job. They include:

- Setting and maintaining the pace of the job
- Loading the workforce properly
- Strengthening the project's support system

Set the Pace of the Project

Once work begins, the crews adjust to the jobsite, learning curves flatten out, and the job settles into a routine. The Project Manager can help set and maintain this pace by:

- Establishing a schedule that is realistic but challenging
- Ensuring that the flow of necessary tools, construction equipment, materials, and equipment to be installed keeps pace with the schedule
- Monitoring job progress via a Three Week Look Ahead Schedule to identify and remove any obstacles that hinder maintaining the pace

For a more detailed discussion of pacing the project see [Section 15: "Job Cost and Labor Control,"](#) [Section 24: "Jobsite and Project Organization,"](#) and [Section 33: "Scheduling."](#)

Man the Job Properly

Under-manning or over-manning any stage of a project can throw off the pace of the job and the synchronization between the jobsite and the shop, the warehouse, the tool room and the purchasing agent. When too few workers are on the job, the project slips behind schedule and deliveries of materials and equipment stack up. The effects of having too many workers on the job are just as serious, although not as obvious. They include:

- Foremen and job supervisors spending time finding "busy work" for idle workers
- Idle workers trying to find ways to "look busy"

- Inaccurate or exaggerated data on labor reports
- Inappropriate unit rates that affect the forecast of the job outcome and the historical data the company uses to bid future jobs
- Pressure to trim overhead by reducing the project's support teams

Consistent use of Short Interval Planning (see [Section 34: "Short Interval Planning"](#)) allows the project team to schedule proper crew sizes, identify the most productive crews, adjust manpower when the plan changes, and create a productive culture. The best projects will have a "controlled sense of urgency."

Use Less Skilled Labor to Reduce Crew Cost

Many project teams focus on reducing manhours on the jobsite while ignoring the cost of each manhour. The attitude is that the collective bargaining agreement drives manning levels and local union leadership often demands control of the labor mix. Many local areas have adopted less skilled labor classifications in an effort to further reduce crew costs. These classifications include pre-apprentices, helpers, applicants, class B journeymen, technicians, etc. The challenge for the project team is to develop an effective strategy to use the less skilled labor.

In the past, a strength of the union movement has been training of the individual craftsman through the apprenticeship program. The best craftsmen would train the best apprentices. The most cost effective crew on a project has been the best craftsman with the best apprentice. If the cost of the journeyman is approximately \$60/hour (See [Section 6: "Other Direct Job Costs and Labor Burden"](#) for a discussion of the cost of a labor manhour) and the cost of an apprentice is \$40/hour, their crew cost is $\$60 + \$40 = \$100 / 2 = \$50/\text{hour}$. Their cost per unit of output is \$50 versus the cost of two journeymen at \$60. That is a 17 percent reduction in cost per unit of output. $(50/60 = 83 \text{ percent})$ $100 \text{ percent} - 83 \text{ percent} = 17 \text{ percent lower cost}$.

Effective use of apprentices on jobsites reduces labor cost. Effective use of less skilled labor can further reduce cost per labor hour. The following two tables graphically show the reduction in crew costs that are possible.

LABOR RATE	Quantity	8/1/09-7/31/10	
Local 72 Pipefitters			
General Foreman		32.40	
Foreman		31.15	
Crew Foreman	1	30.40	30.40
Journeyman	1	28.90	28.90
Apprentice (5th 27 wk period) + 1.00	1	18.90	18.90
Journeyman Fringes	2	12.91	25.82
Apprentice Fringes	1	9.00	9.00
Helper	1	11.40	11.40
Fringes	1	2.02	2.02
A Tradesman		19.07	
B Tradesman		13.20	
Fringes		3.25	
Total	4	Average Rate	31.61

LABOR RATE	Quantity	8/1/09-7/31/10	
Local 72 Pipefitters			
General Foreman		32.40	
Foreman		31.15	
Crew Foreman	1	30.40	30.40
Journeyman	1	28.90	28.90
Apprentice (5th 27 wk period) + 1.00		18.90	
Journeyman Fringes	2	12.91	25.82
Apprentice Fringes		9.00	
Helper		11.40	
Fringes		2.02	
A Tradesman		19.07	
B Tradesman		13.20	
Fringes		3.25	
Total	2	Average Rate	42.56

If the two crews were equally productive, the labor cost would be reduced \$11 or a cost reduction of $\$11/\$42=26$ percent. The challenge for the project team is to make the less skilled crew as productive as possible. Depending on the task, the training of the less skilled worker, and the commitment of field labor to using less skilled workers, actual productivity can become comparable.

Strengthen the Support System

The jobsite is supported by a number of essential support groups within the company, particularly personnel responsible for:

- Safety programs
- Tools and construction equipment

- Warehousing
- Fabrication
- Personnel operations
- Engineering, planning, and coordination
- Purchasing
- Accounting and payroll

The relationships between the jobsite and each of these groups, and among the groups themselves, have a profound effect on project productivity. If communications are open and steady, and if each group is committed to the project and feels confident that the other groups will each do their share, the entire project moves forward without hesitation. When one or more groups become bottlenecks, doubts arise and conflicts erupt. The flow of information and resources becomes erratic. Eventually, morale declines and job gross margin is lost.

To establish and strengthen the jobsite's support system, the Project Manager must establish a "team" identity among all the groups associated with the project. He must include each of them in the planning and implementation of policies and procedures, share information on project progress and problems, invite their feedback, and act on it. He must identify potential problems early and resolve them before they disrupt project operations. He must reinforce each group's efforts with recognition and rewards and avoid giving any one group, even the field crews, all of the credit for any job done well, or all of the blame for a job done unsatisfactorily.

Productivity and profitability are inseparable. Neither can be on the rise if the other is on the decline. Enhancing productivity is largely a matter of establishing procedures and work methods that fit the job and modifying them as necessary. It is also a matter of being sensitive to the fact that everyone on the project team, from the journeyman apprentice to the CEO, is a person who wants to do the job well and takes immense satisfaction from being on a team that does its job well.

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin OT 1, "How Much Does Overtime Really Cost?"
 - Bulletin OT 2, "Shift Work and Its Effects on Productivity"
 - Bulletin PD 1, "Maintaining Control of Labor Productivity"
 - Bulletin PD2, "Factors Affecting Labor Productivity"
- *Change Orders, Productivity, Overtime: A Primer for the Construction Industry*

SECTION 21: SAFETY MANAGEMENT

Safety management is a fundamental part of every successful project. To be profitable, each project must establish a viable safety culture and safe work practices that are effective, practical, and easily implemented by the workforce. The emphasis must be on injury prevention and controlling the other losses associated with project safety and health, including regulatory loss control. The best Project Managers make effective safety management a high priority on every project.

Profitability of Safety

There are a number of reasons why sound project safety management practices result in increased profit. They range from reduced insurance costs to increased productivity. The most effective project managers understand the following basic concepts regarding the profitability of safety.

Experience Modification Rates (EMR) – The EMR is a multiplier used to calculate workers' compensation (WC) premiums. The lower the WC injury costs, the lower the EMR. The lower the EMR, the lower the WC premium. A good EMR can save a company hundreds of thousands of dollars each year. To control your EMR you must prevent as many injuries as possible, and properly manage all workers' compensation claims. EMR is discussed further in [Section 7: "Understanding Bonds and Insurance."](#)

Indirect Costs – Indirect costs are the accident costs that are not covered by workers' compensation insurance. The indirect costs range from two to 20 times more than the costs that are covered by workers' compensation insurance. Indirect costs include injured worker costs, crew of the injured worker costs, crews in the vicinity of the injured worker costs, replacement worker costs, supervisory and administrative costs, damaged property costs, and impact costs.

Construction Owners/General Contractors/Construction Managers – Construction owners, general contractors, and construction managers are becoming increasingly selective about the contractors they are willing to hire. They often look at EMRs, injury incidence rates, and past OSHA citations to determine whether a contractor candidate is safe enough to work for them. With increasing frequency, companies with high EMRs, high injury incidence rates, and/or a history of OSHA citations are becoming ineligible to bid on projects.

Pre-Construction and Pre-Task Safety and Health Planning

Long before a project begins, a tremendous amount of planning is done by all affected parties. Safety should always be a major part of the regular planning processes. Once a project begins, the inclusion of safety in the planning for each potentially hazardous task will prevent injuries and reduce losses.

Pre-Construction Planning

Meet with your workers to establish a safety goal of zero injuries on the project. To have a goal other than zero sends the message that even a single injury is acceptable. If an injury occurs, deal with it accordingly, but continue to strive for zero from that point forward.

Ensure that project hazard identification is performed to identify any potentially hazardous tasks within your company's scope of work. A Potentially Hazardous Task is any upcoming task that presents a substantial probability of death or serious physical harm without appropriate safety or health protective measures. Establish and document a methodical project hazard identification process. Record a brief description of each potentially hazardous task.

Develop a project-specific safety plan to properly address the potentially hazardous tasks that were identified during the hazard identification process.

Establish a safety and health training plan, including a training schedule for all of your company's workers and supervisors. Be sure to include:

- Project-specific safety and health orientation
- Introduction and descriptions of the potentially hazardous tasks
- Identification of, and corresponding protective measures for, the most common trade-specific safety and health hazards
- Project emergency response procedures

Pre-Task Planning

Ensure that a methodical and carefully documented task hazard analysis is performed for each potentially hazardous task before work on the task begins.

Identify the individual who will supervise the work, and the workers who will perform it.

Inform the affected supervisor and workers about the task hazard analysis and require them to participate in the process.

Task Hazard Analysis Guidelines

Perform the task hazard analysis as close to the task's start-up time as possible and determine whether a permit such as a confined space entry permit, or hot work permit is necessary for worker protection.

Identify construction methods and/or control measures to eliminate or control the risks.

Also, identify the safety and health equipment and materials needed to perform the task safely.

Establish safe task procedures and provide task-specific safety and health training for all affected workers. Ensure the availability of safety and health equipment needed for the task.

Ensure that a qualified safety professional or competent person participates when a task is potentially hazardous enough to warrant it, such as tasks that require confined space entry, critical lifts, excavations, demolition, etc.

Perform a pre-task briefing immediately prior to the start of the task to remind affected workers about the hazards and go over the safe task procedures.

Task Hazard Analysis procedures include:

- Refer to the descriptions of each potentially hazardous task that will affect workers on the project.
- Break each task down into specific steps and record them as follows:
 - Record enough steps to accurately identify the potential hazards, but record the fewest number of steps possible
 - Number each step in the sequence in which it will occur
 - Anticipate and record everything workers must do to successfully complete the task
 - Record any anticipated deviations from standard operating procedures
 - While recording the steps, describe the beginning of each individual step with an action verb such as “*climbs* the ladder” or “*enters* the confined space”
 - Include the workers who will be performing the task in the process so important steps are not omitted
- Using the information recorded from breaking the task down into steps, identify and record all procedure-based and environmental hazards by considering several questions about each individual step such as the following:
 - Could a worker fall six feet or more to a lower level?
 - Could a worker be struck by an object?
 - Could a worker get caught up in an excavation cave-in?
 - Could a worker become exposed to an energized electrical conductor?
 - Could a worker become overexposed to a harmful chemical, harmful noise level, or some other health-related hazard?
 - Has a typical task become non-typical due to unexpected occurrences, such as an equipment breakdown, weather conditions, changes in the project-specific safety plan, etc.?
- Develop and record a safe work procedure for each task by:
 - Identifying the best way to perform the task safely and effectively
 - Identifying a way to change the physical conditions of the task

- Identifying an effective way to change the work procedure
- Identifying a way to reduce the frequency of exposure
- Include each affected worker in the safe work procedure development process.
- Where unusual or unfamiliar steps are required to complete a task, train each affected worker how to perform the task safely and efficiently. Ensure workers have a thorough understanding about the safe work procedures developed for the task.
- Just before the task begins, bring all affected workers and job supervisors or foremen together for a pre-task briefing to:
 - Review the hazards identified in the task hazard analysis
 - Review the established safe work procedures
 - Determine whether any changes to the procedures are needed due to changes in scheduling, weather conditions, or any other pertinent factors
 - Account for all of the necessary tools and/or equipment established in the procedures
- Account for all of the necessary personal protective equipment established in the procedures
- Provide each affected worker with a sign-off sheet that indicates that they know the hazards associated with the task and understand how they are to protect themselves from the hazards
- Collect and file the completed sign-off sheets

[“Pre-Project Safety Checklist” \(Figure 21.1\)](#) will assist you in Pre-Construction Planning.

Address the Most Frequently Occurring Industry-Specific Hazards

Establish, implement, and enforce safe work rules for your project based on the most frequently occurring mechanical industry hazards as shown below.

Manual Handling of Materials

One of our industry's most frequently occurring hazards involves the improper manual handling of materials. Most of the injury claims in this category involve lower back injury claims. To address this hazard, have the materials delivered as close to each work area as possible. When materials have to be moved, require workers to use materials moving equipment. When materials must be moved by hand, be sure that the workers have been trained in proper lifting techniques and require their use. Store materials in the staging areas off the ground at waist level whenever possible to reduce the number of times workers have to bend down to pick up objects. Use mobile tables, pipe racks, stacked pallets, or whatever else is available to reduce the number of times workers have to bend down.

Struck by Objects

In the construction industry as a whole, most of the “struck by objects” hazards involve construction vehicles. However, many of the struck by objects hazards in the mechanical industry involve tools or materials falling from overhead. To address this hazard, ensure that hard hats are worn by all company workers at all times. Make sure that aerial lifts, mobile scaffolds, and guardrail systems have toeboards and, where appropriate, some type of mesh or other material to prevent tools and objects from being accidentally dropped or kicked from an upper level. In places where it is appropriate, have the workers install simple barricades around ladders and other areas where work is being done overhead. This will prevent pedestrian traffic from walking directly underneath the area. Plastic caution tape works well for this application. It is easy to install, is relatively inexpensive, and can be reused.

Falls

Half of all falls from elevations in our industry are falls from ladders. We are still falling from ladders because we are either reaching out too far instead of getting down and moving the ladder, or we are carrying tools or equipment in our hands while climbing up or down the ladders. To address this hazard, constantly remind the workers why we continue to fall from ladders and enforce the company's safety procedures. We are also still experiencing falls from aerial lifts, guardrail systems, and occasionally mobile or other scaffolds. Most of these falls are due to workers stepping up on the mid-rail or top-rail to extend their reach. Occasionally, someone falls from a lift because he failed to latch the gate or chain. To address these hazards, continue to remind the workers why we continue to fall from lifts, guardrail systems, and scaffolds and enforce the company's safety procedures.

Objects in Eyes

Most of these incidents occur when workers fail to wear safety glasses. After surveying several groups of mechanical industry workers, we learned that workers don't like to wear safety glasses for the following reasons:

- The safety glasses don't look cool
- The glasses are uncomfortable
- The glasses fog up under certain conditions
- The side shields block out some of the workers' peripheral vision

The good news is that there are many types of safety glasses out there that address every one of these concerns. The bad news is that they cost a little more. However, the cost of buying slightly more expensive safety glasses is a fraction of the cost of a single eye injury.

Slips and Trips

Most slips and trips from working surfaces are from materials, tools, extension cords, welding hoses, and other objects in the walking and working areas. Good housekeeping is the best

defense against this hazard. Even if you can't control what goes on elsewhere on the project, have your workers pick up their work areas as they work throughout each day.

Vehicle Accidents

Most of the vehicle accidents in our industry involve our vehicles running into the back of other vehicles. Other types of accidents occur with some frequency, too. To address this hazard ensure that driver's records or motor vehicle records (MVRs) have been done on all of the workers who drive company vehicles. Those with poor driving records and/or DUI convictions should not be allowed to drive for the company. Train your drivers to keep safe following distances. Three seconds is considered safe for passenger cars on dry, well maintained roads. However, vans and trucks, especially when they are loaded, will need more time and distance to stop. A safe following distance of up to six seconds may be needed depending on the weight of the vehicle and road conditions. Also, ensure that the maintenance records for the vehicles are reviewed regularly and that the vehicles are properly maintained. Be sure that the drivers are properly licensed and receive vehicle-specific safety training. Ensure that the drivers' MVRs are monitored throughout their employment with the company. Accidents and moving violations that occur during the project should be properly addressed.

Distracted Driving

Distracted driving has emerged as a key issue for mechanical construction and service employers. The high risk of worker injury and increased liability from distracted driving incidents requires our attention. Drivers talking on cell phones, regardless of whether they're using hands free devices, may be looking right at, but often don't see, what's happening ahead of them. This is referred to as *inattention blindness*, which is a little bit like tunnel vision where peripheral vision is lost, but central vision remains. In the state of *inattention blindness* the cognitive distraction from the conversation won't let the brain process everything in the roadway ahead. The bottom line is the human brain is completely incapable of multitasking, which is performing two tasks at exactly the same time. In reality the brain focuses back and forth between tasks including driving and the distracting activity. Since the back and forth focus in the brain occurs very quickly, many drivers incorrectly and dangerously believe that they are safely multitasking. However, the back and forth focus taking place in the brain may take several tenths of a second, which equates to much slower reaction times and much greater distances traveled before being able to stop the vehicle or otherwise react to the situation in the road. Reaction times are even slower when a driver's eyes are not on the road, such as when he is texting or reading a map.

To reduce the risk of vehicle accidents due to distracted driving:

- Ensure that all affected drivers/workers on your projects are trained on the subject of distracted driving.
- Require your workers/drivers to set up a voice mail box to receive their incoming calls and return them when they are not driving.

- In those rare cases when they absolutely can't wait to place a call, require them to pull off the road at a safe place and make the call from there.
- Forbid the practice of texting while driving.

Project Safety Inspections

Fairly frequent project safety inspections can help you determine whether your safety program is being properly implemented and enforced. For a checklist of common mechanical industry hazards, see [**"Site Safety Inspection Form" \(Figure 21.2\)**](#).

Regulatory Loss Control

Loss control is a form of controlling dollar losses. It's logical to incorporate regulatory loss control practices into your projects' safety programs. Take every practical step to control the dollar losses on your projects that are related to regulatory initiatives. The following are some practical steps to regulatory loss control.

Most Frequently Cited OSHA Standards

There are two sets of OSHA standards that may apply to you as a Project Manager. OSHA's Construction Standards obviously apply in most cases. However, OSHA's General Industry Standards supersede its construction standards in general industry settings such as fabrication shops and mechanical service work. It can be very beneficial to keep track of the most frequently cited OSHA standards that apply to your projects. If you are in compliance with the most frequently cited standards, you will be prepared if an OSHA inspection occurs.

OSHA General Duty Clause Citations

Section 5(a)(1) of the Occupational Safety and Health Act of 1970 states, "Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees." This provision allows OSHA to issue citations and fines for anything it perceives to be a "recognized hazard," even when it does not have a standard or regulation that covers the hazard. To make the case that something is a "recognized hazard," the agency usually points to existing voluntary guidelines or voluntary standards such as the ANSI A10 Standards. Be aware of this authority because the incidence of OSHA issuing General Duty Clause citations is rapidly increasing. If you are issued a General Duty Clause citation, consider contesting it. It is very difficult for OSHA to get these citations to stick when employers contest them. However, those that go uncontested will stick automatically, and could result in "willful" or "repeat" citations and exorbitant fines for your company in the future.

OSHA's Competent Person Requirements

Many of OSHA's standards require a *competent person*. OSHA's definition of a competent person is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

This definition is rather vague, which forces Compliance Officers to make extremely subjective decisions about whether a person is competent enough to be designated as the competent person. It's best to designate someone who is experienced and has had formal safety training in the subject area. The designated person must also have the authority to do whatever is necessary to protect the workers, even if that means temporarily shutting down the project. The following OSHA construction standards require the presence of a competent person:

- Accident prevention responsibility
- Ionizing radiation
- Asbestos
- Hearing protection
- Welding and cutting
- Respiratory protection
- Scaffolding
- Slings
- Cranes and derricks
- Electrical
- Material/personnel hoists and elevators
- Fall protection
- Excavations and trenching
- Concrete, concrete forms and shoring
- Requirements for lift slab operations
- Tunnels and shafts, caissons, cofferdams, and compressed air
- Bolting, riveting, fitting up, and planking up
- Underground construction
- Demolition and preparatory operations
- Compressed air

- Lead
- Mechanical demolition
- Ladders

Formal Safety Training Requirements

Many of OSHA's standards require safety training that is specific to the subject of the standards. Don't forget that there are two sets of standards: one set for construction and one set for general industry applications, which apply to fabrication shops and mechanical service work. Identify the standards that apply to your projects and determine whether there are specific training requirements. Only a few of the standards specify a mandatory training duration time. Much of the training can be accomplished in short duration training sessions such as Toolbox Safety Talks. Be sure that you document the completion of each training requirement for each affected worker.

Disciplinary Action Procedures

Make sure that disciplinary action procedures have been established for your project. An example of disciplinary action procedures follows:

- Give a verbal warning for the first offense, but also place documentation describing the infraction in the worker's file.
- The second offense results in a written warning to the worker with a copy placed in his file.
- The third offense results in termination with the appropriate documentation placed in the worker's file.

The most important part of effective disciplinary action procedures is the proof that you are enforcing them. You must have documentation in workers' files to prove that you are enforcing the procedures. If you have that proof, you are well on your way to an affirmative defense against an OSHA citation. You have an affirmative defense if all four of the following apply:

- You can prove with the appropriate documentation that the workers on your project have received the proper safety training.
- You have provided the workers with all of the safety equipment, materials, etc., necessary for them to perform their work safely.
- You have documented disciplinary action procedures in place.
- You can prove with the appropriate documentation that you are regularly enforcing the disciplinary action procedures.

Recordkeeping

Recordkeeping is the recording, and in rare cases the reporting, of occupational injuries or illnesses as required by OSHA. You must record a work-related injury or illness when one or more of the following occur:

- A work-related fatality occurs.
- A work-related injury or illness results in the worker spending days away from work (excluding the day on which the injury or illness occurred).
- A work-related injury or illness results in the worker having work restrictions.
- A work-related injury or illness results in the worker being transferred to another job.
- A work-related injury or illness results in medical treatment beyond first aid. OSHA considers first aid to be any of the following:
 - Use of nonprescription drugs at nonprescription doses
 - Tetanus immunizations
 - Cleaning, flushing or soaking wounds on the surface of the skin
 - Use of wound coverings, bandages, gauze pads, butterfly bandages, etc.
 - Use of hot or cold therapy
 - Use of non-rigid means of support such as elastic bandages and wraps
 - Use of temporary immobilization devices such as backboards and neck collars while transporting a victim
 - Draining a blister or drilling of fingernails or toenails to relieve pressure
 - Use of eye patches
 - Removing foreign bodies from the eye using only irrigation or cotton swabs
 - Removing splinters or foreign material from areas other than the eye by irrigation, cotton swabs or other simple means
 - Use of finger guards
 - Use of massages other than physical therapy or chiropractic treatment
 - Drinking fluids for relief of heat stress

You must, however, record the injury or illness when a work-related injury or illness results in loss of consciousness and/or any time a work-related injury or illness results in a health care provider's diagnosis of the injury or illness as "significant." If a work-related injury or illness results in a fatality you must, in addition to recording it, report it to OSHA within eight hours.

Never record an injury or illness that doesn't have to be recorded. Remember that owners and prime contractors often use recordable injury/illness incident rates to determine which contractors/subcontractors will be eligible to work for them. If you are not sure about whether an injury is recordable, call MCAA's Safety Department at 800-556-3653.

If an occupational injury or illness is recordable, you must record it on the OSHA 301 Form (Accident Report), the OSHA 300 Log, and the OSHA 300A Form (Summary) or similar forms. Similar forms are acceptable only if they include the same information requested by all of OSHA's forms. In some states, the workers' compensation "First Report of Injury Form" is acceptable.

Other practical loss control practices regarding recordkeeping are as follows:

- Maintain OSHA 301, 300 and 300A forms throughout each calendar year. Keep them current. It's too hard to catch up if you get behind, and getting behind means you will be out of compliance.
- Keep the forms on your project site or readily accessible electronically in case you get a visit from OSHA.
- Post the completed 300A Form (Summary) from the preceding calendar year in a prominent location on the project where it can be easily seen by the workers. You are required to post it from February 1 through April 30 of each year.
- Keep all of the completed forms for five years.

Preparing For and Handling OSHA Inspections

Always be prepared for an OSHA inspection. To control your losses, be sure to accomplish the following, at a minimum:

- Keep your recordkeeping up to date and have it readily accessible.
- Be sure that your hazard communication program is in order. Historically, this is a frequently cited standard.
- Have your worker safety training documentation up to date and readily accessible.
- Have your disciplinary action procedures and your enforcement documentation readily accessible.
- Be sure that you make a good impression on the Compliance Officer by having your workers' work areas picked up and organized (good housekeeping).
- Make sure all of your safety equipment, such as fire extinguishers and first aid kits, is conspicuous to the Compliance Officer and readily accessible to those who might need it.
- Make sure your safety materials such as your set of OSHA regulations, Toolbox Safety Talks, safety programs, etc., is current and conspicuous to the Compliance Officer.

- Make sure all of your workers are wearing hard hats and safety glasses at all times while on the jobsite.

When a Compliance Officer shows up on your project you should implement a well thought-out and practiced plan. Make sure that someone on your project, if not you, is thoroughly prepared to accompany the Compliance Officer and control your company's losses.

If you are the prime contractor on the project you have two choices: either allow the inspection or require the Compliance Officer to obtain a warrant. Usually it is best to be cordial but businesslike and allow the inspection. If you are a subcontractor and the prime contractor allows the inspection, you won't have an option. However, there are still several things you can do to control your losses.

Regardless of whether you are a prime contractor or subcontractor, make sure you attend the Opening Conference. Find out why the Compliance Officer is there and be sure to hold him or her to the sole purpose of the inspection and no more. OSHA will conduct a regulatory inspection for one of the following reasons:

- An employer or someone else reported a fatality or an accident that resulted in multiple hospitalizations
- OSHA received a formal complaint (written letter) from a worker
- OSHA received an informal complaint (telephone call) from a worker
- OSHA sent a letter to an employer making inquiries about a worker's complaint and the employer failed to respond to the letter
- Someone from another government agency, such as the EPA, observed a hazard and referred it to OSHA
- OSHA is following up on a situation where it previously inspected a project, observed imminent danger hazards, and required abatement
- The project came up on the list for a general schedule inspection
- The agency has a special emphasis program and is randomly conducting inspections related to the program

Hold OSHA to the reason for its inspection and allow nothing further. For example, if a worker complains to OSHA about a scissors lift with a broken gate, the Compliance Officer can and should be limited to inspecting only the specified lift. However, keep in mind that he can cite any violations observed while on the way to the complainant's lift. Avoid as much of the project as possible while visiting the lift. Never leave the Compliance Officer unattended on the project.

Stay as quiet as possible throughout the inspection. Never offer any information and answer all of the Compliance Officer's questions carefully with brief, yes or no answers.

Take careful notes as you go through the inspection. Write down everything said by everyone involved in the inspection.

Insist on a method of abatement for every alleged violation made by the Compliance Officer. If the Compliance Officer points out an obvious hazard, have it abated immediately while the Compliance Officer is still there. Doing so shows good faith.

Every time a Compliance Officer takes a photograph, stop and take the exact same photograph with your camera. After the Compliance Officer leaves the project, go back and take additional photos of the same subject from several different angles. Sometimes photos can be deceiving in terms of depth perception and angles.

Be sure to attend the closing conference. Ask the Compliance Officer for a copy of his notes. Continue to take notes at the conference and ask the Compliance Officer whether there will be citations issued.

After the Compliance Officer leaves the project, interview each worker who was previously interviewed by the Compliance Officer. Find out what was asked and how they responded. Take good notes.

Keep the photos, Compliance Officer's notes, your notes and, where applicable, the notes of other contractors. If you receive a citation, this information may help you get the citation vacated or reduced to a lesser charge.

Multi-Employer Worksites

Most of the time you work on projects where other contractors are also working. Sometimes the lines of safety responsibility are unclear. Here's what you need to know about these gray areas:

- OSHA will almost always cite the following contractors:
 - *Exposing employer* – The employer whose workers were exposed to the hazard regardless of who created the hazard
 - *Creating employer* – The employer whose workers created the hazard
 - *Correcting employer* – The employer whose workers were responsible for correcting the hazard
 - *Controlling employer* – The employer who by contract or by actual practice has responsibility for safety and health on the project

Most of the multi-employer citations received by mechanical contractors are issued to them as the exposing employer. Those contractors who can convince OSHA that they exercised

“reasonable care” in the protection of the workers on the project can avoid the citation or have it vacated. Based on existing multi-employer cases, the best way to show reasonable care is to:

- Document that you did not create the hazard
- Document that you did not have the responsibility or the authority to correct the hazard
- Document that you did not have the ability to correct the hazard
- Document that you informed the creating, correcting, and controlling employers about the hazard
- Document that you informed your workers about the hazard and instructed them how to protect themselves from it

Multi-Employer Contract Language and Other Tips

Good contract language and some simple supervisory work practices can go a long way in helping to transfer risk on multiemployer sites. When working as a subcontractor on the project:

- Be careful not to assume safety and health responsibility for any worksite locations other than your own.
- Negotiate acknowledgements in the contract that you have no safety or health expertise outside of your trade, and that you will rely on the expertise of the prime contractor and the other subcontractors on the site.
- Negotiate a provision in the contract that you will not be responsible to the prime contractor for any safety or health violations that you did not create, control, or know anything about.
- Instruct your workers to travel only through those areas on the worksite that they must go through to reach their work areas (exposing employer).
- Be diligent in monitoring and enforcing safety and health mandates in all exposure areas (exposing employer).
- Report all problems that are not in your control to the creating, correcting, and controlling employers.
- If necessary, take realistic measures to protect your workers, including temporarily pulling them off the project.

When working as the prime contractor on the project:

- Shift responsibility to the subcontractor as much as possible by contract.
- State in the contract that trade-specific safety and health is not your area of expertise and that you will rely on the expertise of your subcontractors.

- Be sure your contracts with the subcontractors include the appropriate indemnification clauses.
- Where you have assumed safety and health responsibility, be diligent in monitoring and enforcing it.

SECTION 22: BILLINGS AND CASH FLOW

No company can exist without cash. Cash comes in from project billings. It is the Project Manager's responsibility to oversee the billing and payment process for his projects.

The contract documents may specify how to calculate the bill amount for each billing. For most construction projects, this is a monthly occurrence. The procedures may be based on the project specifications or a system devised by the customer. Computation of the amount to be invoiced should be based on the job cost breakdown and projected costs and over-billing as defined below.

Organize the Job for Efficient Billing

Whatever the system for the project is, learn it thoroughly and organize the project accordingly. For example, if billing is to be based on percentage of work completed, be sure the job supervisors or foremen report their progress in terms of percentage of project completion. If the number of installed units is the basis for billing, the field progress reports should provide exactly that information.

Include Projected Costs

Assure billings include projected costs. For example, the billing is being prepared on the 24th of the month and is to be projected through the end of that same month. The job supervisor or foreman reports that the crew is 84 percent finished on the condensate piping in one area of the project. The Project Manager and the job supervisor or foreman know, however, that by the last day of the month, when the customer's representative inspects the work to make sure the bill is correct, the condensate piping will be 100 percent complete. *Since the bill should reflect the work completed at the time the owner approves the bill, this portion should be billed as 100 percent complete.*

The same is true for equipment costs. The contract may state that you can bill for equipment and material delivered to the jobsite, even if it is not installed within the billing period. Check the contract for terms on billing for material and equipment that is onsite but not installed. If the bill is being prepared on the 24th and equipment is being delivered on the 28th, be sure to include the price for the equipment on your billing.

Timing Is Everything

Because equipment and large material delivery invoices will likely have to be paid before your company receives payment, timing of equipment and material can significantly reduce the time your company is out of pocket. For this reason, if possible, schedule large material and equipment deliveries to be made the last few days of the billing cycle. For example, an air handler is delivered to the jobsite on the 5th of March. You are allowed to bill for stored equipment and do so on the 25th of March. However, the billing from the vendor for the air handler has terms of net 30 days. Your company will have to pay for the equipment on April 5. Even if your company receives payment for the March 25 billing in 30 days, which is April 25,

your company will still be out of pocket for the air handler for a period of 20 days. This can be a significant drain on company resources.

Projecting costs is especially important at the beginning of a project when your company has mobilization and start-up expenses to pay, tools to buy, construction equipment to lease, and the first month's wages to pay, all before receiving the first payment from the customer. To help alleviate this burden and prevent the project from suffering a negative cash flow from the start, bill for these expenses up front, even before actual construction work is begun, so that payment for these initial costs has been received by at least the end of the first month.

Projecting costs each month can be a tedious, hit-or-miss affair, and because actual expenses vary over the course of the project, cash flow can vary dramatically from month to month. To make your job easier and ensure a steady and reliable income, during your Pre-Construction Planning determine how much *must* be billed to the client each month. This simple calculation, based on your anticipated average monthly expenses and required monthly profit, will produce a basis for each month's bill. Use this figure as a starting point, as the amount can be adjusted *upward* each month to cover unanticipated costs. This document, sometimes called a draw down schedule, can assist company financial personnel with cash planning and forecasts.

This strategy will help you avoid *under-billing* (submitting bills for less than the amount needed to cover actual and projected expenses) and achieve *over-billing* (submitting bills that cover all of the actual and projected expenses and provide a fair profit). This is the secret of profitable billing.

Billing on Time

The contract documents define the duration of each billing period and the deadline for submitting the bill for each period. On most projects, the billing cycle is monthly and bills must be submitted five to 10 days before the end of the month. The penalty for missing the deadline is simple: your company doesn't get paid until the following billing period.

Preparing a bill properly takes time. Information has to be gathered, verified, recorded in the proper format, tallied, and double-checked. Rushing the process leads to errors that can be in the customer's favor. Some will seize a mistake in arithmetic or billing format as a reason to reject the bill and delay payment.

To ensure a billing procedure that works for, instead of against, your company, you should schedule preparation of the monthly bill just as you would every other project activity. The job supervisor or foreman, the accounting team, and the Project Manager need to be given enough time to do a good job, and everyone should be assigned specific responsibilities that become a part of their monthly routine.

Billing Breakdown or Schedule of Values

The contract will generally define the format that is to be used for the billing breakdown. Often, the format is similar to the contract document G702, *Application and Certificate for Payment*,

from the American Institute of Architects (AIA). What is rarely defined by contract is the precise schedule of values required for the billing breakdown. The Project Manager should commence discussions with the customer to promote a schedule of values that is in concert with the construction breakdown, schedule, and cost tracking system. The purpose of the billing breakdown is to provide your company and the customer with an agreed upon basis to arrive at the progress billing due for each billing request period.

Since it is the objective to accelerate cash flow, you will want a billing breakdown or schedule of values that overprices the units of work that will be performed early in the construction cycle and underprices those that will be performed at the end of the construction period. This is known as *front-end loading*.

In order to maximize cash flow, the Project Manager should strive to associate the maximum dollars with those elements that must be incorporated in the work first. If errors are made in determining the sequence of construction because your company had little or no input into the prime contractor's construction sequence, cash flow will be delayed to the end of the job. Generally, it is safe to assume that rough-in activities would precede delivery and setting of equipment, which would usually precede equipment connections and fit-out activities.

Care needs to be exercised to ensure that the project billing is not so excessively front-end loaded so as to constitute fraud. Moreover, excessive front-end loading may result in an inadequate amount of money available to finish the project. The money needed to finish the project, then, either has to come from another project's cash flow, from your company itself, or from other sources.

The number of categories in the breakdown required by the owner might vary from as few as five or 10 items to as many as 100 items. A simple breakdown is more advantageous, since it is more difficult for the owner to evaluate the degree of front-end loading and also more difficult to evaluate the percentage that the unit is complete.

A ["Billing Breakdown Worksheet" \(Figure 22.1\)](#) could be prepared to determine the value to be assigned to each item in the breakdown. The following is a suggested procedure for developing such a worksheet:

- List in the *first column* of the worksheet a description of the individual items that make up the total breakdown.
- List in the *second column* the estimated direct cost for each item, excluding planning, cost of project management, and other indirect costs. The estimated direct cost in the breakdown may be made up of several smaller items in the estimate. Also, the owner will usually permit the breakdown to include labor and burden costs with the materials and equipment. Subsidiary worksheets should therefore be prepared to show the detail of the various elements of cost taken from the estimate to arrive at the combined estimated cost for each item on the top worksheet. Like the original estimate, the breakdown worksheets should be clear enough to permit audit and understanding by a successor.

- In the *third column*, allocate the estimated planning, project control, and other costs, as well as markup.
- In the *fourth column*, add columns two and three. This will give the estimated direct cost for each category, together with indirect costs and markup associated with that item.
- In the *fifth column*, enter the front-end loaded adjustments. In this column, you will be adding to the value of those items that will be completed during the first period of the construction process and will be crediting those items that will be completed late in the construction process. This column will total zero.
- The *sixth column* will be the sum of columns four and five. Each item will now equal its direct cost, plus allocated indirect cost and markup, plus (or minus) the front-end load effect. This is the breakdown that will be submitted to the customer for approval. The total of this column is the contract amount.

The Relationship between Billings and Cash Flow

The size and duration of construction projects and accepted principles of industry economics require that owners fully accept the responsibility to finance the work. An owner has adequate security of contractor performance by the contractual promise of a responsible contractor, by retention of a portion of the contractor's money, and possibly by surety bonding. Progress billings must be accelerated when possible to offset inevitable negative cash flows that occur at various times on all projects and throughout the duration of some projects. Effective project management includes securing acceptance by your customer of front-end loading of the price breakdown, monthly selling of the maximum percentage complete, prompt project completion, and expedited cash flow monthly and at the completion of the project. Your subcontractors should be paid fairly but not in excess of their share of cash flow.

The Four Rules of Billing Profitably

The following four simple rules can ensure that billing procedures won't lose money for your company:

- Always bill for the full amount allowable.
- Always bill on time.
- Always submit bills in the exact format the customer wants.
- Always manage cash flow.

Construction Industry Finance

Owner's Security

Owners must pay out substantial sums of money as the work progresses. If a contractor were unable to complete the work, possibly because of bankruptcy, the owner would want assurance that the unpaid balance of contract funds would be adequate to complete the construction. If owners did not have adequate security, they would be reluctant to advance to contractors substantial sums of money.

Retention is the most universal form of construction contract security. It takes two forms. First, the owner promises to pay only at fixed intervals, generally monthly. The payment date will be some fixed period, say five to 25 days, after the end of the month. This means that payment for the contractor's work performed on the first day of the month is due 35 to 55 days later. Payment for work performed on the last day of the month is due five to 25 days later. Therefore, on any given day, the contractor has completed an average of 20 to 40 days of work for which payment is not yet due if payment terms are less than 25 days.

The second form of retention is that the owner retains a fixed percentage of the contract price on each monthly billing. Generally, this is 10 percent of the monthly payment otherwise due at that date. The owner holds the retained percentage until project completion as security that the contractor will complete the project in accordance with the contractual obligation and will pay all bills incurred while performing the contract.

If the contractor is making satisfactory progress, some owners agree that there will be no additional retained percentage after the contract is 50 percent complete. Thereafter, the typical 10 percent retained percentage gradually declines over the second half of the project life to approximately 5 percent.

Many owners require an additional form of security, in the form of a guarantee of the contractor's performance by a financially responsible third party. For a premium, generally something less than one percent of the contract price, a surety (a company engaged in guaranteeing the performance of others) will issue a bond or guarantee to the owner. A Performance Bond guarantees that the contractor will complete the construction contract, provided that the owner performs the obligations under the contract. A Payment Bond (also called a Labor and Material Bond) guarantees that the contractor will pay all the labor, material suppliers, subcontractors, and others who incurred costs in performing the work. A surety will issue both bonds for a single premium. Surety bonds are further discussed in [Section 7: "Understanding Bonds and Insurance."](#)

Trade Contractor Cash Flow

A trade contractor usually performs the majority of the contract work with his own labor forces. This means that the bulk of the direct labor costs for field craftsmen must be paid each week as the work progresses. The trade contractor will not be reimbursed by the owner until some 30 to 70 days later. Rough materials and equipment, very large elements of direct cost, are due 10

to 30 days following their receipt, and again substantially ahead of reimbursement by the owner. Subcontractors generally are willing to wait for their monthly payment until the trade contractor receives reimbursement from the owner.

If the trade contractor is a subcontractor to a prime contractor, there may be an additional delay in the funds flowing down through one more level. This means, at any given time, the trade contractor has a substantial investment in the project caused by the disbursement of funds prior to the monthly payment date and by the retained percentage.

In addition to the project investment, the trade contractor must invest in construction equipment, fabricating facilities, and/or fabrication inventories. The trade contractor also must invest in the selling expenses, including the cost of estimating many projects for each one project sold.

Project Administration Objectives

A prime objective of good project management is to accelerate cash flow to your company. You expect each owner to discharge fully its responsibility to finance the cost of constructing its project. Unfortunately, some owners cannot or will not discharge this responsibility. Start-up costs, strikes and other delays, improper performance by the prime contractor or other subcontractors, and incompetent or unfair owner administration will impede cash flow on some projects despite your full compliance with your contract responsibilities and despite your best contract administration. Therefore, the delinquent cash flow at some periods on all projects and throughout the construction on some projects must be offset by advanced cash flow at other times and on other projects.

You cannot accurately predict the amount or duration of delinquency. Therefore, every effort must be made to accelerate each project as a partial hedge against unforeseeable cash requirements.

Progress Payment by the Owner

Typical Progress Billing Terms

Many private owners use payment conditions set forth in standard documents prepared by the AIA in their contracts.

AIA contract document A107TM – 2007, Standard Form of Agreement Between Owner & Contractor for a Project of Limited Scope, provides:

4.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

4.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month.

4.1.3 Provided that an Application for Payment is received by the Architect not later than the _____ day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the _____ day of the month. If an Application for Payment is received by the Architect after the date fixed above, payment shall be made by the Owner not later than _____ days after the Architect receives the Application for Payment.

(Federal, state or local laws may require payment within a certain period of time.)

4.1.4 Retainage, if any, shall be withheld as follows:

4.1.5 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

AIA contract document A201TM – 2007, *General Conditions of the Contract for Construction*, states:

9.2 Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work, and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Application for Payment.

9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

Contracts for other public bodies, and for private owners that do not use the AIA form, may be similar to the two examples given. You should familiarize yourself, in detail, with all of the language of the contract documents governing billing and payment terms. This will require study of the contract between the prime contractor and the owner and the contract documents referenced in that agreement.

Monthly Billing Requests

Care should be taken in the preparation of the first billing request to make certain that it is prepared carefully, in accordance with the instructions from the customer.

Poorly prepared billing requests are irritating to the customer and are often the reason for excluding all or a part of request until the next month. A typical effective practice is for you to prepare a draft copy of the monthly billing request, indicating an estimate of the percentage complete of each item of the breakdown. Then, walk the job with the customer's representative, securing concurrence with the estimated percentage of completion of each item. Where necessary, adjustments can be made to the draft copy in order to reach agreement with the representative. The final typed monthly billing request, when received through channels by the customer's representative, should then be in accordance with the oral agreement reached between you and the representative, facilitating a more prompt approval.

As the Project Manager, you should always follow up with the customer to determine if the formal billing request has been approved promptly as submitted. If there are areas of disagreement, resolve them quickly and prepare a corrected one. Lack of follow-up on your part can cause delay in receiving payment.

Change Orders and Proceed Orders

A change order will change your total selling price. Immediately following approval of the change order, you should amend your breakdown to reflect the effect of the change order. This is usually best done by listing the change order as an additional line item, with the percentage complete each month determined in the same way as other items on the billing request are determined. Change orders are discussed in [Section 35: "Change Orders."](#)

Some contracts demand that you proceed on changes when directed by the owner or customer, even though you may not have quoted the change or may not have received a formal change order. If the proceed orders are small in dollar amount and in number, it may be advisable to avoid the administrative problems of attempting to secure a progress billing request on the work performed on proceed orders. This is a decision best made by company management, not you.

On the other hand, proceed orders are sometimes large in dollar amount or in number. In that case, it is incumbent on you to secure progress payments for the work performed on the proceed order. If an informal agreement has been reached on the value of the proceed order, but a formal change order has not been written, the customer will generally approve your billing, including the proceed order as an additionally listed item on the next monthly billing request. Where disagreement exists between you and the customer as to the value of the change order, you should reach an agreement that you can include the proceed order on your next monthly billing request at least at the value equal to the customer's estimate of the value of the change. This way, the customer's interests are protected until a final agreement is reached on the value of the change and your interests are partially protected, because the customer will be partially carrying out the obligation to pay a progress payment as the work proceeds.

Reduction in Retention

You should seek to get retention limits for a project as early as possible. When the contract contains specific reference to limiting or reducing retention, you should make formal application in writing as well as personally discussing the subject with the customer's representative. When the contract makes no specific reference to limiting retention, the subject should still be raised with the customer when your work reaches 50 percent completion. A smoothly operating project and good personal relationships may result in a reduction in retention by the customer.

When your work is substantially completed, or when the customer elects to occupy the uncompleted building, you have additional opportunities and possible leverage to request that retention be reduced.

When the final inspection report, or *punch list*, has been issued, the customer may be persuaded to reduce the retention to an amount that reasonably reflects the cost of performing the punch list work. For example, on a \$1 million contract the customer may be holding \$100,000 retention at the time the punch list is issued. A high-side estimate of the cost of performing the punch list might be \$20,000, and an attempt should be made to persuade the customer to reduce the retention to this amount.

Withholding by the Owner

AIA contract document A201TM – 2007, *General Conditions of the Contract for Construction*, § 9.5.1 provides that the owner may withhold money from the progress payment otherwise due for any one of the following seven reasons:

- Defective work not remedied.
- Third-party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the owner is provided by the contractor.
- Failure of the contractor to make payments properly to subcontractors or for labor, materials, or equipment.
- Reasonable evidence that the work cannot be completed for the unpaid balance of the contract sum.
- Damage to the owner or a separate contractor.
- Reasonable evidence that the work will not be completed within the contract time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay.
- Repeated failure to carry out the work in accordance with the contract documents.

Most contracts contain similar language authorizing withholding of funds by the owner. Disputes involving these items may result in the owner withholding an unrealistic amount of money until the issue is settled. Inequitable though it may be, many owners feel that by withholding a sizable payment they can exert sufficient economic pressure to force your company to settle the issue quickly.

The most frequent disputes concern failure to correct work which the owner alleges is defective, but which your company believes conforms to contract requirements or failure to perform work which the owner alleges is within the scope of the contract but which you deny as being your company's responsibility. Every effort should be made to settle these issues promptly, before the owner withholds a substantial amount of money. In some cases, the prudent solution is to advise the owner of the cost of performing the disputed work, and that your company is proceeding with the work under protest. In this way, you could eliminate a contentious issue, limit the size of the dispute to your costs, and you can continue the negotiations in a calmer atmosphere after the work has been completed.

Final Payment by the Owner: Contract Terms

AIA contract document A201TM – 2007 provides:

9.10.1 Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's onsite visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable.

The key to final payment is that the work must be complete and accepted by the owner's representative.

Prime Contractor Payment

Difference between Being a Prime Contractor and a Subcontractor

If you are the prime contractor, your contractual relationship is directly with the owner. You are bound *only* by the terms of your contract with the owner and the referenced contract documents. You are directly involved in all negotiations with the owner and have knowledge of all matters of controversy or agreement.

When you are a subcontractor, the prime contractor is a middleman. Your contract obligations and rights are not only those contained in the prime contractor's agreement with the owner, but also those contained in the agreement between your company and the prime contractor. An additional administrative layer exists through which money and information must flow. You

no longer have formal direct access to the owner; the opportunity to be kept informed, to settle disputes and to arrive at agreements must now occur through the prime contractor. You now have to be concerned with the prime contractor's credit as well as the credit of the owner, for the prime contractor may be paid by the owner but unable to pay you because of other financial difficulties.

Prime Contractor Contract Terms

Prime contractors have widely varying subcontract terms that they seek to impose upon their subcontractors. In your negotiations with the prime contractor, seek to clarify these terms where necessary in order to be assured of payment.

Generally, your agreement with the prime contractor requires payment to you within a specified number of days following the receipt of the progress payment from the owner, and to pay you for your work in the proportion that the owner approves. The agreement usually provides that your retention is to be reduced in proportion to any reduction made by the owner. Finally, the agreement terms generally provide that the final payment is to be made within a specified number of days following receipt of the final payment by the prime contractor from the owner.

You should be thoroughly familiar with all of the payment terms contained in the contract between you and the prime contractor, as well as the payment terms contained in the principal contract between the prime contractor and the owner.

Concealment of Information

Some prime contractors will seek to keep you separated from the owner, concealing vital information concerning payment. For example, an owner may approve a reduction in retention, but the prime contractor may conceal this information in order to avoid sharing the reduction with subcontractors.

Good project management requires that you maintain effective informal communication channels with the owner and the owner's representative. The maintenance of such communication channels must be done with tact and discretion.

Withholding by the Prime Contractor

As with disagreements between the prime contract and owner, when disagreements arise between the prime contractor and a subcontractor, the prime contractor may withhold a sum of money to enforce performance or to cover the prime contractor's contingent costs. When you negotiate contracts with the prime contractor, seek to obtain an agreement that your company will not be back charged for matters in disagreement.

Every effort must be made to promptly resolve the issues in disagreement. This is particularly important because the amounts withheld will usually be substantially in excess of the reasonable value of the disputed item.

Where the amounts improperly withheld by the prime contractor are substantial, consideration could be given to withdrawing your workforce from the jobsite. This is a serious step, and should only be taken after careful consideration of the risks involved, including consultation with legal counsel.

Prime Contractor Credit

The prime contractor's credit may be supported by a payment bond which gives the added assurance that the surety will pay your company in the event the prime contractor cannot pay the amounts due under the contract. In some states you may have *lien rights*, or the right to file a claim against the owner's property and, if necessary, sell it at public sale in order to provide the funds to pay the proper debts that the prime contractor cannot pay. In addition, many states have provisions for filing notices upon commencement of a project. Failing to timely file notices may preclude you from filing and foreclosing on a lien. Assure you understand these rules for the state in which you are doing the work.

It is important to remember that the prime contractor is your first line of credit. If the prime contractor goes bankrupt, collecting from the prime contractor's surety may take a long time, is subject to significant legal risk, and in some cases is not even available as a solution.

You should be alert to reports concerning the prime contractor's credit. Any adverse credit information, even if unverifiable, should be promptly reported to your supervisor and, if necessary, legal counsel, so the risk may be reevaluated. Such information *should not* be discussed with other contractors.

The best defense against a credit default by the prime contractor is to have collected more funds than your costs to that date. This is another important benefit of front-end loading and effective project administration.

Subcontractor Payment Terms and Practices

Subcontract Schedule of Values

You should instruct your subcontractors as to the specific line items into which their sales price should be allocated. Their schedule of values should provide sufficient detail so that you can reasonably audit and come to agreement with them on the value of their work completed to a billing date. The value assigned to individual items should be audited to verify its reasonableness, and if necessary you should ask your subcontractors for a quantity survey by item.

The schedule of values of the subcontractor's sales price should parallel the schedule of values of your price, although several items in the subcontractor's schedule of values could be combined into a single item in your schedule of values. By having a parallel schedule of values, you can secure approval by the owner as to the subcontractor's values for each group of items and for the subcontractor's monthly billing.

Monthly Billing Request Approval

You have the primary responsibility to audit and approve your subcontractor's billing request, and you should not approve and submit it until you are satisfied that the subcontractor's claim is fairly stated.

Your audit should address two matters. First, the subcontractor's work must be in strict accordance with contract requirements. Your company should not pay for work that is defective in quality or does not meet specified standards. Second, each item of work must actually be completed to the percentage claimed by the subcontractor.

If you approve the subcontractor's billing request as being fair, you owe it to your subcontractor to use your best efforts to obtain your customer's approval. In the event the owner does not approve the subcontractor's billing request, you should attempt to obtain for the subcontractor a direct opportunity to participate in negotiations with the customer's representative. You should not approve any subcontractor's billing request for any amount greater than what is approved by your customer.

Reduction in Retention

If your subcontract agreement provides that the subcontractor's retention is to be reduced proportionately to yours, you should pay the reduction to the subcontractor when it is received.

Withholding by the Owner or Prime Contractor

The owner or prime contractor may withhold funds, properly or improperly. As Project Manager, you should withhold from the subcontractor that share of the withholding which is applicable to its work. If you believe the withholding by the owner or prime contractor to be improper, you should vigorously press for payment and pass along your subcontractor's share upon receipt.

Vendor Payment Terms and Practices

Sales Price Schedule of Values

Large lump sum purchases that will be delivered in several stages over the duration of the project should be invoiced by the vendor as each shipment is made. Before releasing the first shipment, the vendor should be asked to break down the total selling price into items you designate. The schedule of values should be audited to ensure that it is reasonable.

The approved schedule of values will be useful in correctly developing the costs for the schedule of values to the customer and will also aid in approving the vendor's interim bills.

Withholding

The materials and equipment furnished by your vendors should conform in every respect to the conditions, including referenced documents, established in the purchase order or purchase agreement. It is your responsibility to verify that the materials and equipment you receive

comply with these requirements. If the product is defective, prompt written notice should be given to the vendor.

It is also your responsibility to expedite correction by vendors of each element of noncompliance with their order. The vendor's order is not filled in full until every item is complete. Particularly, an order is not complete until operation and maintenance manuals are received, field start-up services provided, spare parts furnished, etc., as called for in the purchase order or purchase agreement and referenced contract documents. The schedule of values should include these final elements as separate items, or funds should be withheld to ensure that all contract requirements are fulfilled.

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin AF 3, "Cash Flow"
 - Bulletin LL 1, "Protection of Lien Rights to Retention"
 - Bulletin LL 10, "Using the Federal Prompt Payment Act Amendment to Collect Billings on Time"
 - Bulletin CT 3, "Payments Clause"
 - Bulletin PC 4, "Why Mechanical Contractors Should Be Paid for Materials Stored On/Off Jobsite"

SECTION 23: QUALITY CONTROL

Project Quality Control: An Investment

Providing quality work at competitive prices is what wins a company work and earns repeat business. A reputation for quality at a fair price is among the best advertising your company can have. Quality control, the procedure ensuring quality materials and workmanship, is an investment in that kind of reputation, and is therefore a good way for the project team to help build job security. It all begins with each member of the team taking personal responsibility for quality control.

Defining Standards of Project Quality

Any approach to project quality control has to start with defining the project's quality control standards. These standards come from three sources:

- *The contract documents* – These documents frequently cite that equipment should be installed in accordance with the equipment manufacturer's installation guidelines and the special requirements of the customer, and specifications which list material installation and testing requirements.
- The mechanical contractor's in-house standards.
- *Industry codes and standards*—Standards such as those developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), American Society of Mechanical Engineers (ASME), Leadership in Engineering and Environmental Design (LEED), Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), the National Certified Pipe Welding Bureau (NCPWB) and others.

The contract describes the exact standards for all work done on a given project: standards that must be met for the customer to be satisfied and the mechanical contractor to be paid fully for his efforts.

Establishing Project Procedures

During Pre-Construction Planning, the project team should establish procedures aimed at meeting both contractual and in-house standards of quality. These procedures should encompass such areas as:

- Inspections by project management
- Code inspections
- Tests
- Welder certifications

- Quality control documentation

Among the specific procedures that the Project Manager and job supervisor or foreman on the project should follow on every project:

- Know your company's quality control standards and the quality standards specified in the project contract and stick to those standards from the first day of the job.
- Establish "quality consciousness" among all field personnel and invite crew member suggestions and comments regarding quality control on the job.
- Monitor the performance of all workers to make sure the highest standards of craftsmanship are being met.
- Encourage workers to continue their career and skills training.
- Take responsibility for quality control of all subcontractors' work.
- Follow established methods for ordering and receiving all materials and equipment to make certain they meet or exceed job requirements.
- Follow detailed written procedures for installation, testing, and repair activities.
- Notify the appropriate members of the project team of any quality control problems that occur.
- File quality control reports, as required by your company, and review them for accuracy and completeness.
- Regularly conduct quality control inspections to verify:
 - Quality of installation
 - Internal and external cleanliness of all systems
 - Accuracy and completeness of as-built drawings
 - Acceptability of work performed by subcontractors
 - Adherence to good housekeeping practices
- Commit to a no punch list project by completing and inspecting an area or system after it is complete. This not only makes the project team more aware of quality, but reduces the cost of completing punch lists.

Assigning Project Quality Control Responsibilities

The Project Manager should assign specific project quality control responsibilities to every member of the project team, but especially to:

- Job supervisor or foreman
- Shop foreman
- Subcontractors
- Quality control specialist
- Other key in-house support personnel, such as project engineers and drafters

Keep in mind that quality control gets results only if it is treated like every other requirement of the job.

Quality Control vs. Perfection

Take quality control seriously and make sure that everyone on the project team understands its importance. Be careful, however, to avoid fanaticism. The goal is to install systems that “look right and work right,” not to achieve perfection. Perfection is not always attainable at realistic cost.

When faced with a situation where you are unsure if a piece of work meets the project or your company's quality control standards, particularly standards of appearance as opposed to function, consult the project documents and your company's quality control policies as soon as the question arises. Acting immediately is the only sure way to avoid installing nonconforming work that must later be removed and reinstalled or otherwise corrected. Rework is costly in dollars and morale.

Quality control is an organized effort to make sure that every piece of work done by your company is worth what the customer pays for it and stands as an example of your company's quality workmanship. If you keep this definition in mind and tailor your quality control procedures to fit it, you are almost assured of a program that pays big dividends.

Additional resources available through MCAA's online [Resource Center](#):

- *Quality Assurance Manual*

SECTION 24: JOBSITE AND PROJECT ORGANIZATION

Jobsite Organization

Few things give a project a better start or pay bigger dividends than professional jobsite organization. Anything you can do to organize your own efforts and coordinate them with other trades on the job will eliminate confusion and improve everyone's efficiency from beginning to end of a project.

The Project Manager's Responsibilities

There are two basic goals in organizing a jobsite:

- Organize your own efforts.
- Coordinate your efforts with the prime contractor and the other trades on the project.

Both of these goals demand that the Project Manager and the job supervisor assume responsibility for organizing the jobsite. Most construction managers and general contractors do not put a high priority on material handling, efficient movement of labor, or requiring all parties to follow the master schedule (if there is one). Since the construction manager and general contractor have no labor exposure, their lack of commitment to an organized jobsite does not cost them money; however poor jobsite conditions can increase the cost of the skilled trades significantly. To assure the best jobsite productivity, the Project Manager and job supervisor or foreman should establish a good working relationship with the prime contractor and the other trades: a cooperative relationship that can be used to mutually solve scheduling and organizational problems as they arise.

A Step-by-Step Process

Organizing a jobsite is not a difficult task, but does require a step-by-step approach that includes:

- Inspecting jobsite conditions
- Assessing facilities for material handling
- Identifying suitable trailer and storage areas
- Meeting with the prime contractor to finalize jobsite arrangements
- Implementing systems for:
 - Handling material and equipment
 - Moving labor to the work area
 - Project orientation
 - Receiving deliveries

- Renting construction equipment
- Controlling tool use and storage
- Housekeeping
- Systemization of coordination drawings
- Systemization of jobsite safety requirements
- Filing project paperwork
- Maintaining as-built drawings
- Drug testing

Inspecting Jobsite Conditions

Together with the job supervisor or foreman and your subcontractors, inspect the jobsite before moving your job trailer and other equipment and facilities there. Pay particular attention to:

- Existing services (water, sewer, gas, electricity, telephone)
- Points of connection to existing services
- Temporary utilities
- Access to and from the site
- Parking areas
- Trash disposal areas
- Security arrangements

Note any situations that require special consideration or that might pose problems at certain stages of the project.

Identifying Suitable Trailer and Storage Areas

Based on your evaluation of jobsite conditions and your material handling strategy, identify suitable trailer sites and storage areas. Pick locations that are:

- Near the work area or inside the job building
- Convenient for all stages of material handling, from unloading through installation
- Permanent for the duration of the project
- Secure

Meeting with the Prime Contractor and/or Subcontractors

After your inspections of the jobsite and your evaluation of site conditions, call together the members of the project team, including your subcontractors, to review your findings and prepare a list of questions and recommendations for the prime contractor. Then, together with your job supervisor or foreman and subcontractors, meet with the prime contractor to discuss your inspection results and your team's evaluation in detail. In particular, discuss:

- Correction of hazardous or otherwise unsuitable conditions, specifying the correction(s) required and setting dates for completion.
- Material handling requirements, including general facilities or equipment (ramps, hoists, crane, etc.) and access or equipment for special deliveries. Give the prime contractor tentative dates for all special deliveries, if possible.
- Locations for office and storage trailers and storage areas.
- Security arrangements and the security responsibilities of both parties.
- If held early enough, this meeting could give your team first pick among sites and facilities available to all the trades on the project. It also helps establish your team's reputation for professionalism and attention to detail and strengthens the channel of communication between your team and the prime contractor.

Implementing Jobsite Systems

Project Files

Immediately after the Pre-Construction Planning Meetings, when you've established the requirements and strategies for the project, have the company office prepare two sets of file folders for all anticipated filing categories, such as:

- Accident reports
- Approved inspection prints
- As-built drawings
- Changes, both approved and unapproved
- Correspondence
- Daily Job Log forms
- Delivery and return records for oxygen and acetylene tanks
- Equipment rental records

- Job meeting minutes
- Purchase orders
- Receiving reports
- Requests for Information (RFIs) copies and RFI log
- Safety reports
- Schedules
- Time cards (labor report forms)
- Warranty information
- Workforce loading charts
- Other

One set of folders is for your own project file. The other is for the job supervisor or foreman's files at the jobsite. Be sure to emphasize to the job supervisor or foreman the importance of filing each project document in the proper folder as soon as it is received. These files may be digital or a combination of digital and paper. In each of the systems, the project team commits to collecting data with integrity.

As-Built Drawings

Be certain that everyone understands that accurate as-built drawings are not only a requirement of the job contract but also an opportunity for obtaining service work after construction is completed. Provide a clean copy of project drawings for exclusive use as as-built drawings and insist that all subcontractors, as well as your job supervisors or foremen, record all changes *daily*.

Establish a procedure for submitting as-built drawings to the company office, both periodically as part of the job reporting procedure and at the end of the project for redrafting and submission to the project owner.

You'll find additional information on as-built drawings in [Section 28: "Documentation"](#) of this manual.

Housekeeping

Good housekeeping isn't just a matter of jobsite aesthetics. Keeping work areas and material handling paths free of clutter is essential to project safety, improving jobsite productivity, and avoiding backcharges. As part of the jobsite organization effort, do the following:

- Review the contract documents to determine the prime contractor's or owner's housekeeping responsibilities and the responsibilities of your company.
- Assign your company's responsibilities to an individual on the project team, and charge him or her with enforcing good housekeeping practices among your company's workers and/or subcontractors.
- Keep track of changes in housekeeping responsibilities as dictated by change order work and modifications of the prime contractor's or owner's policies.

Coordination Drawings

As Project Manager, you establish procedures that will initiate, develop and distribute coordination drawings. The procedures should define the following drawing requirements:

- Scope and purpose
- Activity levels/users
- Schedule
- Review cycle

See also [Section 13: "Fabrication and Shop Drawings,"](#) and [Section 14: "Building Information Modeling."](#)

Jobsite Safety

The Project Manager ensures that adequate safety rules and procedures are being implemented at the jobsite. He establishes a procedure that organizes all jobsite safety paperwork, documentation, and associated requirements. A jobsite safety file is established to retain safety documents and respective forms and reports.

Other safety considerations include:

- Communications; common channel two-way radio, mobile phone, etc.
- Staggered start/stop times
- Prohibition of the use of radios or phones other than those that are company issued
- Safety/first aid locations
- Personal cell phone use rules
- Fabrication areas

See [Section 21: "Safety Management"](#) for a more in-depth discussion on project safety.

Material Handling

Industry studies repeatedly show that nothing increases jobsite productivity as dramatically as good material handling. By properly planning and coordinating material deliveries and movements, a field crew can spend significantly fewer hours moving material and significantly more hours installing it.

Material handling is also a key factor in project safety. A significant number of worker injuries result from unsafe material handling procedures. Consequently, good material handling techniques can greatly improve your company's safety performance.

Efficient material handling begins with a strategy that everyone understands and follows. The basis of this strategy should be your company's written procedures and routine practices. However, because each project is unique, the Project Manager should devote sufficient planning time to designing specialized procedures that match the physical layout of the jobsite and the nature of the project.

In designing a material handling strategy, you should:

- Include the job supervisor or foreman in all aspects of planning.
- Inspect the material handling situation at the jobsite before construction begins.
- Establish and enforce efficient material handling practices from the first day of the project.
- Whenever possible, assign one person the task of overseeing material handling on the project.
- Coordinate the efforts of the company's purchasing department, fabrication shop, and warehouse with those of the field to ensure that the material handling plan is followed strictly and uniformly at all levels. Short Interval Planning is the best tool for managing material flow. More information on Short Interval Planning can be found in [Section 34: "Short Interval Planning."](#)
- Insist that the job supervisor or foreman be informed about all scheduled deliveries in time to prepare the jobsite properly.
- Insist that any materials not needed on the project be identified and returned to the supplier or the company warehouse as soon as possible in order to keep the jobsite uncluttered, minimize deterioration of the material, and either recover the company's investment in the material more quickly or make the material available to other projects.
- Be receptive to suggestions and new ideas.
- Use every opportunity to improve material handling techniques on the project.

Because so many people are involved in material handling, communication, and training play a large role. At the same time, a large number of people offer a large pool of ideas for improving material handling procedures. Regularly dipping into this pool for suggestions and opinions is one of the best and least expensive ways to improve jobsite productivity.

The Jobsite Inspection

It is impossible to know what material handling instructions to give the project team or what packaging and shipping instructions to give your suppliers until you've gone to the jobsite and conducted a thorough inspection of the material handling equipment and facilities that are available to you. You should conduct this inspection along with your job supervisor or foreman, since he is the one with immediate responsibility for onsite material handling operations.

Following your inspection, meet with all the members of your project team to:

- Review the inspection results.
- Discuss existing and potential problems and identify material handling equipment and facilities that you need but that are not available at the jobsite.
- Review all sections of the contract documents that specify your material handling responsibilities and those of the customer.
- Make a complete list of your concerns and your recommendations for resolving potential problems.

Material Handling Conference

Meet with the customer to discuss the results of your inspection and your team meeting. Explain your requirements and concerns and present your recommendations. Be sure that the customer clearly understands that efficient material handling is important to the productivity and the safety of the entire project, not just your part in it.

Work out a satisfactory plan for modifying existing equipment or facilities or providing additional ones. Set deadlines for the completion of the plan. After the meeting, send the customer a brief letter outlining what was discussed in the meeting and what plans were agreed upon.

Handling Material and Equipment

Tight organization of material and equipment handling arrangements is a prerequisite for reducing double-handling and enhancing safety on the project. The organization effort should include establishing procedures for:

- Coordinating purchasing and construction activities to ensure that equipment and materials arrive at the jobsite when they are needed and are packaged for most efficient handling.

- Guaranteeing that proper handling equipment (crane, forklift, etc.) and storage areas are available when deliveries arrive.
- Coordinating with the fabrication shop and jobsite to ensure that fabricated materials are received at the jobsite when they are needed and are packaged for most efficient handling.
- Using paperwork as a tool for communications by including material handling instructions on all purchase orders.
- Coordinating mechanical activities with the other trades to keep material handling pathways clear, prevent conflicts over the use of crane, hoists, etc., and provide for adequate spacing of trades.

Purchasing Techniques that Improve Material Handling

Material handling begins with filling out the purchase order. The packaging and shipping instructions should be stated on the purchase order and directly affect how easily the ordered items can be unloaded and moved around at the jobsite. Consequently, the project team must understand the purchasing and material release system and use it to enhance the material handling effort.

Specifically, purchasing should be organized so that equipment and materials:

- Arrive when a permanent storage area is available, avoiding the need to move them later to another storage location before final installation.
- Are packaged for most efficient handling, with no loose materials delivered to the project.
- Whenever possible, the material is sorted by area and task (bag and tag) to minimize handling on the jobsite.

To make sure that the supplier delivers all materials exactly as needed, all purchase orders or material release requests should specify the following information:

- Type of container required
- Number of items per container
- Type of protection needed
- Required packaging
- Required mode of transportation
- Job identification and destination data
- Specific delivery date(s)

More information about purchasing can be found in [Section 9: "Material and Equipment Acquisition."](#)

Fabrication and Material Handling

Fabrication is a tremendous tool for increasing productivity, but it loses its advantages if the time saved by fabricating in the shop is wasted in handling the assemblies in the field. To avoid this, the project team should make sure that all fabricated assemblies:

- Arrive at the project when the jobsite is ready for them to avoid the need for storage.
- Are crated, palletized, bundled, or otherwise packaged for most efficient handling.
- Are tagged, color coded, or both to allow jobsite crews to know at a glance where a particular assembly should be installed.

The ["Material Handling Checklist" \(Figure 24.1\)](#) can be used to assess the material handling situation on the jobsite.

[Section 13: "Fabrication and Shop Drawings"](#) provides more information on handling materials in the fabrication process.

Receiving and Storage of Material

Receiving and storage operations are too often considered a minor part of the project and given little attention. As a result, shipping errors remain undetected until too late, improperly stored equipment deteriorates, parts and instructions are misplaced, and everything may need to be moved several times before reaching the installation location.

Avoiding these problems requires a simple receiving and storage procedure and a few minutes of planning and inspection each day. But, like other procedures, it must be followed carefully to be of any value.

Receiving Deliveries

Good receiving procedures are critical to maintaining a smooth flow of materials and equipment to the jobsite and identifying problems with incoming deliveries. The most important steps in this procedure are:

- Assign the responsibility of receiving deliveries to one person.
- Coordinate communications between the office and the field to ensure that the jobsite knows all expected delivery dates, knows what is being delivered on each date, and has the required paperwork for verifying the items and quantities being delivered.
- Specify and enforce procedures for inspecting deliveries, comparing the packing slip to a copy of the purchase order, signing the shipper's bill of lading, reporting damage and

shortages to the office, moving deliveries to the installation site or to storage, and submitting paperwork to the office.

The Role of the Job Supervisor

The Project Manager cannot be around when every delivery arrives, nor is it necessary. The job supervisor or foreman should personally inspect incoming materials and equipment, verify their condition and quantities, and move and store them properly. This is the project of the job supervisor or foreman or the person he assigns to the task.

However, it is the Project Manager's responsibility to make sure the job supervisor or foreman understands the importance of strict receiving and storage procedures, assigns a responsible individual to the project, and monitors that individual's performance constantly.

The procedures for efficient receiving are simple but demand careful attention to detail and close coordination of field, office, and shop.

The job supervisor or foreman must:

- Know the company's policies for purchasing, requisition and material handling.
- Establish adequate receiving and storage facilities at the jobsite.
- Assign one person on the project to be responsible for all receiving and train that person in following the company's procedures, whenever possible.
- Know what is arriving before it arrives by maintaining good communication with the office and suppliers/vendors.
- Make sure each purchase order specifies the type, number, and approximate weight of the pieces ordered, the date of shipment, the type of packaging, and the mode of shipment.
- Not accept or allow anyone on the project to accept a shipment without thoroughly checking it.
- Carefully inspect each shipment at the time it arrives. A sample ["Initial Material or Equipment Inspection Report" \(Figure 24.2\)](#) can be found in this manual.
- Check each item against the purchase order and the packing slip and note any discrepancies on the packing slip and the bill of lading.
- Inspect each item for damage and do not discard any damaged material or outer packaging.
- Note all damage on the bill of lading before signing it.

- Protect himself and the company by writing on the bill of lading, *"Received in apparently good condition. Contents to be checked at a later time."* Have the delivering driver sign the bill of lading.
- Note on the ["Daily Job Log" \(Figure 24.3\)](#) all discrepancies between delivered materials or equipment and the purchase order.
- Note on the Daily Job Log any discrepancies between the packaging and shipping information on the purchase order and the actual packaging and mode of shipment of the delivery.
- Submit all packing slips to the company office along with each week's time sheets.
- Advise you immediately of any discrepancies between the purchase order and the types or number of pieces received.
- Report all damage to you immediately, providing details about the type and extent of the damage.
- If concealed damage is discovered after the delivery driver has left the jobsite, notify you immediately and note the damage on the Daily Job Log.

When the job supervisor or foreman or their assignee signs the bill of lading, they are accepting the shipment. In cases where the materials or equipment received are needed immediately, he may have no choice but to accept the damaged shipment and do repairs onsite. If damage is extensive, however, refusing the shipment might be the best course to follow.

In all cases, the job supervisor or foreman should notify the Project Manager to determine the best course of action, since it is the Project Manager's responsibility to initiate claims against the shipper through the company's purchasing department.

Regarding unloading and storage, the job supervisor or foreman or their assignee must be sure to:

- Arrange for all necessary material handling equipment (hoists, crane, forklift, pallet movers) to be available when each shipment arrives.
- Unload material and equipment at a convenient location that will eliminate double-handling of the shipment, preferably directly into the building or to the installation site.
- Remove the manufacturer's installation instructions from each item and file them where they can be located easily at installation time.
- Arrange indoor storage of critical equipment.
- Protect equipment stored outdoors from weather and ground water.

- Follow the manufacturer's written recommendations on storage, protection, lubrication, and rotation of moving parts.

Conscientious receiving and storage of all deliveries is the first step towards efficient installation. This ensures that the right materials and equipment are on hand and in good condition when needed, thereby contributing to productivity and eliminating unnecessary delays.

The Project Manager's Role

To support the job supervisor or foreman's efforts regarding receiving and storage, the Project Manager should provide:

- A copy of the company's receiving and storage procedures
- Written records of what deliveries are expected and when they are scheduled to arrive
- Written updates of the delivery schedule, as required
- Folders for filing bills of lading, manufacturers' instructions, and other documents related to incoming shipments

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin TE 4, "Contractor's Equipment: A Guide to Better Security"

Additional resources available through MCAA:

- *Online Piping and Usage Specification (OPUS)*, www.opuspipng.org

SECTION 25: TOOLS AND CONSTRUCTION EQUIPMENT

Tools

Tools are a worker's means of earning a living. A good craftsman realizes that appropriate tools, when properly used and cared for, make his job easier and safer, and understands that it is a privilege to have good tools available when they are needed. At the same time, the company knows that providing the right tools improves worker productivity.

Theft, loss, and vandalism of tools are expensive problems in the construction industry. Misuse of tools accounts for additional costs in injuries and lost time. With tight market conditions and increasing competition forcing the contractor to trim bids to the bone to get work, there is often not enough cushion in a project estimate to absorb these losses.

The Project Manager's Responsibilities

The Project Manager has five specific responsibilities regarding company owned tools:

- To anticipate what company-supplied tools are needed for each stage of the project and have them available when needed.
- To assign an individual the responsibility for enforcing all company policies and procedures regarding tools on the jobsite and keeping complete and accurate records of tool use.
- To monitor the tool control system on the project to make sure it is functioning properly.
- To develop and maintain a preventive maintenance schedule for all tools assigned to the project, and document all tool maintenance actions.
- To return tools to the shop when they are no longer needed. This will allow other crews to use the tools and may reduce or eliminate the company's need to purchase new tools.

A Tool Control Strategy

The project team must establish and enforce strict tool control procedures aimed at:

- Minimizing loss, damage, and theft of tools
- Ensuring project efficiency and safety

There are three parts to a good tool control strategy:

- Physical control of company tools
- An accounting system for tracking tool use
- Employee training in the proper use of tools

Effective tool control begins with the Project Manager or the job supervisor or foreman assigning one person to manage the system and enforce the company's policies and procedures. On a large project involving several crews, this person might have no other responsibility besides tool control. On a smaller project, the job supervisor or foreman might have this responsibility in addition to his other duties.

Regardless of who is in charge of jobsite tool control, he should understand and rigidly enforce the rules, *with no exceptions*.

Physical Control

Physical control involves three simple but essential steps:

- Permanently marking each company tool with the company's name
- Providing secure storage for all tools when not in use
- When the tool system allows, ensure that a bar code is on each tool to identify the individual tool or class of tool

These steps are particularly important for expensive tools such as saws, pipe machines, and pneumatic wrenches, but they are just as applicable to hand tools that the company issues to its workers.

Etching or stamping is the best way to mark tools permanently. Painting colored stripes or the company's name on each tool is also a good practice, since it makes identification easier. But paint by itself is insufficient; it can be removed too easily.

Mark all tools in the same place: on the left side of the handle, for example. Uniformity makes identification simpler and makes any attempt to eradicate the marking very obvious. Power tools and construction equipment should be marked in more than one place: one obvious, the other hidden. The hidden marking, particularly if it includes a company control code, can prove invaluable in identifying a tool if it is stolen.

The company must provide secure storage for all tools. For centralized storage, a lockable tool shed or trailer is the best answer. For security during work hours, locked gang boxes are a good choice, provided there is control over the number of keys issued and the people to whom they are issued. If a gang box is provided for each crew, only the job supervisor or foreman and the person assigned to jobsite tool control should have a key for it.

Encourage each worker to utilize his toolbox for storage of personal tools and those assigned him or her by the company.

An Accounting System

A tool accounting system involves four things:

- Knowing what tools are on the jobsite.
- Knowing where each tool is and who is responsible for it.
- Inspecting each tool regularly and returning worn or damaged tools to the shop or warehouse for replacement or repair.
- Returning to the warehouse or shop all tools no longer needed on the project.

The basis of the system lies in having one person on the job responsible for maintaining:

- A complete inventory listing all tools issued to the project.
- Tool control sheets used to track tools issued to crews and individual workers.
- An up-to-date preventive maintenance schedule.
- Documentation of employee training and use of all tools.
- Records of tool repair requests and results of tool repairs.
- Records of any tool certifications and employee certifications for tool usage.

The inventory should be issued by the company warehouse at the beginning of the project and updated as additional tools are sent out to the jobsite and damaged or unneeded tools are returned. A standard company form could be used for this purpose.

Regardless of what type of form your company uses to control tools on the jobsite, the rule must be that no tool leaves storage without being properly signed out.

It is difficult to ask workers to have respect for the company's tools if the company demonstrates lack of concern for its tools and the safety of the people using them. On the other hand, a company that pays meticulous attention to the condition of its tools sets an example for its employees to follow.

For this reason, it is important that the person in charge of tools on the jobsite inspect them regularly, tag those that are in need of repair or replacement, and return them to the shop.

An often forgotten element of tool control is promptly returning to the shop or the warehouse all tools that are no longer needed on the jobsite. This practice has several advantages:

- It removes unnecessary tools from the jobsite inventory, making onsite tool control easier.
- It moves unnecessary tools out of the reach of vandals and thieves.
- It puts tools back in circulation so that they may be used on another project.

When a tool is returned to the company's warehouse or shop, it should be noted on both the jobsite and the warehouse inventories.

Training

The most cost-effective way to prevent damage to tools is to make sure each worker knows how to properly use the tools that are issued. Emphasize to everyone that proper use and care prolongs the life of tools and enhances productivity and safety.

When a new or unfamiliar tool is introduced on the project, the Project Manager should make sure that someone with a thorough understanding of it demonstrates its proper use to all jobsite personnel. In addition, each job supervisor or foreman and tool control supervisor in the company should keep an eye out for misuse of even the most common tools.

Records should be kept on each employee who is properly trained in the use of special tools as well as the use of Personal Protective Equipment for safety that is required to operate such equipment. Employees should sign these training records to verify their understanding and completion of the training.

Although it is a widely discussed topic throughout the construction industry, tool control is not difficult as long as the Project Manager assigns specific responsibilities and makes it clear to everyone on the project that the company's policies and procedures will be strictly enforced.

Construction Equipment

Construction equipment is among a company's biggest costs on a project. If the equipment is scheduled and handled properly, it more than pays for itself in the time and effort it saves. If improperly managed, however, construction equipment becomes a serious drain on company resources.

Control of construction equipment has one central aim: to ensure that each piece of equipment is used to its maximum advantage. It is a cooperative effort among all the members of the project team, particularly the Project Manager, the job supervisor or foreman and the purchasing agent, an effort that begins with Pre-Construction Planning and continues to the last day of the project.

Clear written procedures are essential. Certain procedures apply to all situations; others apply only to equipment the company owns or to equipment the company rents specifically for the project. All must be followed and strictly enforced.

When planning for the most efficient use of construction equipment, the project team must:

- Review the scope of the project and the plans and specifications to determine equipment requirements.
- Establish a budget for both company-owned and rented equipment, and stick to it.

- Schedule the arrival, use and departure of equipment in such a way as to minimize the amount of time the equipment is idle.
- Track and document all equipment usage related to change orders. Even if you already have the equipment onsite, this usage must appear on the change order as a billable item.
- Assign specific responsibilities for equipment maintenance and operation and make sure the persons assigned understand and perform their duties.
- Properly tag all equipment requiring maintenance.
- Maintain a complete record on each piece of equipment on the project, including the number of hours of use budgeted to the project, the number of hours actually used, the dates of arrival at and departure from the jobsite, and all dates and reasons for which the equipment is tagged for repair.

Rental Procedures

For equipment or special tools rented by your company, you should:

- Emphasize to everyone on the project team the importance of having the proper equipment onsite when needed and controlling rental costs.
- Identify project requirements, including the type(s) of equipment needed, the quantities and sizes, and approximate dates of use.
- With company management, decide which available option is best for each item: rental, rent-purchase, or purchase.
- Consult **MCAA's Tool and Equipment Rental Guide** for comprehensive cost recovery information for company-owned tools and equipment.
- Select the appropriate vendor for each item.
- Obtain any special insurance required and make sure everyone on the project team knows the terms of the insurance and the company's liability.
- Assign specific responsibilities for keeping records on all rented equipment, maintaining and repairing all rented equipment, and returning equipment and tools to their source as soon as they are no longer needed.
- Keep an accurate record of all equipment rentals and their costs. A sample ["Rental Equipment Schedule" \(Figure 25.2\)](#) in this manual.

For equipment rented by your company to other trades on the job, you should:

- Maintain detailed, accurate records of all equipment rentals, including the date and time each item is rented, the signature of the person renting it, the date the equipment was or will be returned, the rental rate, etc.

Equipment Swaps

Trading equipment with other contractors on the job is risky for two reasons:

- It places your company in jeopardy of legal action if property is damaged or people are injured through use of the equipment.
- It could easily result in damage to your company's equipment for which your company might not be compensated in addition to the equipment not being available for your company to use.

As a result, many contractors strongly discourage swaps of any kind. Nonetheless, situations arise where the benefits of swapping outweigh the risks. The Project Manager must make it clear to every job supervisor or foreman that *he must follow the company's policies and procedures to the letter* when such situations occur. In general, this means:

- Informing the Project Manager immediately.
- Documenting the terms of the swap in writing and having the other party sign them. ["Equipment Waiver and Indemnity" \(Figure 25.1\)](#) can be used to document the use of company-owned equipment.

Additional resource available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin TE 1, "Cost and Control of Tools and Equipment"
- *MCAA Tool & Equipment Rental Guide*

SECTION 26: EQUAL EMPLOYMENT OPPORTUNITY AND AFFIRMATIVE ACTION

The Role of EEO and Affirmative Action

The 1964 Civil Rights Act prohibits discrimination because of race, color, religion, sex, national origin, ancestry, citizenship, disability, pregnancy or pregnancy-related condition, childbirth or related medical conditions (to the extent protected by law), marital status, veteran status, or age (called protected classes). Since 1964, other laws have been enacted to ensure that everyone willing and able to work has the opportunity to do so. Equal Employment Opportunity (EEO) and Affirmative Action programs enforce these laws against discrimination and provide everyone a fair chance for suitable employment.

Your Company and EEO

EEO and Affirmative Action are the law. As a result, your company can face legal prosecution if it does not comply with these programs. Specifically, your company is required to:

- Have an Affirmative Action plan and company policy.
- Ensure that all company facilities remain desegregated, both in policy and in use.
- Afford all protected classes full opportunity and encouragement to participate in all company-sponsored educational, training, recreational, and social activities.
- Conduct regular reviews of all supervisors' adherence to and performance under the company's EEO policies and Affirmative Action obligations.

The Project Manager's Responsibilities

As Project Manager, you are particularly aware of a job's workforce needs. This puts you in an excellent position to help your company comply with EEO rules and regulations. In this regard, your responsibilities are to:

- Be familiar with and maintain a current copy of your company's policies.
- Comply with all EEO and Affirmative Action regulations.
- Be certain all members of the project team, particularly job supervisors or foremen, understand and follow the appropriate EEO and Affirmative Action policies.
- Instruct all members of the project team to inform you immediately if there is an EEO or Affirmative Action-related situation that they are unsure how to resolve.
- Assist company officers in identifying and resolving problems related to EEO and Affirmative Action.

- Regularly discuss EEO and Affirmative Action with labor representatives to verify that your company's policies are being followed.
- Make sure your company's EEO and Affirmative Action policy is clearly posted in an area accessible to all workers on the project.
- Maintain a working environment free of harassment, intimidation, coercion, and other forms of discrimination.
- Encourage all workers equally to participate in company-sponsored educational, training, recreational, and social activities.

In an ideal world, EEO and Affirmative Action laws would be unnecessary. Everyone would be hired on the basis of his or her abilities, evaluated by his or her performance, and trained and promoted to the limits of his or her capabilities. However, historical prejudices and discrimination have necessitated proactive measures to ensure fairness for all. Equal opportunity is a fundamental right and a reflection of our nation's most basic values. Keep this in mind in handling all matters related to EEO and Affirmative Action.

A ["Sample Equal Employment Opportunity/Affirmative Action Program" \(Figure 26.1\)](#) can be found in this manual.

SECTION 27: PROJECT ADMINISTRATION

Project Administration tasks are often the most urgent tasks on a project, but are they the most important? The billings, the labor reports, the submittals, the RFIs, all need to be managed. However, if managing these items does not allow the Project Manager time to manage the schedule and identify negative labor problems, the project will be at risk.

Whenever possible, the tasks of Project Administration need to be done or thoroughly planned during Pre-Construction Planning using a form such as the **MCAA's *Planning for Profitability: Your Guide to Successful Pre-Construction Planning***.

A typical project manager may spend up to 70 percent of a day reacting to minor emergencies, correcting errors, tracking down answers to simple questions, and explaining the obvious. On a six month project (based upon a 40-hour work week), this translates into more than 700 hours of playing "catch-up"--hardly a productive or effective use of time.

If a Project Manager spends 40 hours on project administration and systems as part of Pre-Construction Planning, those 700 hours can be reduced dramatically, allowing the Project Manager to focus on labor issues, change orders, avoiding claims, and improving productivity.

What is Project Administration?

Administration is management. It is a system for controlling project elements and situations to your advantage.

Despite opinions to the contrary, project administration does have a purpose other than saddling everyone on the project with rules and filling every free hour in the project team's schedule with paperwork. Project administration's purpose is simple: increase job productivity and efficiency by establishing proactive rather than reactive management methods.

In other words, effective administration provides a system that actively anticipates and prevents potential problems, saving everyone on the project team from having to react to one unforeseen incident after another. On a poorly organized project, people spend as much time "putting out fires" as they do on installing systems. Since your company earns its money based on the amount of productive work it does each day, it is not surprising that so many unorganized projects lose money.

Good vs. Bad Administrative Systems

A person who sees administration as an obstacle to getting work done has never worked within an effective administrative system. Good project administration clears obstacles out of the project team's way. It resolves details before work begins and gives everyone on the project a formula to follow in every given situation. As a result, no one has to wonder what to do when something unforeseen occurs, and everyone gets more productive work done with fewer distractions and headaches and in a shorter time.

Where an administrative system often goes wrong is in losing its focus. Administration is a tool, not the end in itself. It is goal-oriented. Its objective is not merely to organize, but to organize the project effort towards the specific goal of getting the work done on time and at a profit.

If the Project Manager starts by setting detailed project objectives and then designs policies and procedures that directly relate and contribute to achieving those objectives, the administrative system will prove to be an important ally. If, on the other hand, the Project Manager ignores the fact that each project has its own unique objectives and “personality” and attempts to impose on today’s project the same administrative system used on yesterday’s, the Project Manager will eventually find the system unworkable. Soon everyone on the project team will recognize that the system does not match the project necessary details are missing and some procedures seem to have no purpose at all. What was intended to eliminate problems, double work and distractions suddenly become the project’s biggest problem and most persistent distraction.

This is not to say that policies and procedures that worked on one project won’t work on another. Most will. However, the Project Manager must approach each project from scratch. He must review each part of the administration system with an eye on the project objectives, select appropriate policies, discard others, and create new ones to fit the situation.

The Project Manager’s Responsibilities

Essentially, the Project Manager has three general responsibilities in the area of project administration:

- Establish an effective, goal-oriented system of procedures right from the first day of the project
- Maintain the project team’s compliance with the system throughout the project
- Monitor the effectiveness of procedures continually and modify them as necessary to ensure they contribute to, and do not hinder, the project effort.

Within these three general responsibilities are many specific responsibilities related to organizing the goals and elements of an administrative system. Some are listed below. All are discussed in detail in the appropriate sections of this manual.

Goals of an Administrative System

An administrative system must be goal-oriented. In general the goals of any administrative system are:

- Organize and direct the efforts of the project team for maximum fair profit by:
 - Breaking down the project into achievable, trackable tasks
 - Assigning specific responsibilities to individuals

- Establishing a chain of command
- Ensuring that everyone always has the information, tools, materials, manpower, and cooperation they need to do the job
- Establish a network for communications among all members of the project team and between the project team and other parties involved in the project—the project owner, general contractor, engineer, architect, subcontractors, inspection agencies, etc. by:
 - Identifying who should be talking to whom
 - Providing channels for communication, including reporting and feedback systems, and a schedule of regular meetings
- Devise and implement work methods that maximize productivity and efficiency at all levels by:
 - Applying the most productive methods for fabrication and material handling
 - Employing labor- and time-saving tools and techniques
 - Properly managing project resources – labor, materials, equipment to be installed, tools and construction equipment, and subcontractors
 - Coordinating construction activities with the general contractor, the construction manager, and the other trades on the job
- Monitor and document job progress and events by:
 - Implementing a practical, simple monitoring system that keeps the team apprised of all job situations, helps avoid surprises, and brings the entire team's talents to bear in solving problems
 - Using the project history and present status to forecast project outcome and make adjustments to the project strategy
 - Establishing strict procedures for completing all documentation required to fulfill the contract and to provide the company with detailed project records for planning future projects and substantiating its position in the event of a claim
- Install a proactive, rather than reactive, style of management by:
 - Making everyone on the construction team profit-conscious
 - Encouraging team ingenuity and imagination
 - Looking for and taking advantage of profitable opportunities
 - Anticipating project events and situations, both good and bad

For an administrative system to work, these goals must be applied consistently to every area of the project.

Most, if not all, of the administration system design should be done during Pre-Construction Planning. With the system in place, everyone on the project team will understand their roles and responsibilities.

The very beginning of good project management lies in structuring the project to your own advantage right from the start. Project administration is that structure, and by establishing it early on, you will give yourself a solid management foundation. You also provide everyone else on the team a clear idea of what you expect, specific details of how you want things to be done, and organized, responsive channels for exchanging information, contributing suggestions, and airing concerns.

When used properly, good procedures enhance communication, cooperation, and team spirit. When used inappropriately, they become burdens, obstacles, and sources of resentment. Make your project procedures a means for enhancing participation, cooperation, and imagination among team members, not rules and regulations for controlling and limiting them.

SECTION 28: DOCUMENTATION

The Importance of Documenting the Project

Regardless of its size, a construction project is a maze of details and decisions, successes and errors. To stay on track and to accumulate knowledge to use in managing future projects, the Project Manager must keep complete records of project events, situations, and activities.

Equally as important, the company itself has to know why certain project strategies worked and why others did not, so that successes can be repeated and failures can be avoided. Without this knowledge, everyone in the company from the estimator to the job supervisor or foreman is forced to reinvent the wheel on every project, doomed to working by trial and error, unable to significantly improve their performance or the company's profits.

Goals of Project Documentation

There are five goals of project documentation:

- Create a regular and reliable flow of information about the project so that everyone on the project team is informed about job progress, problems, and opportunities, and so that you have the necessary data for modifying project strategies as necessary.
- Maintain a comprehensive and accurate history of the project for use in planning and managing future projects.
- Record the construction details of the project as built so that accurate technical information is available for operation, maintenance, and servicing of the mechanical systems.
- Establish a set of documents that can be used to verify the actions and decisions of the project team in the event of a claim or dispute.
- Document the project so that the Post Project Review can be used to improve project acquisition strategy, develop competitive advantages, improve construction processes, and validate or change labor productivity factors.

Like every other aspect of a project, documentation is a process that must be planned. As construction starts, grabbing a handful of company forms from the file and assigning someone responsibility for filling them out will not result in a well-documented project. Planning the construction documentation is an integral part of the Pre-Construction Planning process. The documentation trail begins in the acquisition phase and continues into the post job review.

The steps in planning the construction documentation are:

- Review the documentation requirements of the project
- Assess the need and format for:

- Daily job logs
- Labor reports
- As-built drawings
- Change order request and approval forms
- Change order logs
- Forms for recording costs incurred while performing time and material changes
- Purchase orders
- Delivery records
- Requests for Information (RFI) logs
- Submittal logs
- Transmittal logs
- Installation instructions
- Operation and maintenance manuals
- Warranties
- Correspondence
- Other required documents

In most cases, you can use your company's standard forms and procedures for these documents. In other cases, the customer will have specific forms for you to use. Many projects now emphasize digital systems for tracking jobsite information. The Project Manager will need to manage the flow of information, the furnishing of information to other parties, and the jobsite information that might be accumulated for the project that would be used only by the company.

The following three actions will improve the implementation of jobsite documentation:

- Emphasize to everyone on the project team the importance of filling out the necessary forms as construction progresses to avoid relying on their memories and leaving an enormous load of paperwork for the end of the project. Emphasize that documents written and signed the same day an event occurs are more reliable as evidence in dispute cases than documents prepared days or weeks after the fact.
- Make documenting the project a part of every team member's job description. Make your assignments specific and assign them proper priority. Before the project starts, be certain every team member understands his responsibilities and the proper procedures for completing the required forms.
- The quickest way to defeat a good project documentation strategy is to ignore the reports submitted by the project team. Note points that are incomplete or unclear and ask for additional information. Act on recommendations and questions contained in the reports. In short, let everyone on the team know that you value the documentation effort and that effort spent on paperwork is an integral part of the project.

Categories of Project Documentation

Seven categories of project documents are particularly important:

- Project Manager's Site Visit Report
- Daily Job Log
- Project Drawings
- Field-Authorized Change Order Form
- Equipment Documentation
- Transmittal
- Request for Information (RFI)

Project Manager's Site Visit Report

The Project Manager completes the Site Visit Report as part of the regular jobsite inspection routine. The report provides a list of items to check during the inspection. Afterward, it becomes a firsthand record of current job progress and jobsite conditions.

As a record, the Site Visit Report is important for two reasons:

- It provides data for Short Interval Planning
- It serves as a vehicle of communication with the job supervisors or foremen, subcontractors, and the customer

A sample ["Project Manager's Site Visit Report" \(Figure 28.1\)](#) is included with this manual. The Project Manager should complete a Site Visit Report at least once a month. Whenever possible, you should insist that the job supervisor or foreman is present on the inspection tour, so that situations can be discussed immediately.

After the tour, make copies of the completed report form and:

- Place a copy in the project file.
- Distribute copies to appropriate field and office personnel.
- Use the report to prepare memos or other notifications of project situations to subcontractors, other trades, and the customer.
- Use the report as a basis for the next Short Interval Planning Meeting.

Daily Job Log

The Daily Job Log is a record of each day's project activities and events recorded by the job supervisor or foreman. *It is the single most important document on any project, serving four major purposes:*

- Create a thorough, accurate history of the project for planning future projects.
- Document the company's positions in claims and disputes.
- Alert the Project Manager and office personnel to project situations requiring immediate attention.
- Provide a standardized daily means of written communication between the office and the field.

Because the Daily Job Log is so critical, the Project Manager should make every effort to ensure that the job supervisor understands its importance and knows the proper procedures for completing it. In particular, he must understand that:

- It must be completed and submitted daily, even if he keeps a personal diary of project activities and situations.
- It must include *all* the events of the day, both favorable and unfavorable.
- It must describe all project events and conditions accurately and realistically.
- He should use the "Questions/Comments for Office" section of the form for communicating with the office.
- He must *sign and date* the form before submitting it to the office.

At the same time, the Project Manager should emphasize to the job supervisor or foreman that the Daily Job Log is *not*:

- An attempt to describe unfavorable project situations in a favorable light
- A spelling or grammar test

The idea is to make sure that the job supervisor or foreman is comfortable with being honest in reporting and expressing his observations, ideas and questions.

The Project Manager has specific responsibilities regarding the Daily Job Log, namely:

- To provide the job supervisor or foreman with all the materials needed to submit accurate and complete reports, including report forms, stamped envelopes addressed to the company office (if each Daily Job Log is to be mailed), fax machine, scanner, computer, and,

where allowed, a still camera or video camera for recording project progress and conditions.

- To properly train the job supervisor or foreman in completing the necessary forms, operating the camera(s), using the electronics, etc.
- To review each completed Daily Job Log the day it is received.
- To act on the information in each Daily Job Log.
- To establish a policy of responding as soon as possible to any questions in the "Questions/Comments for Office" section of the form.
- To contact the job supervisor or foreman for clarification of any unclear or incomplete information in the Daily Job Log.
- To use the information on the completed forms for Short Interval Planning, tracking job progress, identifying claim situations as they develop, documenting changed conditions, developing a "measured mile" analysis, and communicating with the customer, the subcontractors, and other trades.

Only if the Project Manager upholds personal responsibilities can the job supervisor or foreman be expected to do the same.

A sample ["Daily Job Log" \(Figure 24.3\)](#) can be found in this manual. It may vary from the report form used by your company. If so, replace the manual's copy with your company's form, and include the instructions for completing it.

As an example of the kind of detailed instructions the Project Manager should give the job supervisors or foreman, the following is a set of instructions for completing the sample Daily Job Log form:

- *Job* – Fill in the job name and project number.
- *Date* – The date of the events described. The log is useless unless it is dated.
- *Weather* – Because weather can drastically affect job activities, this information is vital, especially if the report is needed in legal proceedings involving a claim.
- *Workers* – In the appropriate spaces, fill in the number of workers (plumbers, fitters, apprentices, subcontractor's employees, etc.) on the project.
- *Rental Equipment on Job* – List all rented equipment on the project.

- *Deliveries Received* – List all freight shipments received, being as specific as possible. Note any shortages or damaged items in any shipment. If damaged items were received, see [Section 24: “Jobsite and Project Organization”](#) for further instructions.
- *Delays* – State whether your company is delaying other contractors’ activities on the job or other companies are delaying your activities. Identify the parties involved and list the names of people who participated in discussions with you about the problem. If further explanation is needed, use a separate sheet. (This section of the form is particularly important if a delay claim is filed at a later time.) If using Short Interval Planning, show the schedule changes made and actions taken to deal with the delay.
- *Verbal Instructions Received* – If you are given verbal instructions by the owner, architect/engineer, inspector, or prime contractor, record those instructions in adequate detail. Have the person who issued the instructions verify them by signing this section of the report. Remember not to proceed with these instructions until you have received authorization from your Project Manager.
- *Safety Issues* – This section is very important to protect the company and the job supervisor or foreman. List all accidents, both major and minor, in detail, specifying time, location, person(s) involved, extent of injury, first aid action taken, etc. Fill out a separate OSHA (or other approved) accident report form for each accident that occurs on the project. In addition, document all project safety meetings including date, time, attendees, and meeting topic. Document all safety training and operational training done on or off site as that training applies to your particular job. For further details on safety see [Section 21: “Safety Management.”](#)
- *Visitors* – It is important to log all visitors who enter the jobsite. List the visitor’s name and the name of the firm or organization that he represents. Also, list the times of arrival and departure and the purpose of the visit and any significant incidents that may have occurred. (Information about visitors can be important during legal proceedings.)
- *Photographs and Videos* – If cameras are allowed on the jobsite, document with pictures and videos significant project conditions or events. Use the device’s calendar feature to capture the day and time of each event.
- *Questions/Comments for Office* – If you have questions, remarks, requests, or other items for your company’s office staff, list them here. If appropriate, address your questions and comments to a particular person. If your question or comment is urgent, telephone the office for a quick response.
- *Signature and Date* – Be sure to sign the report and note the date that you completed it. Without your signature, it is not a legal document. Once you have completed the form, keep a copy for your records and deliver a copy to your company office.

As-Built Drawings

As-built drawings, sometimes referred to as “as-builts,” are drawings created as construction proceeds in order to accurately record any change in the contract documents. Typically, construction contracts require the contractor to produce the as-built drawings by denoting any change on an unmarked or “clean” set of original drawings.

This duty to produce as-built drawings varies by contract, so it is imperative that during Pre-Construction Planning the Project Manager review the contract documents carefully to ensure the responsibilities are completely understood. For example, some construction contracts now require as-built drawings to be drawn on a digital set of plans using a separate layer. Others simply require a colored pen on a clean set of original plans.

As a job progresses, changes are made. By the time a project is completed, certain parts of the project may be completely different than what was shown on the original plans. As-built drawings are important to your company for the following reasons:

- They are the only way to track and record how the job was actually built.
- They may seriously affect the company's cash flow, as they typically are required before final payment and/or retainage is released.
- When future maintenance or repair is needed or when an emergency arises, they are the only *sure* way the project owner knows exactly where project components are located and how they were installed.
- Most construction contracts require that as-built drawings be maintained *as the job progresses*.
- As-built drawings can be a useful sales tool. If the project owner's set of as-built drawings is misplaced but a set is retained by your company, you may be able to secure future service and construction work.

As with so many other aspects of the project, ensuring that as-built drawings are properly maintained is a matter of setting strict procedures and then enforcing them. The Project Manager should assign a specific individual, preferably the job supervisor or foreman, with full responsibility for the as-built drawings and should make clear to that individual that they must:

- Keep the set of drawings being used for as-builts clean and in good condition by storing them in the job office and not using them for construction.
- Update the drawings *daily*, before important details are forgotten and the work of other trades covers up changes that were made.
- Make sure that subcontractors update their as-built drawings daily and keep their copies in good condition.

- Submit copies of all as-built drawings to the office on schedule so that final drawings can be drafted and prepared for submission to the project owner.

The Project Manager also must make sure that the job supervisor or foreman receives a clean and complete copy of the project drawings to use strictly to produce the as-built drawings.

“Fast Track” Project Drawings

Today more and more projects are *fast track* or design/build jobs. These projects are planned and organized for quick completion. On most fast track jobs, drawings are created as work progresses and are changed frequently. If the project team does not stay on top of these changes, they can easily get out of hand.

These changes can take several forms. Among them:

- New issues of individual drawings
- 8 ½" x 11" drawings that modify parts of existing drawings or add new areas to the project
- Letters of Clarification answering questions that have come up among members of the project team, such as questions about dimensions and other specific project details

As the Project Manager of a fast track drawing project, you should:

- Log every change as soon as it is received.
- Use a colored pen to highlight or cloud the drawing changes on the most current set of drawings.
- Tape all 8 ½" x 11" drawings of the same building area onto the most current set of drawings.
- Make sure each subcontractor's job supervisor receives complete drawings of all changes, whether or not they directly affect their part of the job.
- Update the construction drawings just as the as-built drawings are updated: daily.

Field-Authorized Change Order Form

A Field-Authorized Change Order Form is used for two purposes:

- To obtain written authorization for change work requested by the project owner, the prime contractor, or other project authority
- To track all labor, materials, tools, and equipment used in doing change work

Procedures for properly using a Field-Authorized Change Order Form begin with everyone on the project team, especially field personnel, following the company's procedures for change orders in general, specifically:

- Do not begin any change work until the order is approved by the Project Manager.
- Request that any change ordered by the project owner, project architect/engineer, or prime contractor be given in writing.
- If the schedule requires the job supervisor or foreman to begin work on a change before written approval is received from the owner, design professional, or prime contractor, this must be noted on the Daily Job Log.
- If the job supervisor or foreman feels the work requested is outside the mechanical contractor's scope of work, the Project Manager should be contacted immediately.
- All direct and indirect costs of change work must be accurately recorded and carefully tracked, both to provide billing information for time and material (cost-plus) change work and to provide a historical record for use in estimating costs for future change work.
- All change orders must be recorded and tracked on a change order log.
- When using Short Interval Planning, note on the schedule the field-authorized changes and the impact to the original scope of work.

A sample ["Field-Authorized Change Order Form" \(Figure 28.2\)](#) can be found in this manual.

Equipment Documentation

Equipment documentation includes all written materials required for the installation, testing, and operation of the mechanical equipment by the mechanical contractor or subcontractors. Among the materials are:

- Submittal sheets
- Shop drawings
- Receiving report noting any problems with the delivery
- Operation and maintenance manuals
- Test reports
- Air and water balance reports
- As-built drawings

- Start-up notices
- Warranty letters
- Maintenance contract proposals

[“Equipment Waiver and Indemnity” \(Figure 28.3\)](#) and [“Rental Equipment Schedule” \(Figure 28.4\)](#) sample forms are provided in this manual.

Transmittal

The transmittal is a short letter or memo. It may be used as communication in and of itself, or as a cover letter for additional correspondence referred to, attached, or enclosed. The information referenced in the transmittal may even be already in the hands of the addressee, such as construction plans or specifications of a particular project.

Transmittals contain all the subject matter of a normal letter. They are generally formatted for short messages and do not lend themselves to multi-paragraphed or multi-paged documents. This is true for manual (handwritten or typed) transmittal letters, as well as for computerized printouts.

In most cases, it is better to use a written transmittal than a telephone call for several reasons. The most obvious is that the subject matter is documented, and it can be proved that notification was given and when it was given. In addition, the written transmittal provides the other party with documentation that can be used to formulate a plan of action.

The following items should be included in all transmittals:

- Date
- To
- From
- Project identification
- Transmittal number and identification, if applicable
- Text of transmittal
- Date of response required (if any)
- Names of those to whom copies were sent

A sample [“Letter of Transmittal” \(Figure 28.5\)](#) is included in this manual.

Requests for Information (RFIs)

The Request for Information (RFI) is a specific type of written communication to document contract questions and record the resulting answers. The subjects addressed by an RFI can and will affect the dollars in or out of someone's pocket. An RFI may address critical issues with immediate time constraints, or it may relay requests that flow in the normal course of doing business.

The Purpose of an RFI

The primary purpose of the RFI is to keep the project moving by getting questions answered. Information conveyed promptly assists the project immensely. By the same token, lack of information hinders the project by creating doubt, indecision, frustration, and general dissatisfaction. The following axioms apply:

- Lacking direction, people will make decisions
- Lacking direction or answers, individuals and/or companies will choose the path that maximizes their own profit

Participants in the project make decisions throughout the course of the project. The challenge is to get them to base these decisions on the best interests of the project rather than their own immediate benefit. Favorable responses are much more likely if the information needed by the deciding party is readily available for their review.

The purpose of an RFI is to obtain accurate, reasonable, well thought-out answers to questions so the project can be built to the best of your ability and profitability can be maximized. When the prime contractor or a subcontractor puts the question in writing, the chances of receiving a thoughtful, intelligent answer increase dramatically. By documenting these questions in an RFI, the Project Manager helps to ensure three things:

- Obtaining an answer to the question does not depend solely on someone remembering that the question was asked.
- Documenting questions asked, no matter how insignificant they may seem, will help protect the mechanical contractor's position in the future when that item affects the progress of the whole project.
- It will be assured that the actions taken are correct per the instructions of the architect/engineer, owner, or prime contractor.

Without this documentation, the participants proceed with a solution based on hearsay or someone's interpretation of intent. The result is that the item in question may be installed or built incorrectly.

Consequences of Failing to Use an RFI

Even if the plans and specifications are incorrect, both the architect/engineer and the contractor have an obligation to the project owner to use their “construction expertise” to point out these problems on the owner’s behalf.

Problems arising from unanswered RFI’s are compounded when the prime contractor or owner must contact a third party for information. By documenting the question in an RFI and then tracking and following up on that document, your company and others involved in the process will not have to deal with unnecessary future problems.

Items to Be Included in All RFIs

The following information should be included in all Requests for Information:

- Project
- Location
- RFI number
- Project number
- To
- From
- Details of request
- Date response needed (ASAP is not a date)
- Re: (specific drawing and/or specification references)
- Response from (signature)
- Date of signature
- Distribution: Sent to whom? (This standard item can be an important tool. For example, if a copy is sent to the owner, he is alerted to the possibility that the subject of the RFI may cost some money. The owner should, as a result, be less surprised by the extra expense later on. Sending copies also makes field personnel and subcontractors aware that a question (RFI) has been submitted to the prime contractor.)

General Rules for RFIs

- *Keep It Simple and Limit the Number of Questions* – The number of questions addressed in one RFI should be minimized so the answers are not delayed until all of the information for all of the questions can be obtained. In fact, it is best to limit each RFI to one topic or

question. This does not mean that eight separate RFIs should be sent to address eight different questions about finish hardware. However, individual RFIs should be sent if they pose questions on separate subjects, such as structural steel and plumbing.

Separate RFIs should also be sent, even if they are on the same subject, if one of the questions must be answered immediately, and the other one can wait several weeks. Again, it is easier and faster to obtain an answer to one item rather than waiting for a long series of questions involving several aspects of the work to be researched. It may take weeks to obtain answers to all of the questions when the most important one could have been answered in a day.

- *Provide a Possible Solution* – An RFI should address a specific item or group of items such as:

RFI example: What is the dimension of the hallway No. 101 as shown on page A-5? It scales to 4'-0", but the given dimension is 4'-8". Please respond by [specific date and time by which you would like a response] as we are laying out this area.

Note that this example begins with the question. The question to be answered is right up front with no room for ambiguity. The example also briefly explains why a quick answer is requested.

In the example, the answer most likely will be that the corridor was supposed to be 4'-0" and the drawings were simply dimensioned incorrectly. This may be a simple error, but it should still be documented.

As a side note, it makes no difference that the drawings specify that the printed dimensions govern and that the drawings should not be scaled. In this case, if the contractor had not scaled the drawings, he would have been working with the wrong dimensions. Good communication often means good cooperation. RFIs are a means to establish good communication.

A sample [**"Request for Information" \(Figure 28.6\)**](#) is provided in this manual.

Keeping Good Records of Potential Problems

It is important to maintain a good recordkeeping system for a project for many reasons. Some, such as payment backup requirements, are obvious. Others become evident when records are critically needed to deal with unforeseen problems.

The first thing to think about is the importance of setting up a separate cost or phase code to cover a specific problem. Keeping cost records for a specific problem is no more unusual than keeping cost records for work that you are directed to do on a time and material basis. The only difference is that with time and material work, the owner has agreed to pay for the work subject to support for your labor costs through daily time sheets. The approach you use in

keeping that information separately is essentially the same approach you should use in keeping appropriate records for a claim item.

It is critical to keep good records regarding claim situations. Sometimes those records serve as constructive notice or support for claim items, which initially were not recognizable. They are the keystones to maximizing your recovery for extra costs and time extensions. Good records include:

- Daily time records indicating the types of work and areas of performance
- A separate cost or phase code for the work
- Daily and weekly reports and logs kept by field personnel
- Short Interval Planning schedules used for managing individual crews
- All correspondence
- Memoranda relating to observations, directions, conversations, telephone conversations, and inspections
- Minutes of meetings
- Project schedule updates and supplementary schedules
- Weather conditions and effects of previous weather conditions (e.g., “too wet to work today because of rain yesterday”)
- Transmittals and approvals of submittal date
- Quantity surveys by work period
- Records of drawings received.
- In some instances, particularly when you are attempting to show how your workforce is affected by problems like congestion and disruption, you might want to videotape work as it is occurring on the project.

The process of keeping good records involves more than the routine of preparing and maintaining such records. It involves thinking about what is or might be needed to support your position and what could be harmful if inappropriately recorded. For example, maximizing your recovery on claims for inefficiencies can be largely dependent upon the records that you have to support those claims. Think about what you will be trying to demonstrate to support your recovery. You will be trying to demonstrate that the conditions in which you had to perform differed from what you reasonably expected at the time when the project was bid. Supporting such a claim could include records of:

- The time and cost of performance of similar work that was performed under reasonable conditions at other locations of the project (or, if not available, at other projects). This would include some measurement of how much work was done in a unit of time, the size and makeup of crews, photographs of the area, and information which demonstrates that the condition you are complaining about was not existent there.
- Estimating files, which support your conclusion that the rate of performance is worse than that which should have been reasonably anticipated.
- The inefficient work, showing some measurement of how much was done in a unit of time, the size and makeup of crews, impact factors, photographs of the actual conditions dated and signed with notes about what the picture depicts, interference and/or congestion by others, adverse weather and temperature conditions, experience and continuity of craftsmen qualifying them to do the work efficiently, memoranda explaining the cause of the problem and internal notes indicating who will be able to explain the problem for you later on.
- Charts and graphs comparing the differences in efficiency between “the standard” and the impacted work. See [Section 36: “Claims”](#) for a discussion of a Measured Mile Analysis.

Stick to the relevant facts. When keeping routine records, be careful not to unnecessarily embellish them so as to dramatically point a finger at one party or another.

Without comprehensive and accurate job records, the Project Manager is working in the dark, not only on the current project but in the planning of future projects as well. At the same time, lack of good documentation leaves the company virtually defenseless if claims or disputes arise.

Maintaining good project records is not a difficult task, but it is a detailed and sometimes tedious one. To sustain the project team's efforts on project documentation, the Project Manager must stress that the paperwork is appreciated and contributes to the effective management of the job.

Several sample notification letters for various situations you may encounter on the job are included in this manual:

[Figure 28.7: “Notice of Differing Site Conditions”](#)

[Figure 28.8: “Notice of Acceleration”](#)

[Figure 28.9: “Notice of Delay \(Force Majeure\)”](#)

[Figure 28.10: “Notice of Extended Overhead”](#)

[Figure 28.11: “Notice of Extra Cost”](#)

[Figure 28.12: “Notice of Interference”](#)

[Figure 28.13: "Stop Work Notice Due to Prime Contractor Directive"](#)

[Figure 28.14: "Notice of Work Stoppage"](#)

[Figure 28.15: "Notice of Weather Delay"](#)

[Figure 28.16: "Notice of Delay of Start of Work Due to Prime Contractor Directive"](#)

***Additional resources are available through MCAA's online
[Resource Center](#):***

- *MCAA Management Methods Manual*
 - Bulletin BF 2, "Forms for Temporary Heat or Cooling"
 - Bulletin ET 1, "Business Writing for Success"

SECTION 29: MOTIVATION AND LEADERSHIP

Motivation and Profitability

Everyone works best when motivated. Motivation is why so many people are intensely devoted to their hobbies and are so successful at them. It is also the secret behind those who are best at their jobs. Most often, people who love their jobs are driven to do their jobs well, and feel personally vested not only in their own accomplishments but in the success of the company as a whole.

Of course, money has a lot to do with motivation on the job. Earning a good income and having job security are at the top of the list of factors that motivate most people to work. But, more and more, people are realizing that financial gain is not the only incentive. Others include:

- Social status and the respect of peers
- Challenge and a sense of achievement
- Being treated as an individual
- Having ideas listened to and contributions to the work effort respected
- Having fair, diligent, knowledgeable and responsive supervision

The degree of team motivation on a project dramatically affects project profitability. The reasons are easy to understand:

- Motivated individuals commit themselves to becoming good at their jobs and take pride in the results of their work, ensuring excellent quality control.
- Motivated crews have the highest productivity because their pride can drive them to “beat the schedule.”
- Motivated teams are innovative, constantly designing new ways to improve efficiency.

For these reasons, it is important that the Project Manager learn how to motivate the project team.

Motivation and Leadership

The relationship between motivation and leadership is direct and immediate. Leadership is the combination of abilities, attitudes, and behavior that wins the respect of subordinates and motivates them to assist the leader in getting the job done. It has nothing to do with forcing people to work. There is a difference in both the attitude involved and the results achieved.

Leadership is absolutely necessary for team motivation. It creates the desire to excel, stimulates the self-motivating engine in every individual and focuses attention on the job at hand. It also

removes obstacles to motivation by resolving conflicts, eliminating frustration, and providing the resources the team needs to complete the project as efficiently as possible.

One of the most important motivational relationships you can develop is between you and your job supervisor or foreman. He is your eyes and ears on the project day every day. If this relationship is solid, chances are the job supervisor or foreman will have that same relationship with the crew.

The Challenge to the Project Manager

Though some people seem like natural-born leaders, leadership is a skill that must be learned. Just like in sports, some people have a natural ability to lead and others must try a little harder. The power to motivate is also a skill like any other; it must be practiced and perfected. The challenge to the Project Manager is to develop the abilities, attitudes, and behaviors that enable him or her to lead and motivate the project team.

Among the elements of successful leadership are:

- *Knowledge of your job* – Those under you must recognize that you are technically competent and prepared for every project you undertake. Confidence in leadership is essential for team motivation.
- *Self-discipline* – Stick to the business at hand by:
 - Keeping your attention and efforts focused on what is important.
 - Controlling your temper in front of the team.
 - Avoiding public criticism of company management, the prime contractor, the project owner or anyone else in authority on the project. If you blame others for problems, the project team will come to believe that you are powerless, and your authority on the project will dissolve.
 - Take responsibility for your mistakes.
- *Giving good instructions* – Give instructions that are clear and complete. Make sure everyone understands *exactly* what is expected and that what you are asking is reasonable. Vague or unreasonable goals and instructions destroy team morale.
- *Following up* – After giving instructions, check regularly to make sure they are being followed. This demonstrates that you enforce the instructions you give and are available for clarification and support.
- *Recognizing achievement* – Give outstanding work the recognition it deserves. Even the toughest veteran on the team has an emotional need for recognition, and well-deserved recognition given appropriately is especially rewarding.
- *Inviting input* – Your company doesn't simply hire bodies. It hires brains, too, and a Project Manager who doesn't take advantage of the experience, knowledge and creativity of the

project team contributes to morale problems and overlooks a powerful resource. To avoid this:

- Encourage all members of the project team to share their ideas.
- Let every person on the team know that his contributions are welcome and important.
- *Delegating responsibility* – Project Managers who try to do everything on their own overwork themselves and are not utilizing resources available to them. Delegate responsibility to those who have proven themselves and to those who you believe have potential. They will appreciate your confidence in them, gain recognition from their peers, and usually work harder to prove themselves worthy of your confidence in them. And, with more time to plan and manage the project, you'll be a more effective leader.
- *Applying discipline* – The purpose of discipline is to improve a person's future conduct by identifying problems in his present conduct or performance, and it is a necessary part of leadership. However, you should follow certain precautions when reprimanding anyone:
 - Give reprimands in private, not in the presence of others.
 - Give the person an opportunity to tell his side of the story.
 - Never lose your temper.
 - Identify the problem and a potential solution
 - Be hard on the problem and soft on the person.
- *Communication* – Without communication, there is no leadership. Make every effort to:
 - Communicate clearly and be a good listener.
 - Boost your team's morale by explaining company plans and goals to them and making them feel a part of the overall company effort.
 - Build the team's pride in the company by emphasizing the company's reputation for expert craftsmanship and quality service.
 - Listen to the team's work-related problems, complaints, and suggestions, and be sensitive and responsive to them.
 - Don't just answer questions; ask them.
- *Consistency* – Set standards and stick to them. Everyone deserves a clear idea of what you expect and how you measure performance. Inconsistency leads to confusion and fear of unwarranted and unexpected criticism.
- *Positive attitude* – Maintain a positive, results-oriented attitude. Look at problems as challenges, and unexpected situations as opportunities. A "we can do it, we can solve it" attitude is infectious. Team members catch it from their leaders; it welds them together, gives them confidence, and boosts morale.
- *Profit orientation* – You work to earn a living. Your living, and that of everyone on your team, depends on the company making a profit. It's important that everyone on the team

understands that individual efforts affect company profitability. You, as the Project Manager, must understand and emphasize that:

- In most cases, an employee's concept of how much profit the company makes is greatly exaggerated. A mechanical contractor's net profit on even the most successful project rarely climbs above a few percent of the amount billed.
- Without profits, the company cannot remain in business and cannot continue to employ its workers.
- Everyone's commitment to the project helps boost productivity and maximize profits.
- Time is money. A project that takes longer than expected can lose profit.
- Materials are money. Wasted materials can take a big chunk out of company earnings.

Though not exhaustive, these aspects of leadership form the foundation of effective management and team motivation. If you plan to make management your career, you should study leadership by attending seminars and workshops, taking courses and reading books on the topic. The only way to become a good leader is to know and master what it entails.

Construction is a people business. Consequently, the human factor figures prominently in the success or failure of any project. Good leadership aims at motivating the people involved, strengthening individual and team commitment, and generally ensuring that the human factor is a positive rather than a negative influence on the project and its outcome.

SECTION 30: MANAGING MULTIPLE PROJECTS

Managing multiple projects in any industry usually requires long hours and is full of instant changes, stress, tensions, delays, and uncontrollable events. A construction Project Manager is no different – he handles multiple projects, all in various stages of completion. The challenge you face every day is to manage all projects to a successful, profitable conclusion.

The term Project Manager can be defined as, “The person who has total responsibility for ensuring that the project is completed on time, within budget, within scope, and at the desired performance level.” Similarly, the term project management could be defined as, “The planning, scheduling, and controlling of those activities that must be performed to achieve project objectives.”

If a Project Manager has total responsibility for project outcome, it follows that project management is a series of activities that if done and executed well, projects will meet goals and objectives. This is where some Project Managers get lost along the way. They get caught up in the management and lose sight they are the Project Manager.

Instead of *managing the project*, some become more of an administrator, taking care of details and doing activities that others could (and should) do. The administrative work is a comfortable place with little or no conflict. If the administrative work is taken on in addition to the management of the project, more hours will be spent than necessary. With resources and budgets tight, everyone is taking on more work. And that includes you.

Unfortunately, it is also easy for the Project Manager to fall into the mode of managing by crisis: spending all day, every day, “putting out fires.”

Managing by crisis is a *reactive* management style, or reacting to emergencies as they arise. This style usually results in neglecting important activities that need to be done but do not fall in the category of requiring urgent attention; consequently they may not get done. A superior management style for construction projects is one in which a Project Manager is proactive, anticipating problems and addressing them before they become issues.

How does a Project Manager change from a reactive to a proactive management style? Pre-Construction Planning will enable you to anticipate problems and create opportunities during the course of the project. Any planning that is done prior to the start of construction will aid the Project Manager in being more proactive. Even if you find you must modify the plan during the execution phase, you have something to start with. You must make it a goal to manage each project more efficiently and effectively than the previous one. Achieving this is difficult and complex, involving changing how projects and personal time are handled. This section identifies a series of problems and suggests possible solutions that can help you move from being reactive to proactive through leadership, motivation, communication, and direction.

All of these ideas apply to managing single projects as well, but are especially important when managing multiple projects.

Personal Time Management

Problems

- Deviation from daily plan
- Not enough time to manage site labor
- Lack of effective motivation and communication with different types of people
- Loss of team concept when problems arise
- Too many meetings
- Too much paperwork
- Not allowing time in your day to handle important spur-of-the-moment issues
- Lack of adequate support personnel to handle routine items

Suggestions

- Use a monthly and weekly planning calendar. When planning your days, never dedicate all the time in each day to known work items. Reserve *at least* two hours of each day to handle unknown activities that *will* occur.
- Learn to say “no” to requests that have little value.
- Everyone is different. It is your job as the project leader to understand people. See [Section 29: “Motivation and Leadership”](#) and [Section 31: “Communication”](#) for tips on how to communicate and lead.
- Delegate the responsibility of repetitive items such as routine paperwork, some telephone calls and letters, expediting materials and equipment, and transmittals. If this kind of help is not readily available, discuss the problem with your supervisor or ask someone to help you yourself. You will be surprised what people will be willing to help with.
- Use standard forms, procedures, and checklists on all projects.
- Many times, you are asked to attend long meetings in which subjects of interest to you are covered in a few minutes. If this occurs, you may want to talk to the person conducting the meeting to see if you can be excused from discussions covering subjects of no relevance to you or if you can meet separately to cover your subjects. If you call a meeting, publish and stick to an agenda. More information on meetings can be found in [Section 17: “Conferences and Meetings.”](#)
- Effectively use technology to reduce paperwork and save time.

- Learn to delegate work to your job supervisor, foreman or others, as appropriate. Assure you give necessary guidance. Help him or her grow to carry more of your load.
- Conduct effective Turnover Meetings. This initial meeting is important but is sometimes not considered urgent and is consequently neglected. Strive to prepare well, schedule the meeting, and conduct it on time. A more thorough discussion of Turnover Meetings is found in [Section 8: "Turnover/Kick-Off and Pre-Construction Planning Meetings."](#)
- Schedule your activities so that you spend time at each jobsite to help the job supervisor or foreman manage the field labor and to maintain a dialog with the customer.
- Justify all requests that you make to your supervisor with a cost or quality improvement.
- Avoid some problems by religiously utilizing the tools described in this manual.

Third Party Delays and Schedule Changes

Problems

- The owner's completion date does not change, even though there are significant third party delays. This often results in overstaffing, overtime, and/or remobilization, without compensation from the customer.
- The prime contractor makes schedules without input from the trade contractors, and commitments are made in the form of an overall schedule.
- Delays in the schedule significantly impact workforce loading.
- Late delivery of materials or equipment.

Suggestions

Many of these delay problems are related to the customer. The following apply to these areas:

- Submit, along with your bid, the schedule used as a basis for your bid. A deviation from your bid schedule is a reason for reviewing your project costs and submitting a change order for your increased costs. This same procedure should be used for any schedule change imposed on your contract work.
- Consider submitting a change for your increased costs anytime you have to change your workforce loading, whether or not your schedule is impeded.
- Record all delays, why they occur, and their impact on your job plan. The Daily Job Log is the best way to record these delays.
- Utilize good Short Interval Planning to minimize the cost impact of delays.

- Take a proactive management approach and discuss impending problems with other trades or the prime contractor before the delay occurs. Many times alternate plans can be developed to minimize the impact on your work.
- Taking a proactive approach can usually solve late delivery of materials or equipment. Critical orders, either placed by the owner or by your company, need to be expedited by telephone, fax, e-mail, or personal visits to the supplier. Most owners will welcome your assistance in maintaining the project schedule in this way.

Drawings and Specifications

Problems

- Bid documents are incomplete and inaccurate and the contractor is expected to take care of these problems as a part of bidding the project.
- Space limitations and interferences are usually not discovered until field erection is in progress.
- Design firms are very slow in reviewing and returning equipment drawings, shop drawings, and Requests for Information (RFIs).

Suggestions

- Use an RFI to identify design drawing and specification problems. These issues should be referred to the responsible entity as soon as possible, giving a date when the response is required to prevent cost and schedule problems.
- Identify and resolve problems before the fieldwork begins. Requests for solutions may be made verbally, but should also be put in writing in an RFI. This RFI should also include the response needed date required to prevent cost and schedule problems. The RFI process should be started as part of Pre-Construction Planning. For more information on RFIs see [Section 28: "Documentation."](#)
- Equipment drawings that need review and approval by the design firm should be conveyed by a written transmittal that clearly states the required need date for approval.

Other General Problems

- Labor costs are the most volatile of cost items to be controlled by the Project Manager. They are often neglected because, though critical, they are not as urgent as fighting fires. Here again, as Project Manager, you must strive to review project labor cost trends weekly or biweekly in the early stages of the project. As the project progresses, less frequent reviews may be appropriate, unless some problem in labor cost indicates the need to continue the weekly reviews.

- Construction is a people business. The Project Manager must deal with all types of people, from many different backgrounds, and must do it successfully if the project objectives are to be achieved. One of the primary responsibilities of the Project Manager is to understand each individual, determine how to motivate him or her, and work together in an agreeable manner. This will not happen unless you take time to study each individual and work at developing a good relationship.
- Sometimes your supervisor or your company's CEO may require you to spend too much time and effort on activities that decrease your ability to manage your projects. The best solution is usually the direct approach of meeting together and openly discussing the problem.

What is the upper limit of how many projects a Project Manager should handle at a time? This question is often asked but rarely answered. It is difficult to determine because of the many variables that affect sustained performance, including the experience and ability of the Project Manager, the size and nature of the projects, the location of the projects, and the prime contractor and owner involved.

While the suggestions in this section will ease the coordination of multiple projects, the bottom line is this:

Success in handling multiple projects is achieved by managing each project effectively, efficiently, and with enthusiasm, and taking personal responsibility for each project.

SECTION 31: COMMUNICATION

Why Communication is Important

Communication can seem like an over-used topic in the business world. Many books and training programs on both the value and the “how-to” of effective communication in the workplace exist. Yet, despite this abundance of material, most organizations need to do a better job of communicating to compete in today’s marketplace. In the construction industry, effective communication between managers, supervisors, workers, and the various trades on the jobsite can literally make or break the profitability and productivity of a project.

Part of the problem lies in the nature of the construction business itself. Everyone is in hurry and juggling many jobs at once. No one stands in one place for very long. It is practically impossible to get more than 10 percent of the management team in the same room at the same time. Yet this industry critically depends upon communication.

As a Project Manager, effective communication is a skill that you must use every day. This gives you the opportunity and also issues the challenge to improve the communication process on your projects. This section contains valuable information that should be periodically reviewed to see where you can implement improvements that can ultimately increase the productivity of the projects you manage.

A Matter of Priorities

Another part of the problem is that communication and the communications process are usually not on the priority list. For example, consider this typical list of “Things to Do Today”:

- Convince the general contractor to let your foreman use the crane to set equipment before the contractor pours the overhead deck.
- Track down a 40-foot trailer full of pipe that is lost somewhere between here and Alaska.
- Work out your differences with the construction manager on another project so you don’t have to go to court over \$15,000 of back charges.
- Check on the status of unapproved changes.

After reviewing this list, is there anywhere that a specific task of improving the communication process on the project is listed? Yet, each of these items requires communication in some form. In fact, it is difficult to think of a single project activity – from planning, scheduling, and reading drawings to negotiating change orders, holding safety meetings, arranging for system tests, and completing punch lists – that isn’t, at its core, a communications activity.

Seen from this point of view, it starts to look as though trying to manage a construction project without knowing how to communicate effectively is a little like trying to play one-on-one

basketball without knowing how to dribble. Your lay-up may be a thing of beauty, but you have no way to get the ball down the court for the shot.

A Working Definition

Communication is a collection of tools to help you understand and be understood. Some are best for listening, others for speaking and writing. The most important communication tool is the ability to focus all of your attention on what you are hearing as well as what you are saying – to recognize when someone does not understand what you are trying to convey, and to admit when you don't understand what someone else is trying to tell you. Some tools of communication are most effective face-to-face. Others are best for memos, e-mails, letters, and telephone conversations. As in any craft, mastery lies in using the right tool at the right time. You must choose the communication tool that is most likely to achieve the outcome you desire. Do not choose a communication tool simply because it is easy. You may only have one shot at it. Aim wisely.

Everyday Tools for Communication

There are two basic categories of communication tools: formal and informal. Formal tools are such things as:

- Meetings
- Letters
- Memos
- E-mail
- Fax
- Project contract
- Change order approvals
- Organizational chart
- Project reports and records
- Crane operation signals
- Posted signs
- Submittal data
- Project drawings and specifications

- Written job procedures
- Company policies
- This manual

Informal tools for communications include:

- Conversations
- Asking questions
- Telephone calls
- Notes
- Texting
- Facial expressions
- Body language

Communicating effectively requires you to select the right tool for each task – formal or informal, written, verbal, or gestural. Sometimes selecting the right tool depends on the situation. Negotiating a change order with the project engineer, for example, demands an approach completely different from discussing the weekend football game with him or her over coffee. Explaining a new system for packaging and identifying fabricated work might take several hours while getting the crane to raise that bundle of fabricated components to the roof requires only a few hand signals.

At the same time, the personalities of the people involved in the communications process influence which tools to use. Some people demand full explanations of why you are asking them to do something before they will do it. Others just want the bottom line – what do you want and when. Some people forget everything you tell them unless you put it in writing. Others don't have time for notes and memos; just mentioning something to them is sufficient.

Again, the trick is choosing the tool that will achieve the result you want.

Verifying Communication

One of the most forgotten facts about communication is that the communication process is a cycle. It starts with someone having a message that needs to be communicated to someone else. He analyzes which approach is best for the type of message, the situation, and the person he is trying to communicate with, then follows that approach in communicating the idea. Or perhaps he does not analyze which approach is best. They simply use the approach that works for them. As discussed, because of different personalities, this could prove disastrous. And, for

a lot of managers, this is where the process ends and is a major reason why project communications are often so poor.

Communicating to someone is only half of the cycle. The other half is verifying that the message is received and understood. In many cases, you will know just by looking at someone's body language, posture, or facial expressions whether or not you are communicating your point effectively.

Relying on body language for feedback might be adequate for informal communications where the message isn't too important, but when the information you are trying to communicate is really vital—such as a change in drawings, schedule, a new policy issued by the general contractor, or a warning about a safety violation—you must make sure your message is understood. The best way to do this is to ask directly, “Do you understand what I just said?” or “Okay, what did we decide?” Your only other option is to assume that the person understands what you told or asked, and then wait to see if the action based upon your message is what you expect. But by relying on this alternative you often learn too late that you were not understood at all. That could cost the company and the project money and cause unnecessary frustration.

The Communications Network

Know who you have to communicate with on a project and make a point of learning how to communicate well with each person. Don't wait until you have a critical message to get across before having your first conversation with the people in charge. Have an informal meeting or two with every principal on the project – from the project owner to your company's chief accountant – as part of Pre-Construction Planning. Get an idea of how to communicate with each one of them, how each one likes information to be presented, which communication approaches work and which ones don't. Information like this will prove invaluable later on.

On your list of people to learn to communicate effectively with, be sure to include:

- Project owner
- Project architect and/or engineer
- Construction manager or general contractor
- Project manager for each of the other trades on the project
- Each of your subcontractor's foremen and project managers
- Each of your suppliers
- Your supervisor
- Each member of your project team (job supervisor or foreman, shop foreman, accountant, administrative or support personnel, estimator, purchasing agent, etc.)

- Local inspection authorities
- Local union representatives
- Representatives of other government agencies with whom you would need to interface
- Your company insurance agent

Contacting and developing a relationship with everyone on this list will help you later when you need to communicate with them and you have already met them.

Ensure that everyone else on the project team is communicating with one another. Do everything you can to stimulate communication between the jobsite and the office, the office and the shop, and the shop and the field. If you hear of or sense a problem, attempt to resolve it immediately. Even though you may not be involved in a problem or a conflict between people, rest assured it will impact your project.

Make a Study of Communication

Communication is an essential part of everything that happens in the world, in your company, and on the jobsite. Tools you learn can be used in any venue. It is a basic skill that some are better at than others. When you are talking or listening to someone, pay attention to how they communicate. You can learn what works and what does not. Read trade journals, take classes, and read magazines and books. Communication is an art, not a science, one which requires constant learning and fine-tuning.

SECTION 32: GOALS AND GUIDELINES

The Purpose of Goals

To succeed, a business must set long-term and short-term goals and design strategies to meet them. These goals might be target profit figures for the coming year or the next five years. They might be potential clients that the company wants as regular customers or markets they want to pursue. Whatever form they take, specific company goals give everyone in the company a sense of purpose and a way to measure individual performance and that of the team.

Just as the company must have goals, so should each project. These goals must fit into the overall business plans of the company. For example, the primary goal of a particular project might be to win an important new customer. If so, the company owner may have a project bid close to cost in order to get a foot in the door. Or, he may consider meeting a project schedule more important than meeting a budget.

To manage the project in such a way that it contributes to the company's long-term and short-term goals, the Project Manager must know the goals of the project. He must be especially aware of any "behind the scenes" factors that might influence the project team's strategy.

Company Goals, Guidelines, and Mission Statements

Goals are the framework for all company activities. Guidelines are the policies and procedures that a company establishes to help it meet goals. They give everyone in the company a clear understanding of what is expected and general instructions for handling situations that arise on the project.

A company often summarizes its goals and guidelines in a mission statement. A mission statement is a brief, broad-brushed description of what the company stands for, how it views the market and its customers, and how its employees should behave in pursuing company objectives.

Job-Specific Goals and Guidelines

Before Pre-Construction Planning begins, the Project Manager should discuss with top management the objectives of the project. At the end of the discussion, he should have all the information needed about project profit goals, and any politics that may be involved. He should share this information with other members of the project team during Pre-Construction Planning, as appropriate, so everyone has the same understanding of the job's priorities and special procedures. Only then can the team begin to plan a practical strategy that will not only accomplish the actual construction but also satisfy the company's goals.

The rationale for a company's policies and procedures becomes clear when viewed as a means for achieving a particular set of goals. Consequently, if everyone on the team understands the company's business goals as well as goals for the project, everyone on the project team can contribute to company and project success.

SECTION 33: SCHEDULING

All projects have a schedule. Some are formal and some are informal. Two things all projects have in common: a start and completion date which are fixed. Within these dates a specific amount of work must be done. Scheduling and managing of work activities maximizes planning and cooperation, and therefore, profit.

Basic Project Schedules

There are three very basic project schedules that should be prepared.

- *Bid Schedule* – This is your commitment to meet the overall project schedule requirements as defined in the bid documents. It is usually not detailed; it may be only a commitment to complete your work by a specific date, or in so many workdays, and may include milestones. This type of schedule is very important as it represents your contractual commitment to complete your work within specified time frames.
- *Detailed Construction Schedule* – This should be prepared by the entire project team during Pre-Construction Planning and is used for schedule control during the construction phase of the project. This type of schedule is discussed in more detail later in this section.
- *As-built Schedule* – This is the detail construction schedule, modified to reflect when work was actually accomplished.

Purpose and Types of Project Schedules

Scheduling serves these purposes:

- It fits all necessary project activities into the project's master schedule, giving each one a target start and completion date.
- It gives the project team a blueprint for coordinating the resources (labor, materials and equipment, tools, subcontractors, storage facilities, etc.) and secondary activities (fabrication, purchasing, material handling, inspection and testing, etc.) necessary for completing each project activity on time.
- It provides a time scale for monitoring project progress and adjusting activities as necessary to make sure that the project as a whole is completed on time.
- It can enable the mechanical contractor to assume leadership of the entire project. A comprehensive construction schedule demonstrates the project team's capabilities and degree of organization, and a prime contractor may adopt it as the basis for the overall project schedule, thereby giving mechanical activities priority and making your job easier.
- It should be used to analyze the project cash flow, forecasting by month project expenses, billings, and income.

- It enables you to compare the three basic types of schedules, as defined above, for the basis of a change order or claim, if the changes in the schedule resulted in increased costs were caused by the construction manager, general contractor, other trades, or the owner.

Most project schedules are compressed and accelerated. When this occurs, these basic schedules serve as a basis for evaluating the increased costs resulting from less time available to complete the contract requirements. It is very difficult to verify cost increases unless a comparison between the original schedule and the shorter schedule can be made.

The following are some of the items which may result in cost increases and need to be analyzed in order to determine cost impact:

- Rescheduling
- Material handling and purchasing
- Labor impacts caused by others (See *MCAA Management Methods Manual* Bulletin PD 2, "Factors Affecting Labor Productivity")
- Increased crew sizes
- Increased need for supervision
- Increased need for tools and construction equipment
- Changes in planned activities
- Overtime and/or shift work

Types of Project Schedules

There are several types of schedules needed for every construction project, including:

- Bid Schedule
- Prime contractor's or construction manager's master schedule
- Trade construction schedule
- Manpower loading schedule
- Drawing coordination/layout schedule
- Fabrication schedule
- Major equipment, materials, systems purchasing, submittal, and delivery schedule

- Subcontractor schedule

The Project Manager must remember that all construction project activities are schedule driven. Tools, information, materials, equipment, workers, and supervision must be supplied not only in the proper amounts but at a specific point for a specific duration within a specific sequence. A construction project is an ever-changing environment. The active work area for a particular activity is constantly moving through the project. The types of work activities evolve from rough-in to equipment setting to connection and fit-out to start-up and commissioning to punch list. All of these issues affect not only how the Project Manager plans the activities of the workforce, but how the Project Manager would want the activities of other trades to be conducted. The schedule can be one of the most valuable tools to help you manage the project.

Construction schedules are designed to establish the sequential order in which construction is to be completed. Establishing this sequential order requires an intimate knowledge of construction methods combined with an ability to visualize discrete work elements outlined in the design documents, the physical restraints of the work on the assembly during and after construction, and the establishment of the mutual interdependence of these discrete elements. Once sequential order is established, staff-loading, equipment, material, or other resources may be easily added for greater degrees of control. Their addition may force changes in the schedule. Unfortunately, many schedules are made without thought to, or knowledge of, any of the above.

Construction scheduling is a time-consuming task. It is an art as well as a science, and it is far from easy. Most construction projects are extensive and involve thousands of activities with intricate and complex relationships which are physical or economical. The use of any scheduling technique will produce a schedule that is only as effective as the time invested and the knowledge of the scheduler. If a schedule is based on faulty logic between activity relationships and faulty estimates of activity duration, its utility will be limited.

Construction scheduling is also an attempt to look into the future and must be continuously revised to reflect present conditions. Without the ability to change, the schedule becomes useless. A construction schedule must be based on the best present information. When earlier assumptions or ideas are changed because of superior information, the schedule must also change.

A construction project is the ultimate in flexibility: the ingenuity of contractors to work around missing pieces is without equal. Lack of control, missing pieces, and owner-caused labor shifts all change the construction schedule and require a schedule revision to reflect these present conditions. There is a constant need to change the schedule based on present, actual information.

Who Does Scheduling and When?

Because scheduling must take into account every aspect of the project, it can be a very complex activity, particularly on large projects. For this reason, it requires the cooperation and participation of every contractor on the project team.

Initial schedules should be prepared during Pre-Construction Planning, when the entire project team is together and can focus its attention on the effort. As construction progresses, the schedules will undoubtedly require revision as unforeseen situations arise. Adjustments should also be a team effort, since a change to one activity or schedule almost certainly affects the other schedules or activities as well. Short Interval Planning Meetings and project conferences are ideal opportunities for regularly reviewing and modifying project schedules.

It is essential that one person on the team be responsible for updating the schedules as necessary and letting everyone know what changes are made. To avoid confusion, each revised schedule should be dated and should list the previous schedule(s) it replaces.

The Mechanical Activities Schedule

A mechanical activities schedule identifies the construction activities for which the project team is responsible and places them into a sequence that takes full advantage of company resources and the overall contract project schedule. It is the foundation of all other project schedules.

The procedure for preparing a mechanical construction schedule, either manually or using a software program, involves four basic steps:

- Review the overall contract project schedule:
 - Is there an overall project schedule or just milestone activities?
 - Is it complete?
 - Is it feasible?
 - Does it adequately allow for completion of mechanical activities?
 - What clarifications or information is necessary before the schedule design can begin?
- Identify milestones in mechanical trade activities:
 - Project start date and completion date
 - Activities of other trades (steel contractor, concrete contractor, electrical contractor, drywall contractor, and others) that must be complete before your activities can begin
- Identify float functions: float functions are activities that can be started and completed within one or more windows in the prime contractor's schedule. If the prime contractor's schedule shows an activity is to be completed during an eight-week period, and 480 labor hours are estimated for this activity; a two-person crew can complete it in six weeks. This gives the project team the option of starting the activity any time during the first two-week period. Float functions allow for flexibility in scheduling. They give the project team room

for adjusting to unforeseen situations and allow it to do certain jobs when conditions are favorable, to extend lead times for such things as processing submittals, and to avoid problems such as working in congested areas.

- Activities that can be done concurrently

Manpower Loading Schedules

The purpose of a manpower loading schedule can be the following:

- To be used during estimating to establish crew rates, supervision plan, and adjust labor productivity factors
- To ensure that the project always has enough of the right people to do the work
- To avoid unnecessary fluctuations in labor and supervision load during the course of the project
- When evaluated with other company project manpower loading schedules, the company can predict manpower needs
- It can be the basis for understanding and quantifying financial impacts if a project is compressed and manpower must be increased

The procedure begins with a mechanical activities schedule and the project labor breakdown and involves three steps:

- Plot a bar chart graph based on the mechanical trade schedule. As in the mechanical schedule, the length of each bar (horizontal x-axis) indicates the duration of a particular activity. In addition, the height (vertical y-axis) of each bar shows the number of workers assigned to a task. The horizontal scale is the same time scale used in the mechanical activities schedule. The vertical scale indicates numbers of workers and supervisors.
- Analyze labor usage shown by the bar graph. Once the labor and supervision requirements for each task are plotted, it is easy to calculate the overall workforce required for each week of the project. It is desirable to keep the crew size as low and as steady as possible throughout the duration of the project.
- If necessary, modify both the mechanical activities schedule and the labor and supervision bar graph until a mechanical schedule that best utilizes company labor is attained. In modifying the schedules, there are two major objectives:
 - Attain a fairly even workforce load throughout the project.
 - Make sure the right number of people with the right qualifications are onsite when required.

Meeting these objectives is a juggling act that requires judicious use of float functions, knowledge of available personnel, and sometimes the cooperation of the prime contractor in modifying the overall project schedule. Here again, team participation is essential, since it is virtually impossible for the Project Manager alone to know all the information needed to design an optimum schedule.

Equipment and Materials Purchasing, Submittal, and Delivery Schedule

The controlling factor in the completion of the information for each equipment/material item on the schedule is *the date that the equipment/material is required onsite by the contract schedule*. The date for the issue of the purchase order/subcontract is derived by working back from the required date of onsite delivery. This is accomplished by factoring in:

- The anticipated shipment time frame from factory to site
- The anticipated factory fabrication lead time
- The anticipated architect/engineer review and approval time frame
- The anticipated shop drawing production time frame

If this process demonstrates the need for an unrealistically early or an impossible date for the issue of a purchase order or subcontract, then either an adjustment is required in the time frame for shop drawing, review/approval, or fabrication/delivery, or the contract schedule must be modified.

If the process demonstrates that there is more than enough time to accomplish all of the steps from a reasonable anticipated date for the issue of a purchase order or subcontract, then the “excess” time is expressed in “delivery float.” It is desirable to build in at least four weeks of float for each item to allow for unforeseen delays.

Each step of the process for each material/equipment item must be monitored at least monthly by the Project Manager to determine if the process is on track or whether corrective action must be taken.

Subcontractor Schedule

A subcontractor schedule is essential to guaranteeing maximum productivity in all the subcontractors’ efforts and smooth coordination of these efforts with the other mechanical activities. To be successful, the scheduling procedure must involve the subcontractors themselves. Their participation ensures that each has a clear overview of the project and fully understands how their efforts will affect those of the other members of the project team.

Keep in mind that subcontractors could perform up to 40 percent (or more) of the work specified in your contract. This gives them enormous influence over the outcome of the project. Since many subcontractors are small, it is important to involve them in Pre-Construction Planning, Short Interval Planning, and all other activities that deal with project scheduling.

A good procedure for scheduling subcontractors is the following:

- Ask each subcontractor to supply information on:
 - Delivery dates and storage requirements for equipment, materials, and tools
 - Workforce requirements throughout the project
- Plot a schedule for each subcontractor on a separate bar graph and on a master subcontractor schedule showing all subcontractor activities. Using the mechanical activities schedule and the information supplied by the subcontractors, plot the bar graphs using the same time scale used in the mechanical activities schedule. Include on the graphs:
 - Deadlines for submittal of necessary drawings
 - Start dates and completion dates for each task
- Analyze the master subcontractor schedule:
 - Does it coordinate subcontractor activities with the mechanical construction activities and the other trades?
 - Does it allow each subcontractor enough time and room to work productively, avoiding the “stacking” of trades in any project area at one time?
- Be considerate of subcontractor space and time requirements. You become frustrated when your company is not given ample time and space by the general contractor. Do not do the same thing to your subcontractors.

Critical Path Method or CPM Schedule

The critical path method of scheduling has contributed significantly to construction contracting. It reduces the time necessary to complete a project. It is a well-proven, effective tool for planning and scheduling work, directing work and, finally, measuring and controlling work. It permits the work schedule to be understood and thought out well in advance for material procurement, equipment availability, and to some extent, staff loading. The CPM schedule is easy to pass to others. This diagram permits efficient schedule communication between field and office forces. These tools make project coordination easier among material suppliers, contractors, subcontractors, owners, and architects/engineers.

Preparing a critical path method schedule requires three steps:

- Determination of most of the elements of construction that must be performed in order to construct the project
- Ascertainment of the sequential relationships or logic among these activities
- Presentation of this information in the form of a network diagram

The elements into which construction projects are subdivided for CPM planning purposes are called *activities*. An activity is a single work step that has a recognizable beginning and end. Activities are defined as a time-consuming task. No standards exist as to the number of activities any CPM schedule should have, but sufficient activities are needed to control the work. Although no standards exist as to how long activity durations should be, minimum duration for a construction activity is recommended to be not less than one day, but durations can be in hours, or minutes, if needed, depending on the type of work to be scheduled, such as a turn-around or shut-down.

There are many activities that are independent of one another and can proceed concurrently, although much project logic follows from well-established work sequences that are customary in construction contracting. Nevertheless, there is always more than one way to approach a project, except in the rare case no unique logic exists. There are always many ways to construct a project; consequently, many different schedules are possible.

To be realistic, a CPM schedule must reflect the practical restraints that apply to the project activities. The restrictions of the project logic itself are restraints. For instance, the completion of the supporting structure restrains the installation of the roofing membrane. These restraints arise from the necessary order of construction operations and are simply a part of project logic.

There are other types of restraints. Structural steel cannot be erected until it is available at the site, and steel availability depends upon preparation, transmittal, approval of erection diagrams, shop drawings, mill orders, rolling, delivery, steel fabrication at the plant, and delivery to the jobsite. Thus, the start of steel erection is restrained by approvals, steel fabrication, and delivery. These are restraints that must be shown on the schedule (or at least considered) before being dismissed as redundant or as an unnecessary degree of detail.

At the end of the procedures outlined in this section, the project team has in hand a set of bar graphs, or a CPM schedule, or both, that visually depict all aspects of the project on the same scale. This set of documents is invaluable. It makes Short Interval Planning and project monitoring easier, helps everyone see the interrelationships of their responsibilities and schedules, and allows the Project Manager to see at a glance how a delay or other unexpected event affects all aspects of the work.

Additional resource available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin JM 3, "Scheduling"
 - Bulletin PD 2, "Factors Affecting Labor Productivity, including 'How to Use the MCAA Labor Factors'"

SECTION 34: SHORT INTERVAL PLANNING

What Is Short Interval Planning?

The master schedule developed in the Pre-Construction Planning Meeting is usually too long and complex to manage jobsite construction effectively. *Short Interval Planning* is the way to break down the overall project schedule into small, manageable segments as needed. Short Interval Planning involves dividing the project into tasks that take one to two weeks to complete, then meeting at the end of every week to review progress and plan the next interval. The advantages of Short Interval Planning include the following:

- It gives you, your project team, and your field crews specific work goals that can be achieved in five to 10 work days.
- It gives a practical way to track progress. It is far easier to determine whether a two-week task is 50 percent complete than to determine the same thing for an entire 10-month project.
- Problems can be spotted and corrected quickly.
- It gives the project team an opportunity to prepare for upcoming project conferences and meetings with the customer.
- It focuses attention on tools, materials, and equipment that must be available so that crews can work efficiently.
- It gives the team an opportunity to celebrate successes and create a controlled sense of urgency for the work.

Who Should Attend?

Everyone who is directly involved in the preceding or upcoming short interval or who have information of general interest should attend. The following team members are examples of attendees.

- Project manager
- Job supervisor(s) or foremen
- Shop foreman
- Subcontractors
- Drafting/engineering personnel
- Purchasing agent

The Process

The Short Interval Planning process begins during Pre-Construction Planning, when the project team reviews the job breakdown, creates a master schedule, and determines planning procedures to follow for the course of the project. It is at this stage that the Project Manager must persuade everyone on the team that Short Interval Planning will improve communication, improve productivity, and drive success on the project.

The initial Short Interval Planning meeting should be held before the first day of work on the jobsite. Subsequent meetings would be held every week, on a regular basis. To take full advantage of the Short Interval Planning process, every meeting should be driven by an agenda. See a sample ["Short Interval Schedule" \(Figure 34.1\)](#) and ["Short Interval Planning Checklist" \(Figure 34.2\)](#) in this manual.

At each Short Interval Planning meeting, you should:

- Review the work scheduled during the last interval and check work progress:
 - What has and has not been accomplished in the last interval?
 - What caused the team to fall short of its goals?
 - Delays caused by owner, prime contractor, design professional, or other trades?
 - Delays in material or equipment deliveries?
 - Poor weather?
 - Lack of planning, communication, or necessary action by member(s) of the project team?
 - Error in the original estimate of the time required completing the task?
 - Change in crew assignments?
 - What effect will uncompleted activities have on:
 - The next interval?
 - The project as a whole?
- Modify the project schedules to reflect the impact of the previous intervals by:
 - Scheduling completion of uncompleted activities
 - Adjusting and utilizing float time
- Plan the work for the next interval.
 - Use the master schedule to identify tasks to be accomplished in the next interval.
 - Organize work into a priority sequence.
 - Quantify work goals for the next interval.
 - Identify "ready work" that can be done if the plan is disrupted.

- Make specific personnel assignments that:
 - Give responsibility for a task to a particular individual.
 - Create crews that are of optimal size and have the skills required to get each task done efficiently.
- Schedule subcontractors and related trades, being sure to:
 - Identify priority tasks for completion.
 - Create a checklist that tells you, at a glance, what each subcontractor and other trades are expected to be doing on a given day. (A [“Short Interval Planning Checklist” \(Figure 34.2\)](#) can be found in this manual.) Use the checklist to minimize stacking of trades and to schedule your crews to avoid congested areas.
 - Verify the availability of each subcontractor's materials and equipment.
 - Make sure each subcontractor or trade has the sufficient skilled workers on the project.
 - Provide adequate instructions to each subcontractor's job supervisor or foreman.
- Plan fabrication requirements by:
 - Identifying fabricated components needed on the project during the next interval.
 - Coordinating delivery and erection of materials.
 - Establishing a sequence of fabrication for components needed for the next two to four planning intervals, so that drafting and fabrication priorities can be set to support project requirements.
- Satisfy tool and equipment requirements by:
 - Determining what tools and equipment not already on the jobsite will be needed during the next interval.
 - Scheduling deliveries of necessary tools and equipment to the jobsite.
 - Returning all unneeded tools and equipment to the warehouse or to other projects, as needed.
- Assign an individual to make sure that all suppliers will meet all delivery dates for material and equipment needed during the upcoming intervals, allowing adequate lead times.
- Establish material and equipment handling procedures on the jobsite to make sure that:
 - Everyone understands how specific items will be received, unloaded, and moved to their final destinations.
 - All equipment (cranes, hoists, etc.) needed to handle deliveries will be available.
- Discuss the interval that will follow the upcoming one, paying particular attention to:

- Meeting all lead times for purchases, fabrication, and the scheduling of labor, construction equipment, and tools.
- Anticipating the effects that project situations and scheduling changes may have on subsequent intervals.
- Regularly review the planning process itself and make changes to improve effectiveness.
- Identify the date of the next general contractor meeting and ensure that the project team is prepared to furnish needed information and scheduling input to maximize labor productivity.

The Importance of Accurate Reporting

When a particular activity falls behind schedule, some job supervisors or foremen tend to hide the fact, hoping to compensate during the next interval and therefore avoid performance questions or criticism. This behavior is often due to lack of trust among project team members, and it can have a devastating effect.

For Short Interval Planning to be successful and project cost forecasting to be accurate, the Project Manager must know at any given time exactly where each task stands. One inaccurate report of project progress can throw the entire project off balance further down the line, upsetting the sequence of activities and the coordination of trades and crews, and creating inaccurate data for the planning of other intervals and projects. To avoid this, the Project Manager will from the first day of the project:

- Encourage each job supervisor or foreman to honestly and accurately report his crew's progress on each activity.
- Avoid criticizing or reprimanding a job supervisor or foreman for using more labor hours than anticipated to complete a task.
- Treat overruns on task labor hours as situations to be analyzed, not as personal mistakes.
- As part of the analysis of each labor overrun on a task, explore the reasons the overrun occurred, what effect it will have on other project activities, and how to avoid future overruns on similar tasks.
- When task labor is less than estimated, celebrate the success of the team, and explore how to have similar results in the future.
- During the Post Job Review, use the successes and failures of the project to refine the company's estimating procedures, identify company competitive advantages, improve construction processes, improve project close-out procedures, and celebrate the accomplishments of the project team.

By creating a “safe environment” for everyone on the project team – an environment where no one fears reporting negative project developments and suggesting solutions – the Project Manager can create a team focused on delivering the project on time, meeting the owner’s goals, and redeeming or improving the project gross margin.

Documentation

The Short Interval Planning process documents the actions of the project team from the initial session to planning job completion. Maintaining these records gives the contractor an accurate record of project conditions and the actions taken to produce the project. In case of a claim or dispute, that record can be invaluable to help all parties understand the problems experienced and action taken or not taken by the various parties to resolve those problems.

Pre-Construction Planning and Short Interval Planning go hand in hand. Pre-Construction Planning creates an overall strategy for the project and breaks the project into workable units. Short Interval Planning continually updates and revises that strategy to keep it on track despite the unexpected developments that disrupt almost every project. Without Pre-Construction Planning, Short Interval Planning has no foundation; without Short Interval Planning, the results of the Pre-Construction Planning effort become obsolete within the first few weeks of work.

SECTION 35: CHANGE ORDERS

What Is a Change Order?

A *change order* is a *written* order issued after the contract has been awarded that either increases or reduces the scope of the contractor's work. A project owner or his engineer might issue a change order as a result of a change in the plans or specifications or the correction of a design error. A prime contractor might issue one for the same reasons or to adjust the work effort to an unforeseen situation on the project. Finally, your company may request a change order to improve or otherwise change the plan for the mechanical work, adjust to a given circumstance, allow the correction of design errors, or work around another contractor's error.

Regardless of the reason for the change order or who requests it, the change will affect gross margin on the project. In a case where the change eliminates work included in the original contract, you will lose the profit on the reduced scope of work. If the deduction is large, the contractor would need to evaluate whether to pursue the lost gross margin and potential home office general and administrative expense while recognizing that collection may be difficult.

It would seem that a change order that increases your work should also increase profit. Indeed, most owners and construction managers believe that contractors automatically get rich on change work. A change, like every other aspect of the project, is profitable only if it is handled properly. For a well-planned project, change orders can be very expensive since they disrupt execution of the plan.

Who is Responsible?

The Project Manager is primarily responsible for identifying, pricing, and defending change orders. Because a Project Manager often manages multiple projects, he must depend on the other members of the team including job supervisors or foreman to identify potential changes. Therefore it is the responsibility of the Project Manager to educate each team member of the project scope, contract terms, types of changes, and the proper change order procedures.

Client Agreement on Change Order Procedures

Since change orders will usually occur on every project, the contractor is well served to seek agreement on change order procedures during the Pre-Construction Planning phase of the project. If the contracting entity is unwilling to establish those procedures, the Project Manager will carefully use the first change order to clarify the change order form. Many contractors have a digital master change order form that identifies all the contractors' direct and indirect costs associated with the change order. This form can be easily edited to meet the needs of a particular project. If the contract documents are ambiguous, the first change order is the opportunity for the Project Manager to include all items possible in reimbursable cost.

Standard Procedures for Processing Change Orders

To handle change orders profitably, your project must have standard written procedures and insist that all team members follow them. These procedures would cover in detail the following:

- Identifying when a change order is needed
- Issuing requests for changes
- Estimating the costs of doing change order work
- Processing requests for change work
- Obtaining approvals for change orders
- Documenting change work progress and cost
- Billing for authorized change orders
- Identifying cost on unapproved change orders

Doing all the above establishes a process for managing change order work profitably. The procedure for measuring cost on unapproved changes is important for the company to manage cash flow. Too many projects force contractors to proceed on changes before approval. Approval can take many months while the contractor spends money and no payments are made. Financing these costs can impair the company's ability to pursue other business and, in extreme circumstances, the lack of cash may force the company into bankruptcy.

Obtaining Approval of Change Orders

Work on a requested change should not begin until the Project Manager has received written approval of his estimate for the work from the appropriate project authority. The appropriate authority is a person responsible for both approving change work estimates and authorizing payment for the work.

Most contracts include a provision that the contracting entity can direct the contractor to proceed with a price to be determined at a later date. At other times the contractor is encouraged to proceed "in good faith" and as a good "team member." To manage the risk, all change orders should be quoted with a deadline for approval. If not approved by a certain date, the price is subject to revision or can be withdrawn. When proceeding with work on unapproved change orders, the Project Manager can bill for the unapproved change work and can sometimes be paid. When the contracting entity refuses to accept billing for unapproved work as a part of the billing, the Project Manager must be concerned for future payment and take every means necessary to properly notify the contracting entity of the cost to date, expected total cost, and the necessity for reconciling the unapproved status as quickly as possible.

A Practical Change Order Strategy

Each company has its own approach to estimating and managing the change order process. The Project Manager will apply that process while accommodating the project's unique contract requirements. The following are important guidelines that are applicable for all projects.

- Complete the estimate and submit the quote as soon as possible. Some contract documents have a deadline for submission. You must meet the deadline or ask for an extension. The project owner is less likely to resist the added cost when the need for the change is fresh in his mind.
- Whenever possible, specify a lump sum for the change. A lump sum change order requires accurate and detailed estimating up front but spares the project team the paperwork of tracking every piece of material and every hour worked to prove cost on a time and material change.
- Materials for the change will probably be bought from a supplier's stock and may leave some material unusable on the project. The unit prices of unusable material and any surplus/restocking fees for materials that were not used should be included as costs on the change order.
- The contract documents often attempt to define acceptable change order costs. Reimbursable costs should be considered a negotiation and all possible costs included such as safety, drafting, as-built drawings, Project Manager, project engineer, trucking, communication devices, bond premiums, warranty, etc.
- The contractor is responsible for the worst case outcome when quoting the work. The Project Manager should expect the worst case and price the work accordingly.
- Payment for changes will require active management. Putting a deadline for approval creates a sense of urgency in the process. Billing for all changes whether approved or not, puts the owner on notice you are expecting full payment. Knowing cost on unapproved change orders alerts company management to potential cash flow problems.

Documenting Change Work

No matter how minor the construction tasks involved, a change order requires careful documentation. For cost-plus and lump sum change orders, the paperwork must be accurate and complete. Each change order should be assigned a control number and a separate file as soon as it is received. It should also be recorded on a ["Change Order Log" \(Figure 35.1\)](#) or similar. The log tells everyone the status of each change, whether it has been approved, and how it affects the project gross margin.

Among the documents filed for each change would be:

- The original change request

- The estimate for the change
- The project authority's approval to proceed
- The memo to all team members notifying them of the change
- Minutes or notes of any meetings held regarding the change
- Copies of cost tracking forms and data
- All permits, inspection reports, and testing results relating to the change

Other documents will need to be prepared once a change order is approved, such as:

- A revised project estimate reflecting the effect of the change
- A forecast of the impact of the change on the project gross margin
- A revised project schedule

Change orders are very common on construction projects. They are often disruptive and annoying. Managed well, they can improve the gross margin on the project. Whether or not a Project Manager can take advantage of those opportunities is largely a matter of how well he and the other team members take control of each change order request and manage it to their advantage. Following is a more extensive discussion of the specific types of change orders the Project Manager may encounter in his career. Fortunately few projects will experience every one of these changes.

Principles of Contract Changes

Change in the Work

When a construction contract is accepted, your company agrees to perform the work specified by, and reasonably interpretable from, specifications, drawings, and other contract documents. The description of the work is normally highly specific and defines the work to be done and the conditions under which it occurs. A construction contract can only be changed by agreement between the parties to the contract. A *change in the work* is any revision to the contract documents that affects the quantity, quality, or arrangement of the work and usually results in adjustments to the contract price, time, and/or schedule.

Quantity changes increase or decrease material and/or labor units defined by the contract documents. Changed quantities can result from simple additions or deductions from the scope of work or from a change in the work arrangement.

Quality changes result from revisions to contractually defined quality, such as gauge, thickness, finish, efficiency, capacity, dimensions, material, and other technical standards.

Obligation to Perform Changes

Most contracts obligate you to perform change work required by the owner. AIA contract document A201™ – 2007, used for many private projects, states in paragraph 7.1.3, *“Changes in the Work shall be performed under applicable provisions of the Contract Documents and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the work.”*

Obligations to accept changes extend only to “work of a similar kind” to that of the base contract. The scope of the change must not be so dissimilar, so huge in size, or so great in number that it becomes “cardinal.” (Cardinal changes are discussed later in this section.)

Three generally specified methods, or a combination of these methods, are used for adjusting the contract price: lump sum, unit price, and actual cost plus a fixed or percentage fee. All of these methods require that the parties ultimately agree on a format and amend the contract in some way.

In a *lump sum change*, the scope of the change and a lump sum price are agreed to by the parties. A sample [“Lump Sum Change Order Form” \(Figure 35.2\)](#) is included in this manual.

For *unit price changes*, unit prices for specific work items are stated in the contract documents or are subsequently agreed upon, and the customer directs performance of such items.

In changes that are *actual cost plus a fixed or percentage fee*, the customer directs you to change the work and the price is adjusted on the basis of actual cost plus a fee. The cost items which are to be reimbursable and those which are to be included in the fee will be defined in the contract documents, by subsequent agreement or by negotiations at the time of the change. The fee may be a percentage markup or a fixed fee. Often the first change will set the precedent for defining cost and fees for all subsequent changes.

[“Consumables” \(Figure 35.3\)](#), [“Consumable Tools” \(Figure 35.4\)](#), and [“Expendable Materials” \(Figure 35.5\)](#) list items considered consumable and expendable. Be sure to include costs for these items when pricing a change order.

As discussed in [Section 28: “Documentation,”](#) it is imperative to track change orders.

Making Changes without Affecting Contract Price

Changes do not always affect contract price. These are often called *no-cost changes* because there is no change in cost to the customer. However, no-cost changes may negatively affect your cost, profit, and risk. No-cost changes require written documentation, just as a cost change would.

Here are two common no-cost change situations:

- You can informally trade or offer the customer greater quantity, higher quality, a more expensive arrangement or a solution to a design error in exchange for savings in the

contract work. In this case, a written contract amendment or confirming correspondence should be issued. While informal trading can be expedient and often occurs in practice, it is always a contract violation, and all contract violations offer some risk.

- You can do more work than required by the contract without receiving additional compensation or a trade-off. However, you must guard against the customer taking advantage of you. Your best defense is a thorough knowledge of the work and of contractual obligations, and the ability to recognize contractual revisions.

Taking advantage of the customer occurs when you do less work or work of poorer quality than contractually required, without giving the customer an agreed-upon trade-off in return. *Taking advantage of the customer creates the risk of replacing work and damaging your reputation, which far exceeds any benefits that might be received.* It is far more costly to go back to install missing work or to replace non-conforming contract work than it is to do it right the first time. If a question about work conforming to the contract is raised at project completion, often the other party who made the verbal exception has left the project, “forgets” the exception, or exceeded their authority when they made the exception.

Points to Remember When Quoting Changes

Quotations for changes are not just estimates or cost breakdowns. A change order quotation is also a sales document similar to the quotations for the original contract. When quoting changes, all the rules of salesmanship apply. The quotation should be attractive, logical, easily reviewable, and persuasive. It should present every facet of the change that will support the highest possible selling price consistent with maintaining customer goodwill.

As stated previously, early change quotations and settlements will set the precedent for all subsequent changes. Before an item is settled for the first time (unit prices, charges for tools and construction equipment, markups, etc.), you have some leverage. The change order is a statement of estimated cost, offering the opportunity to sell the maximum justifiable amount. Consequently, the initial change quotation should have unchallengeable justification to help gain customer respect for labor, material, indirect costs, and other cost units. Use early changes to establish all the conditions that will improve the odds of obtaining the highest selling price on later changes.

Some customer representatives will always insist on reducing the quotation before recommending approval, regardless of any justification you may have. Your sales strategy may need to allow for this practice.

Changes may have ripple effects on other phases of the work. It is an advantage to recognize these ripple effects, point them out to the customer and include costs to cover them in the initial quotation. This tends to reduce overall administrative problems because it is easier to negotiate the costs of ripple effects as part of the change quotation, rather than when they are discovered in the field. Ripple effects are usually not included in a customer's comparative estimates (if they have one), because their estimators are unfamiliar with field conditions. They

are usually nonstandard types of costs, such as relocation of work, changes in labor efficiency, etc., and other irregular but still predictable effects resulting from a change order.

Ripple effects also can be caused by an overwhelming number of changes occurring on a project. Industry literature states that this happens when the hours spent on extra work exceeds the original base bid hours by five to 10 percent.

Multiple change orders can create a negative, cumulative effect on a project, so much so that they may impact tasks that would seem to have no direct correlation with the changes. Owners and contractors often disagree about this, because owners want to see tangible evidence of the negative impact.

It's hard to document lost productivity and other damages that accumulate in the wake of multiple change orders, and it's even more difficult to recover the costs. The result of this disagreement is often litigation and, unfortunately, the sheer magnitude of change orders on a project does not guarantee that the courts will rule in the contractor's favor. The burden of proof for cause and damages falls upon the contractor, and the results of many court decisions have set the standard for what contractors are required to provide as convincing evidence.

Quite often a contract will specify, or the customer will demand, that changes are to be priced in accordance with MCAA, NECA, or some other standard. This can be acceptable provided that *all* the work for the change can be done in sequence with all the other work of a similar kind within the location of that change. Work for the change includes purchasing, coordination/layout, delivery of materials, and tooling and scaffolding. Any standard pricing method must be adjusted for conditions if the change work is to be performed out of sequence. The conditions requiring price adjustment may include:

- Separate delivery and separate handling of materials
- Remobilization and/or demobilization of tools, workers, and/or scaffolding back into and out of an area
- Higher prices for materials that are not purchased in bulk
- Drafting and coordination of the changed work
- Special consideration for working around previously installed work

Atypical working conditions, which could affect the cost of a change, must be clearly identified. Overtime requirements, occupied or congested areas, or other inefficient conditions increase costs. Changed project conditions must be explained with the assumption *that the customer may not intuitively recognize and understand them*.

The change order quotation may be reviewed by a remotely located customer representative who has limited personal knowledge of current field conditions. Since they are skilled and

critical reviewers who must be influenced by a single document, it is important that your total position be in writing and as clear and concise as possible.

A net cost or credit may be the result of the mixture of additions and deductions involved in a change. The customer will be looking for full credit for deleted work; credit is only due for the work that can be stopped. You cannot give full credit for work that is partially or fully shop drawn, fabricated, or installed. However, you should adequately specify in writing why you are not giving full credit. Specially purchased materials that cannot be put into normal inventory must be credited at net restocking cost or at scrap value.

Demolition should be itemized separately, showing labor and removal costs. The customer is entitled to a credit resulting from the sale of scrap materials.

It is a good idea to review any items in your project that are over budget (phone, utilities, etc.) and include costs for these items in the change order pricing.

Finally, you must qualify all quotations, clearly stating project conditions which you have assumed for estimating the change. Explicit qualification protects you against changes in field conditions that occur after quotation and prior to notice to proceed.

Changes Initiated by the Owner

There are many reasons an owner may make changes, including:

- Misinterpretation of the owner's building requirements that cause errors which are not recognized until after construction begins.
- Technical errors in pipe sizing, equipment capacity, work arrangement, etc.
- Changes to the occupancy requirements during the period between design completion and occupancy.
- Changes during the course of construction from owners who decide to upgrade their project through improvements or additions.

How Owner-Initiated Changes Are Made

Changes can be initiated through agreements with the owner on scope and price, by directive from the owner to proceed, and/or by your recognition of certain owner actions as changes in your work.

The owner generally wants to know the cost of the change before proceeding with the work. If time is available, a Bulletin or Request for Quotation is issued that specifies the work in detail. An estimate is prepared and a quotation is submitted for the customer's review and action. If the parties agree on the price of the change, the contract is amended.

Alternately, the owner may direct your company to proceed with a change prior to a price agreement. These directives are sometimes called Proceed Orders, Price to Be Determined Later (PDL) Orders, or Emergency Field Orders (EFO). The price to complete these changes may be determined at a later date through lump sum, unit price or cost-plus arrangements.

A ["Field-Authorized Change Order Form" \(Figure 28.2\)](#) can be used to track material, labor, and subcontractors for a change order.

It should be a general policy not to proceed with a change unless you have an agreement on how the incurred costs will be handled. However, some contracts require you to proceed with changes at the owner's direction even though you have not agreed on a price or a method for determining price, allowing work to continue without interruption. AIA contract document A201™ – 2007, which is used for many private projects, authorizes the owner to direct performance of changed work ahead of agreement. This is accomplished by the "Construction Change Directive" clause, which reads:

7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

Many state, municipal, and private contracts require agreement on price before proceeding with a change. The contract documents should be carefully studied for each project to avoid being trapped into proceeding ahead of agreement when not required.

Change directives have distinct disadvantages. Because the work is not delayed, the owner is under no pressure to reach an agreement. The owner can arbitrarily tie up working capital by issuing inadequate partial payments or pay nothing until long after the work is completed and a formal change has been agreed to. You may be forced to accept an inadequate price to accelerate collection of money. When this happens, the Project Manager must project the anticipated cost in the cost control system.

Frequently, changes for other trades are issued during the course of a project, any of which can affect your portion of the work. Often, however, the architect/engineer does not recognize that structural, architectural or other trades' changes affect the mechanical contractor and therefore does not issue a bulletin. You must review all changes, even if the architect/engineer and/or prime contractor does not think they affect your trade, and distribute to your subcontractors information relevant to their work.

Your customer's actions, or failure to act in accordance with the contract, can result in constructive changes that can be difficult to identify. Constructive changes may often arise out of errors in the design, making it impossible to perform the work; out of improper

interpretation of contract documents and improper direction by the owner; or out of failure by the owner, other prime contractors, or prime suppliers to perform as specified.

If the owner has constructively changed the work, you should send written notification as soon as the change is discovered, if possible, before the work is performed. The discovery of constructive changes is an important part of your responsibility as a Project Manager. Notice requirements may be different, so be sure to check your contract language.

You will sometimes disagree with the customer regarding the intent of contract documents. When disagreements arise, the customer will sometimes issue an interpretation that you feel is a change. Under these conditions you have two possible courses of action:

- Refuse to proceed with the directive. The dispute will then have to be settled under the contract provisions for resolving disputes.
- Proceed with the work under written protest. The contract documents may require you to proceed with the work in accordance with the owner's or prime contractor's written direction even if you believe the direction is a change in the work. Prior to performing the work you should notify the owner that a claim for extra work will be submitted. You should then submit a quotation and attempt to "sell" your position. If necessary, the dispute may have to be settled under the contract provisions for resolving disputes.

Be sure to send written notification that a change has taken place and that you will be submitting a price for the work.

Changes Initiated by the Contractor

Contracts provide specific, but limited, rights to initiate changes. Your awareness of these rights and of opportunities to exercise them, can be beneficial to your company's reputation and profitability. You should request legitimate, beneficial changes to increase profit levels, reduce risk, and enhance your reputation as an alert and responsible contractor.

Types of Contractor-Initiated Changes

Nearly all project designs are deficient to varying degrees: in achieving lowest first cost, lowest operating cost, satisfactory performance, compliance with applicable laws and regulations, and flexibility. These deficiencies offer opportunities to: (1) help the owner get a more satisfactory job, (2) help the owner reduce costs without jeopardizing the design intent, and (3) allow you to participate in the resultant savings. Opportunities to initiate changes originate from several sources:

- *Construction standards* – Frequently, you submit to construction standards that prescribe the type, gauge, and manufacturer of materials that will be used on a project and, less frequently, the installation methods. The owner and designer are primarily concerned with the ultimate performance within budgetary limitations; they realize that there are many satisfactory ways to do most jobs.

- *Alternate sources* – Often, alternative sources for equipment and materials can be requested. Specifications often name one or only a few acceptable sources to establish a quality standard. You can request approval of equivalent products that are more economical. Customers and their consultants do not normally object to an occasional equipment or material substitution; however, be careful not to abuse their goodwill by submitting an exorbitant number of substitutions, or submitting substitutions of substandard products.
- *Design deficiencies* – The need to refine the design to correct deficiencies may be discovered by the architect/engineer or by the mechanical contractor. The corrective changes can be incorporated in the contract through the owner, architect/engineer, prime contractor, or as a contractor-initiated change.
- Your ability to identify design deficiencies, offer practical design refinements, and recognize areas for potential savings can significantly affect customer satisfaction and job profit. Solutions to design deficiencies can be suggested to the architect/engineer, but you, as a constructor, should be cautious and be sure not to re-engineer work. Your suggestions, however, can discreetly direct the architect/engineer's redesign to your benefit. You should strive to develop a feeling of mutual respect with the architects/engineers, earning their respect for the value of your suggestions and your ability to institute them.
- *Value engineering/thrifting* – Value engineering or *thrifting*, as it is called in some areas of the country, is defined as an organized effort to attain optimum value in a product or system by providing the necessary functions at the lowest cost.

You should not expect to see a formal value engineering incentive program specified on many jobs. Most customers prefer to get the full value of cost savings by incorporating cost reductions in the base contract. Their normal reaction to a value engineering proposal is, "Why didn't you bring it up at bid time?"

Nevertheless, many customers will consider changes which will give them more value even though there is no formal value engineering contract provision. With discretion, you can make proposals to the customer outside of the normal contractual relationship. If the changes are agreed upon, the change can be executed through the "Changes in Work" contract clause.

If value engineering adversely affects system performance, you are morally, if not legally, liable for any necessary corrections. You should guard against requesting and receiving approval for a work simplification change and then attempting to shift the responsibility to the architect/engineer if the change causes operating problems.

- *Poor coordination* – Most contracts require coordinating the fit of mechanical work with other trades: *you are responsible for making your work fit into the available space*. To the owner and its architect/engineer, the "coordination" clause in a contract often means that you are to solve any and all problems related to interference from other trades.

Costs resulting from unreasonable coordination demands can constitute a change, but you must initiate the request for payment for the change. Such a request should be made as early as possible in order to properly establish a basis for cooperation and also to change the unreasonable demands. "Unreasonable demands" can best be described as those coordination conditions which you could not be expected to foresee in the contract documents during the bidding stage.

The National BIM Standard – United States, Version 2™ § 5.1.1 defines spatial coordination for the industry. It is written for Building Information Modeling but also applies to all coordination of the mechanical trades.

a. Standard and acceptable industry practice for spatial coordination performed under the contract documents is a collaborative process executed between the primary installation contractors and overseen by the general contractor or construction manager. This practice for spatial coordination seeks to integrate objects, systems and components into spaces allocated in the contract documents. Standard and acceptable industry practice for coordination does not include adding pipe, ductwork, fittings, conduits, cable tray, junction boxes or other appurtenances to remedy spatial constraints. Such work falls beyond the scope of what is considered standard and acceptable industry practice for coordination and will be performed as expressly directed pursuant to the terms of the contract. Achievement of spatial coordination under the contract documents that represents standard and acceptable practice in the industry assumes:

- *The contract drawings have been fully designed and coordinated by the owner and/or its design professionals such that, if installed as shown on the contract drawings, the finished product will result in systems operating as designed by the owner and/or its design professionals.*
- *Systems fit within the spaces allocated on the contract drawings as qualified below.*

b. Spatial coordination that is standard and acceptable practice in the construction industry does not include relocating systems from their allotted spaces as shown on the contract drawings when such relocations require added materials, shop or field labor, or coordination time. Any such relocations or alterations of components and/or systems may compromise the integrity and/or the planned performance of the system(s) as designed by the owner and/or its design professionals. Responsibility for the integrity and/or planned performance of the relocated systems will remain the sole responsibility of the owner and/or its design professionals.

c. Depending on the complexity of the project, from one to three iterations each of clash identification and attempts at clash resolution are considered standard and acceptable industry practice for coordination. Further iterations fall beyond

the scope of what is considered standard and acceptable industry practice for coordination.

d. The physical spaces for electrical, mechanical, sheet metal, and plumbing equipment rooms must be adequate to allow for the installation of equipment as shown on the contract drawings. All designed spaces must include clearances in and around equipment as required by the contract documents, applicable codes and the equipment manufacturer's specifications. Adequate spaces must be included in the design to accommodate incoming and outgoing services to and from the equipment and for maintenance as required by the contract documents.

Spatial coordination is a cooperative and collaborative effort between the design professional, owner, general contractor or construction manager, and the trade contractors. Normal and expected spatial coordination performed by the trade contractors after the execution of a contract is not design. Rather, it is the reflection of the design in a three dimensional model. Trade contractors rely on complete and accurate designs when bidding projects in order to provide accurate bid pricing. In return, trade contractors, such as those represented by the MCAA, SMACNA, and NECA, using that design, are able to produce reliable models by which the project can be constructed in a more efficient, timely and cost effective manner.

Contract Provisions

Contract provisions typically describe your rights to initiate change through one of the following two vehicles:

- *Shop drawings* – Each contract has specific provisions for approval of shop drawings. Most contracts provide that approval of a shop drawing does not, in and of itself, authorize a deviation from the contract requirements. AIA contract document A201TM – 2007 , requires that you disclose proposed deviations to the architect by letter and receive specific approval in writing. Quantity, quality, and arrangement changes can best be expressed in the form of shop drawings or schedules. Since most owners delegate shop drawing matters to their consultants, the communication on errors, simplification, and standards is a little more private.

The shop drawing approach has a distinct advantage. Generally, the architect/engineer can trade with the contractor through the medium of shop drawings. Although architects and engineers may not have final approval of shop drawing deviations, they can exercise considerable discretion and influence in your favor.

- *Approval of manufacturers* – Specifications frequently require obtaining owner approval of manufacturers for each equipment item shortly after contract award. Specifications also may limit the manufacturer of an item to specific firms with or without the “or approved equal” clause. If you want to use an alternate manufacturer, you must initiate the change by requesting approval from the architect/engineer. If the deviation is approved, the contract has been effectively changed.

Customer Reactions to Contractor-Initiated Changes

Customer attitudes are normally contradictory when a proposed change is submitted. Customers generally want to consider changes carefully as they may offer added value or eliminate design defects. However, many customers instinctively resist changes because they believe that: They will not receive full value for the changes.

- An economical, well-coordinated, and sound design should not require changes.
- The suggested changes may have a ripple effect on the other contractors.

An architect/engineer may be reluctant to review unsolicited ideas because they generally do not receive an additional fee, and they are legally liable for design performance if they approve the changes. Most owners and their consultants, however, recognize that your company has in-depth knowledge of available construction materials and methods, and are therefore willing to listen to suggestions. Consultants are usually grateful if you diplomatically and privately point out design errors before installation so that revisions cost less. Prime contractors are normally neutral to proposed changes unless the changes jeopardize other phases of the work or their position with their customer. You should carefully consider possible ripple effects.

How to Sell Change Ideas

There are many things to keep in mind when selling change ideas to the owner, architect/engineer, or prime contractor:

- You should develop and maintain mutual respect between your company and the customer.
- All potential changes should be developed early in the project. In this way, the chance of acceptance is not reduced through concern that the change will delay completion of the work, or that the interrelated items are already committed.
- It only irritates the customer to be told that there is a problem when no immediate and practical solution is offered. The customer wants to know how to solve the problem and how much the solution will cost.
- Suggesting changes of marginal value will only aggravate the customer. Avoid bombarding your customers with insignificant or unhelpful suggestions.
- Try to avoid going outside the "chain of command" by discussing design directly with the owner or the architect/engineer.
- The maximum justifiable dollar amount for changed work is desirable, but keep in mind the customer's sensitivity and vulnerability. It is always better to sell a change idea at a reasonable profit rather than lose it because of an exorbitant potential profit.
- You should always support your suggestions with sound engineering reasons as to why they should be accepted.

- Suggestions can be properly evaluated only if sufficient detail is offered. The amount of detail you present in the quotation will vary with particular customers; you should be familiar with your customer's buying habits.

Changes Initiated by Subcontractors

Subcontractors normally have the same limited contractual rights to initiate changes as you have with your customer. You should not discourage subcontractors from offering changes. After all, you want them to make money on their work, and you can add profit to their approved changes without assuming any additional risk. You should not permit subcontractors to initiate changes that are not technically sound, since you are recommending the idea to the customer and/or the architect/engineer.

You must be careful that subcontractors only process changes through you and in the contractually prescribed manner. Many subcontractors are very relaxed about getting formal approval for a change, preferring to trade directly with your customer. You should control the actions of your subcontractors by obtaining advance understanding that their change ideas must be directed towards your company and then be passed on to your customer.

Changes Initiated by Vendors

Vendors offer changes primarily to alter specifications to fit their standard practices and products, thereby reducing their costs. It is to your advantage to have vendors recommend cost-saving changes prior to awarding them purchase agreements, so that the full benefits of competitive pricing can be used at bid time.

Some manufacturers will accept a purchase agreement that requires strict compliance with the contract documents without modification even though their standard product does not comply. By doing this, vendors risk owner rejection of their changes and the insistence of compliance with the contract documents, increasing the vendor's cost or even forcing the vendor to furnish another manufacturer's equipment. It is in your company's best interests to assist manufacturers in obtaining approval of their standard product, provided such standards will work effectively, since such assistance encourages the vendor to accept orders at lower prices. If the manufacturer's request for approval will critically delay the project or irritate the architect/engineer, you should insist on prompt compliance with the contract documents.

Changes Initiated by the Architect/Engineer

The architect/engineer usually initiates a change for only one reason: they have made an error.

Remember that architects/engineers may not have contractual authority to issue change orders on behalf of the owner. Their authority may be limited to no-cost changes or to changes having a fixed dollar ceiling, above which owner approval is necessary. It is your responsibility to determine, from the contract documents or from a written delegation by the owner, the extent of the architect/engineer's authority; you must guard against accepting work orders from unauthorized sources.

Architects/engineers do not like to initiate changes because they often indicate design errors. However, changes are sometimes necessary if the system is to operate properly or coordinate with the structure.

Architect/engineer initiated changes are formalized through two basic mechanisms:

- A formal change order
- Trading via shop drawings or alternate manufactured equipment

Changes Initiated by the Prime Contractor

Prime contractors may request changes to the contract to purchase work that they failed to include in the original scope or in order to purchase special or temporary facilities that were not specified in the original contract documents.

Contracts normally specify a time period to respond to a request for change. Frequently, this is a very short time frame of five to 10 days. These contracts generally provide that failure to respond within that time frame may compromise rights of recovery for the cost of the change. It is critical that you either provide a price within the specified time frame or provide written explanation of why that time frame is unreasonable.

A prime contractor has three basic options when faced with issuing a change in the work:

- Negotiate to include the changed work in your scope through a mutually acceptable change order. The prime contractor can do many things to help or hurt your performance. It is wise to perform the changes and perform them at a fair price.
- Self-perform the work.
- Get another mechanical contractor to do the work.

Prime contractors will usually negotiate the change in work with your company because they are not qualified to do the work themselves and because another subcontractor's costs are higher due to higher fixed expenses for mobilization.

Administering a Change

How a change is administered can significantly affect profitability, relationships with the customer, and the ability to negotiate future work with a particular customer. Your company's integrity is often judged by how you handle changes.

Responsibility for administering a change and maximizing profit should rest with one person who is authorized to act for your company during customer negotiations. The representative must be diplomatic and consistent, smoothing negotiations which are often irritating to the customer. Typically, this person is the Project Manager.

Remember, if you fail to be diplomatic and if you do not consistently justify your changes, you risk poor results: less than maximum profits, a poorly administered project, and a very unhappy customer.

Qualify each quotation as being “subject to revision” after a specific date or if project conditions change. The change proposal cover letter should provide that the quoted price is valid only if accepted on or before a specific date. At the expiration date, or when project conditions change, you can void the quotation and immediately submit a revised quote or re-quote at a later date. Be sure to always allow the customer reasonable time to act on the quotation.

Prime contractors may receive an approved change that affects their subcontractor but fail to incorporate the owner's change in the subcontractor's amendment. Instead, prime contractors may initiate their own subcontractor change order language and define the scope of the change in their own words. Contractually, this is the prime contractor's risk. You are obligated to do only the work defined by the amendment to the contract, even if it is less than the scope included in the owner change given to the prime contractor.

However, since prime contractors are the “conduit” for your money, they may use leverage to compel you to comply with the owner's language. Good project management practice would be to encourage the prime contractor to incorporate the owner's change order exactly in the change order they give to you.

Prime contractors may direct you to proceed with change work before they have received proper authorization from the owner in an attempt to keep the owner's representatives happy or to keep the job moving. This action increases your risk and can lead to customer relations problems. If the prime contractor does not receive the owner's formal authorization, you may find it difficult or impossible to receive payment. Your best defense against this situation is to encourage the prime contractor to comply strictly with the contract documents and insist on formal owner action.

Most contracts specify a completion date which must be met. A change increases the amount of work that must be performed and may disrupt the work operations. Either reason is a proper basis for an extension of completion time. The change order proposal you submit to the customer should request an extension of time.

Changes disrupt contractual schedules in varying degrees: large changes are more disruptive than small changes; many changes are more disruptive than a few changes; changes issued near project completion are more disruptive than when issued at the project's beginning; changes that both add and deduct work can substantially delay completion because of administrative complexity.

Schedule adjustments because of a change must consider the effects on purchasing, planning, fabricating, delivery of equipment and material, and possible rework of already installed work.

If a change requires additional labor, you should either increase the labor force or ask for a time extension. If the labor force has been efficiently sized, the addition of more workers makes it less efficient (lowers productivity) as a total labor force, so an extension of time may be the economical method to pursue.

Sometimes, it is impossible to determine the exact time extension that should be requested for a change. Under these uncertain conditions, you should inform the customer in writing that an extension is required and that its extent will be determined after you have specific direction to proceed or have complete knowledge of the entire schedule or the scope of your work.

It may be prudent to use each change to seek an extension of contract completion time, even if you believe at the time that the extra work can be done without additional time. Gaining a contractual extension of time can be a prudent hedge against the risk of possible delay damages.

Customers are quite often reluctant to extend contract time and do not respond to requests for extensions. In any case, you should protect yourself by diligently requesting extensions in writing.

Cost-Plus-Fee Changes

Documentation of a cost-plus-fee change is important if you are to earn the maximum selling price. Some contracts require you to follow specified procedures for administering cost-plus changes, but most specify only the cost-plus markup percentage.

Daily reports covering all costs should be collected and submitted for customer approval. Ideally, the reports should be signed and returned to you within 24 hours, a realistic time if the customer's representative is on the jobsite. If the reports cannot be approved within 24 hours, you should agree to a reasonable time, but in no case should it be more than one week.

Daily reports should be detailed and include all applicable costs. Your company will likely not be paid for items not shown on the daily reports. Include all direct labor, material, equipment, tools, job supervisor or foremen's prorated time, project control, off-site fabrication, and subcontractors.

Be sure the daily reports are signed by an *authorized* customer representative. All too often these reports are signed by field clerks and other unauthorized personnel. The identity of the authorized person should be confirmed in writing by the customer.

Liquidated Damages

Contracts sometimes contain *liquidated damages* provisions. These are agreements between the parties that a delay will cause material damage to the owner, that the amount of the damage will be difficult to ascertain, and that a specific amount per calendar or working day will be the measure of the damages. A contract without a liquidated damages provision still exposes you to delay damages, the difference being that the injured parties must prove the amount of the actual damages they sustained because of the delay.

Typical Changed Conditions

Owners stipulate in the bid documents the conditions they believe essential to their building program and to their planned use of the structure. Owners also give benefits and assurances to the contractors in an effort to induce lower bids through more efficient practices and reduced contingency allowances for uncontrollable or unpredictable events. The owner's contract objectives may change during the course of construction and thus cause them to delay portions of the work, suspend all performance, accelerate work, deny access to a portion of the site, take possession of a portion of the project, or take a number of other steps which will have an impact on your work. Owners may have made errors in their design. Prime contractors may fail to carry out the obligations they have undertaken. The owner may, negligently or inadvertently, misdirect you or improperly administer the contract. These are some of the reasons the owner may be responsible for changes in the conditions under which you perform the work.

Prime contractors, in their contract negotiations with a trade subcontractor, usually attempt to avoid undertaking any obligations for conditions beyond those they have undertaken by the owner, except for highly specific elements such as construction services. Even though prime contractors try to avoid responsibility for the conditions under which you work, they cannot avoid their inherent responsibility in such areas as scheduling, performing the work expeditiously, and avoiding hindering your performance. During the execution of the contract, prime contractors may be unable or unwilling to deliver on all of their commitments. *If this happens, changed conditions result.*

Conditions also may be changed by the occurrence of a disaster or other event, whether man-made or natural. Fire, extraordinary weather, underground subsidence, explosion, strikes, acts of war, and installation of government priorities are some of the events that may destroy the work or delay its completion. Such events almost certainly impose conditions different from those specified in the estimate.

Delay of the Work

You can expect to perform the work in a particular order and time frame in order to finish the work by the completion date. If you are delayed by conditions beyond your control (for example, by a major change order), you are entitled to an extension of time. The only exception to your right to an extension of time would derive from a provision in the contract that expressly imposed upon you responsibility for delays arising out of that particular cause. When you are delayed by conditions beyond your control and for which you did not assume contractual responsibility, *you must promptly notify your customer in writing at the outset of the delay and ask for an extension of time.* Notification is generally required by the contract documents and allows the customer the option of limiting the adverse impact of the delay through modifying other elements of the work.

You may be delayed by conditions beyond your control and within the control of the owner or prime contractor. In that event, the owner or prime contractor will be responsible for the damages done unless it is found that you waived your rights to recover such damages.

A claim for delay damages requires you to prove that you were delayed, that the delay was not your fault, that the delay was unexpected, that the delay was due to the fault or negligence of the owner or prime contractor, that you gave the owner or prime contractor timely notice of the delay and potential damages caused by the delay, and that the delay caused you damage. You also must state the amount of the damage. It is not enough for you to prove that the owner was late in the performance of some duty, such as a delay in approval of shop drawings. It is necessary to prove that this specific delay, or the accumulated effect of a series of delays, was material and that it did in fact delay your performance.

The Project Manager must learn to distinguish, based on a careful analysis of the contract documents, between the three distinct types of causes which may delay the work:

- Delays for which you are entitled to neither a time extension nor the costs of delay and acceleration – Generally, these are causes of delay for which you assumed the specific risk under the contract documents, or causes for which you implicitly assumed the risk. Typical contract documents make you accept the risk of delay due to bad weather, unless the weather is abnormally severe. You implicitly assume the risk of delays due to shortages of workers in the area of the project (unless the shortage is due to specific owner actions not disclosed prior to award), and to interference and disruption caused by other contractors that is typical of the construction process.
- Delays for which you are entitled to an extension of time but not for the cost of delay – Contract documents, through “no damage for delay” clauses, reserve to the owner the right to make changes in the work for which you are allowed only the direct cost of the changed work, plus markup, and an extension of completion time. You are not allowed the costs of delay (such as pushing the unchanged work into later periods and the increased fixed cost of being on the project for a longer period of time). These “no damage for delay” clauses are onerous and can leave you with no recourse for costly delays. However, it should be noted that courts in many states have carved out narrow exceptions to these contract clauses that may provide some relief. Additionally, you are entitled to time only, not money, if the delay is beyond the control of the customer. Strikes, atypical weather, and government regulations and restrictions, known as “force majeure” clauses, are some of the delay clauses beyond the control of the customer for which you can recoup only time, not money.
- Delays for which you are entitled to both an extension of completion time and the cost of delay – If the owner or prime contractor delays you because of a cause that was within their reasonable control to avoid or due to their fault or negligence, they have damaged you. You are entitled to an extension of time to complete the work and to the cost of damages due to the delay. Examples of delays for which the owner may be financially liable include delays due to a defective design, failure of other contractors and suppliers to perform their work on time, or a cardinal change in the work. Delays for which the prime contractor may be financially liable include failure to complete preceding work in accordance with agreed upon schedules or in a reasonable time.

When in doubt as to whether a cause of delay makes the owner or prime contractor accountable for delay damages, the prudent Project Manager will give prompt notice of the delay and of a potential claim, pending a more thorough analysis or the development of later events. If a detailed schedule exists, which you and the owner or prime contractor have approved prior to the occurrence of the delay, then the schedule will serve to prove the effect of a particular delay. A sample ["Notification of Schedule Delay Letter" \(Figure 35.6\)](#) can be found in this manual.

Delays in completion will cause you to sustain increased costs through extension of fixed overhead for project control, supervision, construction equipment, and temporary construction services. Delays will increase construction costs during periods of rising labor and material prices by pushing you into later periods. Delays may cause problems with storage, access to the building, and more difficult handling of materials and fabrication.

Delay by You

Your customer has the right to expect that you will start your work promptly and complete it in an expeditious manner within the time period established by the contract documents. You may be late in the performance of the work, delaying performance of other contractors and possibly the completion of the entire project. If the delinquency is due to your fault or negligence and/or due to conditions that were within your control, you may be responsible to the prime contractor or owner for the damages you have caused.

It is not necessary that you complete every detail of the work in order to meet the completion date of the contract, unless the documents specifically provide that total and strict completion is required by that date. Generally, the completion time will be satisfied if the work is substantially completed and can be used for its intended purpose.

A proper backcharge by your customer for delay damages would require the customer to prove that your delinquent performance delayed other work or the completion of the project, that the delay was due to your fault or negligence, that the delay was not due to the fault or negligence of the owner or prime contractor, and that the delay caused damages to the owner or prime contractor. It would not be enough to prove that you were late in performing some portion of the work, such as a failure to occupy an area when it became available to your workforce. It is necessary that the owner or prime contractor prove this specific delinquency or the cumulative effect of all delinquencies was important, and that you did in fact cause delay of completion of the project.

Since contract payment usually flows from the owner through the prime contractor to you, the owner and prime contractor can be somewhat more careless in backcharging you for the alleged damages caused by delay. By merely withholding from you the amount of the alleged damage, the owner or prime contractor shifts the burden to you to prove that you were not delinquent.

You are responsible for the failures of your subcontractors and suppliers. Their unexcused delinquencies expose you to delay damages imposed by the owner or prime contractor.

The benefit of a detailed schedule which you, the owner, the prime contractor, and your subcontractors approved prior to the occurrence of the delinquency will serve to help you defend yourself against unwarranted claims of late performance and will assist you in shifting the responsibility for delinquency to your subcontractors if they in fact are failing to meet the agreed upon schedule.

Acceleration of the Work

The dimension of the space and time envelope within which you can expect to perform the work is defined by the specific contract document clauses such as starting and completion dates, supplemented by the more detailed work program, such as a CPM schedule, that should have been formulated with your participation and approval. Such a schedule should allow adequate lead time for the commencement of the work, during which trade construction activities that must precede the installation of field work (purchasing, shop drawing submittal and approval, fabrication and manufacturing, delivery, etc.) can be performed.

Preservation of your space/time envelope will require the timely performance of preceding construction activities by the prime contractor and other trades, and the deferral of work by the prime contractor and other trades which normally, or by schedule agreement, is to follow your trade work. This way, you can complete your work in a normal sequence, with adequate time to complete each operation, and without the disruption or interference of other work. Schedule agreements should permit the performance of various operations in a sequential manner, so that the workforce can be maintained at a uniform level throughout the duration of the construction period. If your schedule does not provide for reasonable sequencing, the prime contractor may delay the start of virtually all activities and impose on you the demand to occupy many areas concurrently. Such concurrent work may require a workforce far too large to maintain, supervise, and tool efficiently. It may also prohibit specialization of your crews to increase efficiency by performing similar operations repetitively.

Delay of the work entitles you to an extension of time. If the owner or prime contractor fails or refuses to grant you the extension to which you are entitled, and holds you to the original completion date, they are requiring you to accelerate your work pace in order to meet the original date. Likewise, if the owner or prime contractor denies you an appropriate extension by failing to restrain other trades that follow you, this will force you to accelerate your pace to avoid being caught up in a disruptive, congested workplace.

An owner's needs may change after the award of the contract, and this may require possession of the construction at an earlier date than specified. The owner's demand that you complete the work sooner than the contract completion date is another form of acceleration.

If the owner or prime contractor has constructively accelerated the work, they should be notified, in writing, that the consequence of their continued failure to extend the completion time or allow appropriate time to complete an operation will create an acceleration of the work at an increased cost. You should notify them of the specific acceleration efforts that you propose to take unless an appropriate time extension is granted, and the "relative" cost

consequences of those actions. You should try to avoid quoting specific costs of acceleration, as they would be difficult, if not impossible, to accurately price.

Suspension of the Work

Despite the owner's implicit obligation to allow you to complete your work without interference, occasionally the owner's program changes to such an extent that part or all of the work must be suspended. Such suspensions are frequently called *stop orders*.

An owner may want to stop the work because of the need to make a change. If the owner does not suspend the work, payment for the originally specified work and its removal, as well as the substitute work, may be required. Occasionally a change may be so extensive that the suspension of a major segment or all of the mechanical work is required.

Owners may desire the benefits of suspension while attempting to avoid the cost obligations that would result from the issuance of a formal stop order. The owner may unreasonably delay approval of shop drawings, making it impossible for you to perform your work, while taking advantage of this delay to prepare the revised contract documents that will describe a change in the work. You should give prompt written notice when you believe work is being suspended. Given prompt notice, such unreasonable delay by the owner is a constructive suspension order and the owner would be liable for the damage done to you. Contracts with most federal agencies (e.g., the General Services Administration, the U.S. Army Corps of Engineers, and the Veterans Administration) now authorize the contracting officer to suspend work at any time, subject to an equitable adjustment in the contract price. Many private contracts similarly reserve the right to suspend work, subject to the owner compensating the contractor for reasonable additional costs.

Non-Availability of Workplace

An implicit obligation of the owner is that the workplace will be available promptly following award of the contract. Despite the owner's best intentions, the workplace may not be made available when promised. The owner may be delayed by an unforeseen zoning restriction or other impediment to using the site, or a preceding contractor may have failed to complete work in a timely fashion.

A material delay in making the site available following contract award is generally considered to be a breach of contract. In such event, the contract is terminated and you are entitled to recover the damages that are incurred through termination of purchase commitments, effort expended in preparation of shop drawings, and other considerations.

Alternatively, you may be able to negotiate an understanding with the owner to continue the contract, subject to the owner or prime contractor compensating you for the additional costs incurred through delay in the commencement of the work.

The Burden of Working Out of Sequence

Another implicit obligation of the owner and/or prime contractor is to permit you to perform your work in a normal economical sequence. Occasionally, you may be required to perform the work in a different relationship to other work that will increase costs.

A detailed schedule, which you and the customer have approved prior to the occurrence for the demand for out-of-sequence work, will serve to prove agreement on the normal sequence for performing the work. The schedule will help defend against unwarranted demands to perform out-of-sequence work and will assist in recovering the additional costs incurred through compliance.

Construction Services Not Furnished by Others

The estimate and planned construction sequence were developed with reliance on the owner or prime contractor furnishing the construction services specified by the contract. The work sequence may require significant modification, and costs may be materially increased if these construction services are not furnished, or are not furnished in the scope, quantity, quality, or timeliness stipulated by the contract.

If the contract documents merely state the general obligation of others to provide construction services, but fail to specify the quantity, quality, or timeliness of such services, then you should encourage the owner or prime contractor to provide these services. If the services are not provided, you should adopt the lowest overall cost solution and give written notice that you have been forced to adopt this alternative course.

Misrepresentation of Existing Conditions

The contract documents frequently contain representations by the customer with regard to the physical conditions existing at the site at time of award. The most frequent of such representations are the existing soil conditions at the site. If the soil conditions are materially in error, the cost for excavation for underground utilities may be seriously affected.

Other typical representations are existing underground utilities, work completed under prior contracts, or location and arrangement of existing structures. A material misrepresentation in any of these existing conditions, whether by fault or negligence, may impose severe cost penalties.

You are generally obligated by bid document language to make a careful examination of the site prior to submitting a proposal. In this way, the owner seeks to shift the responsibility for conditions different than were originally represented. (The owner or prime contractor does not always make areas of the site available for inspections. In such cases, you would not be held responsible for these unknown conditions.)

The federal government and many other contracting agencies require their contractors to notify them in writing immediately upon discovery of a condition other than as represented in the contract documents. Such notice gives the opportunity to examine the “undisturbed

conditions” and to evaluate the most economical alternative, possibly by issuing a change in the contract documents. If the customer fails to respond to such notice, you should preserve a careful, objective record of the misrepresented conditions as they were discovered, as a basis for supporting a later claim for the damages that were sustained. Such evidence might include photographs, surveys, logs, etc., and should be authenticated by an independent professional if there could be any future doubt as to the actual conditions.

Error in Design

The implied warranty of the owner, as the drafter of the contract documents, is that the design is structurally sound, workable, and in conformance with applicable laws. If the owner breaches this warranty, additional costs may be incurred.

Owners do not like to pay for the unnecessary costs that flow from a design error. These costs might include wasted effort, damage to other work, or delay. The owner's architectural and/or engineering consultants also are dismayed by the discovery of errors in their design, since such errors are a reflection of their professional competence. Where possible, you should seek to discover the errors before you have made major expenditures in fruitless effort. Then you may be able to suggest to the consultant a solution to the error that involves little or no increased cost to the owner.

Cardinal Changes

Owners routinely reserve the right to make changes in the work. Since this right was contemplated in the contract documents, the great bulk of change orders do not constitute a change in the conditions under which the balance of the work is to be performed.

Occasionally, an owner makes changes in the work of such tremendous number or size as to completely disrupt the originally planned work program. The unchanged work may therefore be suspended, delayed, accelerated, interfered with, or otherwise impacted so as to greatly increase its costs. Although the owner may be willing to pay for the additional costs of the changed work, this payment could be limited to the cost of performing the change and not include the cost of the impact effect on unchanged work.

When the number, frequency, or size of changes completely disrupts the originally contracted work program, it is called a *cardinal change*. A cardinal change goes beyond the owner's reserved right to make changes that are reasonable in number, frequency, and size, and therefore constitutes a breach of the contract by fundamentally changing the conditions under which you must perform your work. If a change order is of such size or nature as to have a material and independent impact upon the unchanged work, the owner should promptly be advised of what is anticipated to be the impact of the change apart from the cost of simply performing the changed work. Prompt notification will enable the owner to review the proposed change, which may have previously been considered only in the context of direct rather than overall project cost.

A series of changes of such number and frequency as to constitute a cardinal change may be difficult to identify as each change order is issued. Eventually, you may notice that the cumulative effect of the number and frequency of changes is causing a breakdown in your ability to control work in the manner contemplated in the original schedule. At this point, you should notify the customer of the cumulative effect of its actions and the nature of the additional costs that you will seek to recover.

With respect to the great bulk of change orders that do not appear likely to have any significant independent effect upon the project as a whole (and will therefore probably not constitute a cardinal change), you can best recover the impact effect of such changes on the unchanged work by the inclusion of a disclaimer on each change order request reserving your right to submit a claim at a later time for any cumulative schedule impact. A sample of such a disclaimer follows:

This proposal is for direct costs only and does not include any amount of compensation or time for delay and rescheduling, and/or impact costs, and the contractor specifically reserves the right to make a claim for any or all of the related items of additional costs prior to any final settlement of this contract.

Change orders are second only to labor in risk and are not to be taken lightly. Improperly pricing or neglecting to submit a change order request can be devastating to the bottom line, or at the very least have a major effect on the profit margin. Assure your foreman or job supervisor understands the scope of the work and together you can protect it by doing everything in the scope of the work and using every tool available to get paid for work that is done outside of the original scope.

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin CO 1, "Change Orders"
 - Bulletin CO 3, "Time Impact Analysis—Measuring Project Delay"
 - Bulletin ES 2, "Unit Pricing"

Change Orders, Productivity, Overtime: A Primer for the Construction Industry

SECTION 36: CLAIMS

How Claims and Disputes Arise

A claim is a demand by one party for payment or other compensation from another party for work completed or conditions encountered outside the scope of the original project documents. Examples are a claim filed by a mechanical contractor against a project owner or prime contractor, by a subcontractor against a prime contractor, or by one contractor against another.

In many cases, a claim represents a legitimate disagreement between the parties. In others, a claim is a symptom of distrust between the parties. Either way, money is at stake, and both parties have an interest in having the claim settled in their favor and at the lowest cost.

The Best Solution Is to Avoid Claims

Some suggestions to avoid claims are as follows:

- Maintain good communication and a good relationship with your customers and other contractors on the jobsite.
- Develop a high level of trust in all relationships. When parties trust each other, disputes can be settled more easily.
- Manage *all* elements of your project well.
- Settle differences (future claims) at the lowest possible level in both organizations.
- Remember that most disputes are based on honest misunderstandings on the part of one or both parties.
- Maintain good project documentation.

Alternative Dispute Resolutions

The following six methods of alternative dispute resolution are listed in order of preference, with negotiation being the preferred method and litigation being the last resort because it consumes the most time and money. In most cases lawyers are the only people making money when a dispute is litigated.

Negotiation

Most claims can be settled through negotiation, thereby saving both parties time, money, and effort while preventing permanent damage to the business relationship. The negotiation can usually be accomplished in one or more private meetings and preferably without legal counsel being present. In preparation for negotiation, it could be worthwhile to privately consult your legal counsel.

Dispute Resolution Board

Both parties will select a member of the board, and then these two members will select a third member. The board will then review the issues of the dispute and recommend a solution to the parties. This solution could be binding, but it is usually non-binding for both parties.

Mediation

The two parties will select a mediator (one with considerable knowledge and experience in construction) who will work separately with each party and, through a series of meetings, try to bring the two parties to a common solution.

Mini Trial

The two parties will hire a retired judge, and each will present their side to him or her. The judge will review the issues and render a decision. This solution could be, but usually is not, binding on the parties.

Arbitration

Arbitration is a process whereby independent reviewers examine the evidence presented by both sides in a dispute and decide on a settlement. Most arbitration is done by the American Arbitration Association, an organization of professional arbitrators who are knowledgeable about the construction industry. Arbitration can be less costly and less time-consuming than litigation, and the reviewers are more familiar with the construction industry than are judges and juries.

Litigation

Taking a claim to court is usually the most costly and time-consuming route to settlement and *should be used only as a last resort*. The claimants must keep in mind that by putting their claims in the hands of the legal system they are taking a serious risk: lawyers, judges, and juries often know little or nothing about construction practices and procedures. This risk should be weighed carefully before litigation is begun.

In seeking a resolution you must always remember that the final solution will be somewhere between the positions of the two parties. Usually, neither party will win 100 percent of what they want. Therefore, you should work to resolve any claim in the shortest possible time because this will save both time and money.

Documentation

For any claim to be successful, it must be thoroughly documented. This is one of the most compelling reasons for maintaining complete and accurate records of all events and conditions on the job. Situations that result in claims often are not recognized until after they have occurred. If the job supervisor or foreman or Project Manager has not kept accurate and detailed records throughout the project, it is nearly impossible to properly document a claim. This is especially true if the claim goes to court, where the direction and the amount of the

judgment often rely on documentation. For more detailed information on proper project documentation, see [Section 28: "Documentation."](#)

Among the types of documentation useful in substantiating a claim are:

- *Daily Job Logs* – the single most valuable type of documentation because they are official, legal records of job events, recorded and signed on the day the events occurred.
- *Job Supervisor or Foreman's Log* – useful for corroborating Daily Job Logs. This log is not subject to the legal hearsay rule and can be submitted as evidence if entries are made in the regular course of business, at the time the events occur, are original and unedited, and are based upon the firsthand knowledge of the person making them.
- *Short Interval Plans* – Similar to job supervisor's logs, the Short Interval Plans developed to manage the individual crews. In many ways Short Interval Plans are superior since the as-planned work is documented as well as the response made by individual crew.
- *Photographs and Videos* – especially effective as documentation. They must be labeled with the date, the time, and a description of what is shown. The signature of the photographer must appear on the back of each photograph, and videotapes must be original and unedited.

Other important documentation includes:

- Correspondence
- Meeting and job conference minutes
- Supervisory interview
- Project cost reports (especially unit-rate production figures)
- Delay surveys
- Change order requests and change work documentation
- Schedules
- Transmittal logs
- Discovery documents
- Consultant or expert witness analyses

Common Types of Claims

Most claims fit into one of the following categories:

- *Injury or damage claims* – request compensation for personal injury or property damage resulting from an act or omission of one of the parties, its employees, agents, or anyone else for whose acts it is legally liable.
- *Delay or disruption claims* – request compensation for costs resulting from a delay or disruption of the schedule resulting from another party's actions or failure to act.
- *Change in conditions claims* – request compensation for costs incurred due to the discovery of conditions that differ from those stated in the contract documents.
- *Change in scope claims* – request an increase in the sum of the original contract due to an unforeseen increase in the amount of work involved in meeting the contract requirements.
- *Time extension claims* – request an extension of the project schedule to compensate for events or conditions beyond the control of the claimant.
- *Termination claims* – request compensation for costs incurred as a result of a project or a contractor's involvement in that project being terminated before completion.
- *Payment delay claims* – request compensation for additional costs incurred as a result of not being paid according to the original, agreed-upon schedule.

Productivity Loss Claims

Productivity loss claims result when a contractor feels that one or more factors beyond his control have hampered the company's efforts, delaying completion of certain work activities and then forcing the acceleration of the schedule in order to complete the project on time. A productivity claim can cite any of several unforeseen site conditions or shortcomings on the part of the prime contractor or project owner, such as:

- Lack of coordination of trades
- Delays in clarification of design
- Design constraints
- Changed site conditions
- Preceding work not completed as scheduled
- Unqualified inspections
- Excessive change orders
- Slow responses to submittals and change requests
- Lack of access to work areas

- Work delays or suspension

From this list of possible causes, you can see that a productivity loss claim can involve several factors listed under other types of claims. Where a productivity loss claim differs from other types of claims, however, is that it cites impact on productivity as the cause of losses incurred, particularly:

- Loss of momentum and productive rhythm
- Redundant mobilization and demobilization
- Demoralization of workforce and supervision
- Disruption of orderly flow of materials
- Excessive short-term and long-term replanning
- Uneven workforce loading
- Need for additional management and supervisory staff
- Congestion and crew interference
- Inability to achieve learning curve improvement

These effects can be difficult to prove in a court of law. Nonetheless, they are legitimate grounds for a claim and should be considered. In substantiating a productivity loss claim, the contractor should calculate the total costs involved (see ["The Cost of Claims"](#) later in this section) and establish that:

- The original bid was reasonable
- The costs claimed are reasonable
- Your company is not responsible for any of the losses claimed
- There is a significant difference in productivity between impacted and non-impacted areas or time periods

The Different Viewpoints of Claims

There are two sides to every story. As such, there are two perspectives in every claim situation. When a contractor files a claim against an owner, the contractor is likely to cite the reason as the owner's:

- Financial difficulty and payment delays

- Increased retainage
- Work suspension or stoppage
- Schedule interference
- Errors in specifications or drawings
- Late drawings and specifications
- Excessive changes and rework
- Delayed decisions or quality approvals
- Construction method interference
- Excessive inspection or quality control requirements
- Differing site conditions
- Limited site access
- Interference with work crews
- Owner-furnished equipment or material constraints

The owner's defense to the contractor's claim often will include the following reasons for the contractor's increased costs:

- The contractor's or subcontractor's original bid was too low
- Inefficient management and supervision
- Inability to coordinate subcontractors
- Lack of planning, scheduling, and control
- Lack of motivation among supervisors and workers
- Workforce skill level constraints
- High percentage of absenteeism or turnover
- Inefficient procurement, warehousing, and delivery of materials
- Insufficient tools, equipment, and scaffolding

- Strikes, slowdowns, and other union actions
- Ineffective quality control and excessive rework

When a subcontractor files a claim against a prime contractor, the subcontractor is likely to cite the reason as the prime contractor's:

- Lack of planning, scheduling, and control
- Inability to coordinate subcontractors
- Delays in progress payments
- Inability to control quality deficiencies of other subcontractors

Measured Mile Analysis

The first defense of the owner when a contractor files productivity or other claims will be that the original labor estimate was flawed. The burden of proof for proving the validity of the estimate lies with the contractor. Contractors do make estimating errors and must recognize their duty to prove the validity of their estimate for that particular project with the as-planned job conditions. The most effective validation of the contractor's original labor estimate as modified by change orders is best done using a Measured Mile Analysis. The analysis eliminates concerns over under-bidding and contractor caused problems.

The Measured Mile Analysis consists of comparing productivity in an impacted labor period or area with productivity in an unimpacted labor period or area to establish what the cost "should have been" in the impacted labor period or area. To be effective for the analysis, the work done in each needs to be of a similar nature. The work in the unhindered or unimpacted labor period or area is referred to as the "Measured Mile." The difference in actual cost and the "should have been" cost is a measure of the impact. The more detailed and accurate the labor record, the more relevant and persuasive the Measured Mile Analysis will be. The Project Manager is well advised to evaluate his recordkeeping procedures to ensure that the information necessary for a Measured Mile Analysis is being regularly collected and maintained on every phase of the project.

A comparison of the measured mile experienced on the jobsite and the cost predicted in the original estimate as modified by change orders can then be done. If the costs are similar, the original estimate is validated. If the cost is less, the contractor would have performed better than original estimate. If the cost is more, the contractor has now established a non-impacted performance factor for that particular project and its unique project conditions. The increase in project costs when comparing estimated to actual costs becomes the responsibility of the contractor. The difference in the project factor cost and the increased costs in the impacted areas is then discussed and responsibilities established. The Measure Mile Analysis only addresses the validity of the original estimate. It does not establish owner responsibility but does establish a reasonable anticipated cost for the project.

The Project Manager who consistently pre-plans his work and creates a mechanical schedule in close coordination with the general contractor's schedule can significantly improve tracking of the measured mile. The Project Manager, in coordination with this developed schedule, will create an area-specific labor-coded schedule of activities that follow the logical construction sequence of the project. This area-specific data is broken down by individual system or piping material. The guideline is that activities can usually be done by a single crew in three to 22 work days. Collection of the payroll data then gives the contractor timely data on how each area performs in comparison to his original breakdown. Since the estimated hours are used to populate the area-specific labor-coded activity schedule, there is a record of performance compared to estimate. The time record is integral to the payroll data including which individuals worked in which areas. This invaluable record is compiled in the regular course of "doing business."

The Measured Mile Analysis is further discussed in *MCAA Management Methods Manual* Bulletin PD 3, "How to Apply the Measured Mile Method of Productivity Analysis."

The Cost of Claims

The primary reason for filing a claim is to recover costs incurred as a result of some action on the part of the other party. Among the costs to be considered in determining the amount of a claim, the contractor must consider:

- Labor hour overruns
- Wage increases
- Material quantity overruns
- Subcontract overruns
- Additional site and office overhead
- Additional equipment and tools
- Finance charges
- Mobilization and demobilization
- Lost opportunities
- Claim preparation fees

Claim Preparation

Before submitting a formal claim to recover damages, every effort should be made to find informal or alternative means of achieving an equitable settlement. Alternative work programs may be developed. You may be allowed to include in change order quotations the cost

consequences of the change that are in addition to the direct costs. If informal or alternative solutions are not available to achieve an essentially fair solution, then a formal claim may be submitted. The written claim must be complete, self-explanatory, and convincing to a higher level authority in the organization of the customer, who may lack any personal familiarity with the problem or who has received biased, inaccurate reports from their subordinates. The written claim should cover the following points:

- The specific contract document provisions that were changed
- Evidence that these conditions were, in fact, changed
- Evidence that the change was unexpected
- Evidence that the changes in conditions were due to the customer's own fault and negligence and were not due either to events beyond their reasonable control or to events over which the contractor could exercise reasonable control
- Evidence that you gave *timely notice* of the events that caused the change in conditions and that such change would cause damages to be incurred
- Evidence that you attempted to mitigate the damage
- A claim for additional compensation, supported by detailed cost records or estimates that relate the increased costs to the specific changes in conditions

Any significant exposure to damages should be brought to the attention of your supervisor *at the time the event occurs*. Your supervisor should then, with the assistance of legal counsel, work with you to ensure that adequate records have been and will be kept. You should not submit a claim to the customer without first consulting with the highest authority in your company and legal counsel.

Avoiding Damage from Changed Conditions

Your primary objective should be to avoid being damaged by changing conditions, rather than to recover the damages from the owner or prime contractor. The most important contribution you can make to avoid damage is to negotiate, as part of the contract documents, explicit, unambiguous understandings concerning the conditions under which the work will be performed. If both parties clearly understand what they must do to avoid damage to each other, there is less likelihood that they will fail to comply with their contract obligations because of negligence or deliberate action.

You should seek to implement these contract document conditions by careful planning and negotiation early in the construction cycle. If you promptly notify the customer that a course of action will cause damage to you, the customer will more likely seek a means of avoiding that injury. If you suggest to the customer in a timely manner an alternative course that will avoid that injury, a new program can be adopted rather than exposure to a later claim for damages.

Remember that simple customer relations dictate that every effort should be made to limit the damage done to you and to help the customer understand the importance of mitigating the damages with the recovery of claims considered a path of last resort.

In dealing with each problem that arises to threaten the orderly and efficient performance of the work, keep in mind the basic fact that the most effective project administration is often the most imaginative project administration. Letters of notice or protest constitute only one means, and frequently the least effective means, of overcoming disruptions to the work.

Recovering for Damage

Bid prices are established under keen, competitive pressures. At bid time you accept many risks over which you or the customer has control. For these risks, contingency allowances can be made that may or may not prove to be adequate. Bid prices, however, do not allow a contingency factor to cover the risk that the customer may fail to provide the conditions which were promised in the contract documents.

You are more likely to recover damage claims in full if you observe the following practices:

- Anticipate major potential difficulties and resolve them by early negotiation and agreement with the customer.
- Encourage the customer to carry out their contractual obligations by expediting their actions, working with them to mutually solve problems, and executing your own obligations in a prompt manner.
- Give the customer *prompt written notice* of their failure to provide the contractual obligations, so that they may remedy the problem in a timely manner and limit their exposure.
- Build a favorable record that will show your efforts to anticipate and resolve difficulties rather than a determination to exploit the difficulties of others.
- Avoid needless and destructive antagonism with the other parties.
- Adopt and maintain a project program and work sequence that will keep added costs at the lowest possible level.

Avoiding Liability to Subcontractors

You should attempt to see that the customer provides the conditions for your subcontractors to the same extent that you seek to have such conditions provided for your own benefit. Your subcontractors should make a similar effort to anticipate problems, develop economical solutions, give timely written notice, and to adopt an alternative work sequence which will keep their added costs at the lowest possible level.

You communicate to the customer, on behalf of your subcontractor, the notices and demands made upon you and seek to preserve their claim rights.

The objective of your conduct towards your subcontractors will be to avoid independent liability due to the failure of your customers to discharge their contractual obligations.

Securing and Detailing Agreement on Conditions

Even after award of the contract, it will be necessary to continue the negotiations regarding conditions and to confirm successive agreements.

Construction services (such as heat, enclosures, toilets, power, etc.) which the owner or prime contractor may be obligated to provide will still be subject to negotiation of the implementation details. Try to reach agreement on quantity, quality, schedule, and locations of the services, as well as the specific contribution you are to make to these services. The details of construction services should be worked out in conjunction with the detailed schedules and work plans.

Negotiations that change or modify contract document conditions should be suitably confirmed in writing. This confirmation may take the form of a change order, an exchange of letters, or the formal issuance of a schedule by the customer and its acceptance by you.

Similar negotiations will be conducted with your subcontractors. Your subcontractors should accept, and be bound to, your schedule agreements. In turn, you need to have their written concurrence with the agreements that have been reached for implementing the conditions to be performed by the owner or prime contractor.

Early detection of problems that may change conditions gives a far greater number of options to obtain a mutually agreeable solution. Many alternative courses may be available. You may offer to waive already incurred delay costs in exchange for desirable schedule changes or change orders. You may be able to propose a rescheduling of work that permits a more normal sequence and crew size in exchange for some acceptance by the owner of specific costs of acceleration. You may be able to trade a solution to a design error for a beneficial deviation from a contract requirement. Key project management tools in dealing with changed conditions are prompt detection, an imaginative solution, and skilled negotiation.

Preserving Claim Rights

Effective project management requires a clear understanding of all contract provisions, at all contract levels, which deal with the conditions under which the work will be performed. The contract between the owner and the prime contractor should be studied just as carefully as the contract between your company and the customer. A detailed study of these documents will enable you to establish the precise notice requirements that must be satisfied throughout the project.

Give all the notices required by contract. In the event that you are a subcontractor, request in writing that the prime contractor submit your notices to the owner as may be required by the owner's contract documents.

Give notice of a change or threatened change in contract conditions, even if not required by contract documents. By giving such timely notice, you offer the customer the opportunity to take remedial action that may prevent or limit the damage done to you. It is far better to avoid the damage or to minimize its effect than to attempt to recover a large claim.

If a change order is of such magnitude or timing as to have a material, independent impact upon the project schedule, the Project Manager must promptly advise the customer of the approximate additional cost range incurred, apart from the cost of simply performing the changed work. With such notice, the customer may review the wisdom of proceeding with the change. If the customer withdraws the proposed change, you would avoid added costs that may not be recoverable. If the customer decides to go forward with the change, in spite of added costs, then the customer has been informed in writing of the potential added cost and cannot argue that he was not aware of the cost of the decision.

In addition to preserving rights to a claim, by giving appropriate notice you have to preserve an objective record of the changed condition and its effect. Effective Project Managers will analyze each element of the work program in which cost increases can occur that are reasonably traceable to the change in condition caused by the customer. Such analysis will focus their attention on the specific efforts that must be made during the course of construction to preserve an objective record.

Records may take the form of Daily Job Logs prepared by the job supervisor or foreman and/or Project Manager, photographs, marked-up drawings, and/or the retention of outside professionals (to verify contours and subsurface conditions, for example).

If the only work placed in suspense because of a design change is limited to mechanical work, and the general construction work proceeds, it may be desirable to take photographs to illustrate the conditions at the start of the suspension and at its conclusion. These photographs would then illustrate the trouble-free work conditions under which you should have been allowed to work and under which others were allowed to work, in contrast with the physically more burdensome and disruptive conditions under which you had to work because of the suspension and the greater progress of the general construction work.

The evidence and information that is gathered should not be disclosed prematurely to the customer. It should be set aside as raw material which may later be used to develop and support a specific claim whose theory and approach cannot be formulated until all relevant facts and losses are known.

Responsibility

Generally, the customer is responsible for the damage done by changes in conditions they contracted to provide, but only to the extent that such changes are due to their fault or

negligence. They will not be held responsible for the consequences of events over which they could not have exercised reasonable control.

A number of unrelated events may cause a change in conditions, and appropriate notice should be given at the occurrence of each event. It may be that such notices merely call attention to the event and that it will cause a change in the conditions of the work, not attempting to identify the precise effect of each event. Later, when the claim for damages is submitted, you may wish to carefully identify that it was the events within the control of the customer which caused the damage, rather than those beyond their control.

You are similarly responsible for the delays in your performance that are due to your fault or negligence, but you are not responsible for those that are beyond your control. Again, a delay on your part may appear to be due to several events, some within your control and some not. It is therefore important that you request extensions of time based on events outside your control (strikes, change orders, fires, and other disasters, etc.) in order to limit exposure to claims that your delays were due to other events over which you had control. *Note that the customer will often try to defeat a claim for damages due to customer delay by claiming a concurrent delay on your part.*

Mitigation of Damage

You have a legal obligation to mitigate damage, even if the damage is due to the fault or negligence of others. To mitigate damage means to *do the prudent things to keep losses to a minimum*. Courts and arbitrators will routinely limit recovery to the loss that would have occurred if such prudent action had been taken.

In addition to the legal obligation to mitigate loss, you have an important customer relations responsibility to do so. You want to maintain a favorable reputation with each customer. This may not happen if major catastrophes occur which you were capable of preventing or substantially limiting. If you take the initiative to mitigate loss, you should give notice to the customer describing the actions you propose to take, the reasons for taking these actions, and your right to recover actual costs and damages.

Filing a Claim Is a Last Resort

Pressing claims for changed conditions by litigation or arbitration is typically an unsatisfactory remedy of last resort. You risk the customer's goodwill and the goodwill of potential customers who believe that your company is too hard to deal with. You expose yourself to the risk of counterclaims and to the unpredictability of third-party decision making where the facts may be disputed, obscured, or difficult to analyze. Litigation or arbitration is expensive and time-consuming. Before relying on the simplistic solutions of third-party decision making, you should exploit your skills of perception, analysis, imagination, and negotiation to reach a mutually agreeable solution.

Additional resources available through MCAA's online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin CO 1, "Change Orders"
 - Bulletin CO 2, "How to Organize and Submit a Claim"
 - Bulletin CO 3, "Time Impact Analysis—Measuring Project Delay"
 - Bulletin ES 2, "Unit Pricing"
 - Bulletin JM 5, "Effects of Job Schedule Delays on Construction Costs"
 - Bulletin LL 12, "Liability of a Prime Contractor for Interference with a Subcontractor"
 - Bulletin PD 3, "How to Apply the Measured Mile Method of Productivity Analysis"
- *Change Orders, Productivity, Overtime: A Primer for the Construction Industry*
- *Tool & Equipment Rental Guide*

SECTION 37: TESTING AND TEST REPORTS

The Importance of Testing and Test Reports

Test results are the proof of job quality and compliance to contract documents. For the project to be considered finished, all systems and components must perform as specified in the contract documents. However, it is not enough for the systems and components to pass their various tests; the test results must be accurately recorded and *documented* as proof of satisfactory job completion.

Types of Tests

Depending on the type and size of the project, any of the following tests may be required:

- Pressure testing
 - Piping system
 - Air system
- Operation and quality control testing
 - General equipment performance tests
 - Control systems
 - Hydrostatic tests
 - Chlorination tests
 - Certification tests for domestic water
- Code testing
 - In-plant
 - Local and state government
 - Municipal
 - Testing agency (Underwriters Laboratories, etc.)
 - Insurance companies
- Permit testing
- Pre-start-up testing
- Fire suppression testing
- Fire alarm testing

Other tests may be required for specific types of projects or projects in particular parts of the country.

Testing Responsibilities

The Project Manager should assign specific responsibilities for testing to one or more individuals on the project team and give them specific instructions regarding the procedures involved. Among the most important responsibilities are:

- Being certain that all test procedures specify:
 - Method for conducting tests
 - Target results
 - Acceptable tolerance ranges
 - Preparations for retesting
 - Types of test documentation required
- Preparing all systems and components for testing and notifying the Project Manager when preparations are complete.
- Notifying all persons required by the contract documents to witness each test, including (as appropriate):
 - Architect/engineer
 - Prime contractor
 - Owner's representative
 - State, local, and/or municipal authorities
 - Local fire marshal
 - Local plumbing inspector
- Properly documenting all test results

Testing Documentation

It is vital to properly and accurately record all test results. The procedure to be followed should include:

- Using a report forms that is acceptable to all parties. The sample [**"Standard Testing Record Form" \(Figure 37.1\)**](#) in this manual is generally accepted within the industry.
- Completing all applicable sections of the form ahead of time (including project name, number and location, test date, and the details of the testing methods to be used).
- Verifying that all results are accurate as recorded.
- Having everyone who is required to witness the test sign the test form.
- Transmitting copies of all test results to the customer and your company's main office.

There is nothing difficult about the testing procedure. If quality control standards have been maintained throughout the installation process and the system is prepared properly prior to testing, satisfactory test results are almost assured. If the results are accurately documented, the results will stand as valid evidence that your company fulfilled its contractual responsibilities.

SECTION 38: START-UP

The contract documents typically require the mechanical contractor to:

- Demonstrate that the equipment and systems that have been installed function according to the specifications of the manufacturer and the project documents.
- Provide the project owner with operation and maintenance instructions for all equipment and systems.

Start-up is the phase of the project when both of these requirements are met.

Guide to a Successful Start-Up

The best insurance for a successful start-up is to install the equipment and systems properly. This is a project-long responsibility that requires the Project Manager to assure that the job supervisor or foreman and the installation crews:

- Read the manufacturer's instructions carefully.
- Check the manufacturer's identification numbers against those in the project plans to avoid costly installation errors.
- Resolve any problems or confusion regarding installation *before* beginning work.
- Tag all equipment with identification numbers, as required, *before* installation. This avoids installation errors and saves time and effort at the end of the project.
- Follow the manufacturers' instructions throughout the installation procedure.

Once installation is complete, the Project Manager must be sure that all systems are ready for start-up when the start-up date arrives. This means assigning someone on the project team the responsibility for:

- Final lubrication
- Removal and replacement of temporary filters
- Proper rotation of pumps, fans, chillers, etc.
- Testing, evacuation, and charging of refrigerant piping and removal of shipping blocks
- Checking all power and control wiring
- Aligning all equipment
- Verifying that all utilities are operational

- Testing, flushing, and filling of all piping systems
- Scheduling factory personnel to be present to conduct or assist with start-up, if included in scope of work
- Notification to be made:
 - Notify the testing and balancing contractor of the start-up date and arrange for a qualified technician to be on hand to assist during balancing procedures.
 - Notify the owner so that his representative can be present at start-up.
 - Notify the owner that instructions for operation and maintenance of equipment will be given as part of the close-out procedure.
- Documentation: Prior to the start-up date, gather the following:
 - A fully revised equipment submittal booklet
 - A complete set of plans
 - All warranty documents
 - All necessary start-up check and test and balance forms
 - A complete set of factory start-up instructions
- During start-up:
 - Document all start-up activities and results
 - Verify that all results are accurately recorded
- After start-up:
 - Transmit copies of the start-up documentation to the owner, the prime contractor, and the company office.
- Instruction:
 - Turn over all required documentation, including operation and maintenance manuals, submittal data, as-built drawings, warranty information, test reports, etc., to the owner's representative when appropriate.
 - Instruct the owner's representative regarding proper operation and maintenance of the system.

"Notice of Start-Up" (Figure 38.1) could be used in lieu of the start-up reports.

Start-up is the demonstration which proves the quality and reliability of the work the project team has done. It should be viewed as much as a customer relations activity as a requirement of the contract and arranged and prepared to put your company in the best possible light.

SECTION 39: CLOSE-OUT

The Final Ten Percent

The end of a project is not an easy time. There are many loose ends to tie up, and everyone is anxious to move on to the next project. The old adage, "The final 10 percent of the project takes 40 percent of the team's effort" proves itself repeatedly. All the little details can try the patience of even the best Project Manager.

At the same time, the end of the project is what the general contractor and/or project owner remember long after the job is finished. As a result, your company's performance in the final days makes a strong and lasting impression. Remember: Finish as strong as you started.

Although close-out appears at the end of this manual, most of the close-out procedures can begin when the project starts. Beginning with the end in mind will assure smoother close-out. Instead of waiting until the end of the project when enthusiasm may have waned, people are eager to move on to another challenge, or the project has strained people and relationships, the close-out process should be done as the project progresses, and can literally begin on the first day of the project, if the project team prepares for and understands it.

Before a project can be closed out and final payment can be processed, the customer must be assured and satisfied about four issues:

- The work was performed to the standards of quality and methods required by the contract documents.
- All of the systems are functioning properly.
- All of the required physical installation has been completed.
- All services have been provided and deliverables have been turned over, some of which may include:
 - Inspection certificates
 - Training
 - Warranties
 - Operation and maintenance manuals
 - Spare parts, tools, attic stock, valve tag charts, etc.
 - As-built drawings
 - Commissioning reports

Failure to provide even small portions of any of the above can prevent timely project close-out. The result to your company could be:

- Tie-up of cash in retainage and final progress payment

- Tie-up of project personnel attending to the open issues
- Wasted field labor going through the same areas of the project multiple times addressing punch list issues

The key to an effective and efficient project close-out is careful planning early in the project and effective follow-through during the execution of the project.

The Project Manager's Responsibilities

The Project Manager has five primary responsibilities relating to the close-out of the job. They are:

- Design and implement the system, procedures, and responsibilities for close-out.
- Encourage everyone on the team to be “punch list conscious” from the first day of work. During the course of the project, make every effort to complete each task before moving on to the next in order to avoid long, involved punch lists at the end of the project.
- Prepare and act on your own preliminary punch list (completion list).
- Complete all project close-out procedures specified by the contract documents and your company's policies.
- Maintain your project team's motivation until all details of the project are completed.

Quality Control

The purpose of quality control is to make sure that the quality of the work meets the requirements of the contract documents and enhances the reputation of your company. The procedures for doing this begin on the first day of the project and include:

- Establishing quality control policies and procedures at the beginning of the project and enforcing them throughout the course of the project.
- Regularly conducting quality control inspections to verify the acceptability of all work performed by company crews and subcontractors.
- Maintaining good housekeeping practices.

As part of the preliminary inspection at the end of the project, the Project Manager must:

- Verify that all work conforms to the scope of work and the contract documents.
- Review inspection reports completed by quality control personnel throughout the course of the project.

- Identify areas where problems remain.
- Assign responsibility for correcting problems.
- Ensure that all tests have been successfully completed and documented.

See [Section 23: "Quality Control"](#) for more information on this topic.

Preliminary Inspection

As the project draws to a close, the Project Manager should conduct a thorough preliminary inspection of the project to:

- Ensure proper installation of all systems and components.
- Reduce the potential number of items on the customer's final punch list.

By identifying details that need attention and acting on them before the customer conducts his own inspection, the Project Manager minimizes end-of-project detail work and creates a good impression of the company's thoroughness.

Testing

Testing ensures that all installed equipment and systems perform as specified. Among the types of tests commonly required are:

- Pressure tests of piping and air handling systems
- Operation and quality control tests
- Certification tests for domestic water
- Code testing
- Permit testing
- Pre-start-up testing
- Fire-suppression testing

For each type of test, it is important not only to make certain that the equipment and system operate as specified, but also to document that the equipment and system comply with the project's operational specifications.

The general procedures related to testing are to:

- Be certain all test procedures specify the method(s) to be used and ranges of acceptable results.

- Assign specific responsibilities for preparing each system and component for testing.
- Notify all persons required by the contract documents to witness each test.
- Properly document all test results.
- Transmit copies of all test results to the appropriate parties.

Testing is discussed in further detail in [Section 37: "Testing and Test Reports."](#)

Start-Up

Start-up procedures do two things:

- They establish a deadline for installing and readying the system.
- They provide the customer with a demonstration of system functions.

For the Project Manager, general start-up procedures include:

- Assign responsibility for verifying proper installation of all piping and equipment and preparing each system for start-up.
- Conduct a pre-start-up inspection to make sure everything is ready.
- Notify the test and balance contractor of the start-up date and arrange to have qualified technicians present to assist with start-up.
- Notify the customer and/or owner of the start-up date so that a representative can attend.
- Document all start-up activities and results and transmit copies to the appropriate parties.

Start-up is discussed in more detail in [Section 38: "Start-Up."](#)

Completion of As-Built Drawings

Complete and accurate as-built drawings are required by the contract documents. They also give your company an advantage in obtaining mechanical service work once construction is complete.

Completion of as-built drawings is an ongoing process that begins at the outset of the project and continues throughout. It is not something that can be left until the end of the project.

The procedures involved are:

- Assign responsibility for daily maintenance of the as-built drawings throughout the project.
- Make inspection of as-built drawings a priority item during each site visit.

- At the conclusion of the project, have the completed as-built drawings redrafted into final project drawings (if required by the contract documents).
- Give the required number of copies to the project owner and keep one set for your company.

As-built drawings are discussed further in [Section 28: "Documentation."](#)

Instructing the Project Owner

Giving the owner's representative adequate instruction on the operation and maintenance of installed systems is a matter of courtesy as well as a requirement of the contract. It is also a potential opportunity to discuss the possibility of obtaining a service and maintenance agreement on the installed system.

The Project Manager's first step is to schedule the instruction session. If possible, he should combine the instruction session with start-up. This prevents having to schedule and hold a separate session and prevents the owner from delaying the instruction session.

The instructions given should include the following:

- A detailed review of the operation and maintenance manuals and other relevant information.
- A discussion of your company obtaining a service contract.

To obtain the service contract, the Project Manager should emphasize the company's familiarity with the system. Once a service contract is agreed to, he should complete the necessary paperwork immediately and provide his company's service department with copies of the operation and maintenance manuals and the as-built drawings for the project.

Initiating the Warranty

Initiation of the warranty on a system or a piece of equipment marks the transfer of responsibility for that system from the mechanical contractor to the project owner and the manufacturer. Consequently, it is important that the Project Manager do so at the earliest possible date to relieve the company of unnecessary liability.

The procedure to follow is:

- Notify the owner in writing of the date when the warranty period starts.
- Notify the manufacturer, if applicable.

A sample ["Warranty Letter" \(Figure 39.3\)](#) can be found at the end of this manual.

Extension of Warranty

Typically, construction contracts require contractors to warrant their installation against defects in workmanship and material for a fixed period: usually one year following date of acceptance of the work.

If the owner were to require you to operate systems for their benefit, but delay acceptance of the work because some portions of the total contract are uncompleted, the owner would be, in effect, extending the warranty period.

Generally, warranty costs are small since a well-constructed system will reveal few defects in workmanship and material within the first year following start-up. On the other hand, the contingent warranty risk is great since there is always a small chance that a major component will fail during this period. Not only may the direct costs of repair be extremely high, but there may be consequential costs in terms of the damage done to other work as a result of the breakdown or the damage that is done to other work to gain access for repair.

Generally, you should seek to pass on to suppliers all or most of the warranty obligation which is undertaken as a part of the contract documents. Suppliers, however, are rarely willing to extend their warranty beyond the specific obligations undertaken in the purchase agreement. Therefore, the extension of the warranty period, although you may believe it will cause little cost, does expose your company to substantial contingent liability without the opportunity to pass that risk on to suppliers.

Consider separate warranty periods for systems or equipment that the owner has taken beneficial use of before substantial completion of the project.

Punch Lists and Completion Lists

The punch list for the close-out of the project is prepared by project owner or prime contractor representatives. It lists all the details that must be completed before the customer will release the final payment to your company.

Despite the importance of the final punch list, it is important that the project team not begin work on any punch list item until the entire list has been reviewed to ensure that every item it contains is within the mechanical contractor's scope of work.

To minimize the number of items on the punch list and get a head start on project close-out, clear up as many loose ends as possible ahead of time by:

- Inspecting the project yourself *before* the customer's representatives do and preparing a completion list of all items that must be completed or corrected.
- Preparing a separate completion list for each of your subcontractors.
- Assigning specific responsibilities and deadlines for completing all items on the completion lists.

- Inspecting all mechanical work areas to make sure that your crews and your subcontractors have finished work on all items on the completion lists *before* the customer's inspection.

When the final punch list comes to you should:

- Review all items to make sure they are within your company's scope of work.
- Assign specific responsibilities for completing items that are within your company's and your subcontractors' scope of work.
- Conduct a follow-up inspection to ensure that all necessary work has been completed satisfactorily.
- Notify the customer that all punch list items have been completed.
- Accompany the customer's representative on the final inspection so that you are available to immediately answer any questions.
- Return the completed punch list to the general contractor with a transmittal.
- Obtain the customer's sign-off and authorization for final payment.

Demobilization

Demobilization is the removal of all company personnel, tools and equipment from the jobsite and includes the final clean-up of all mechanical work areas. Strict procedures must be established for demobilization to avoid leaving behind material, tools and equipment and incurring backcharges for failure to leave the jobsite in the condition described in the contract documents.

These procedures should include:

- Scheduling the removal of all company property just as carefully as you schedule its delivery to the jobsite.
- Initiating a system to account for all tools and equipment; assign responsibility for collecting them, checking them against the initial jobsite inventory and returning them to the company warehouse.
- Returning all unused materials either to the company warehouse for use on other projects or to the supplier for credit.
- Inspecting the jobsite when demobilization is completed to verify that necessary clean-up has been done and all company property has been removed.

Demobilization does not have to be completed at the end of the project. As tools, construction equipment, and materials are no longer needed, remove them from the jobsite. This will make the sometimes arduous task of demobilization and close-out easier.

A [“Project Close-Out Log” \(Figure 39.1\)](#) and a [“Job Completion Checklist” \(Figure 39.2\)](#) are forms at the end of this manual that can assist you in tracking and completing the close-out of the project.

Additional resource available through MCAA’s online [Resource Center](#):

- *MCAA Management Methods Manual*
 - Bulletin CT 6, “Warranty”
 - Bulletin BF 2, “Forms for Temporary Heating or Cooling”

SECTION 40: POST PROJECT REVIEWS

By the time a project is finished, everyone is usually glad to be done with it and looking forward to moving on to something new. In fact, as the project winds down, many members of the project team are already assigned to other projects.

Why then should the company invest additional time in the project when there is so little time to get ready for the next project? Whether or not the project has been profitable, there is little that can be done now to improve the outcome. However, learning the lessons of past projects that were either profitable or not so profitable can assist in the planning and implementation of future projects. Project reviews force everyone, including the project team, the company and the customer, to sift through the facts and see those facts objectively, apart from the immediate pressures and confusion of budgets and schedules.

Project review is where valuable lessons are learned, where mistakes are identified and where procedures are instituted to avoid repeating them. Procedures that turned out right can be incorporated into policies that improve the profitability of every future project. Project review is also a time to resolve any interpersonal conflicts that arose during the project before they develop into hardened antagonisms that infect other projects.

Objectives

Project review has six objectives:

- Identify project successes and failures and understand their causes.
- Analyze the effectiveness of the project's management, communications, and relationships.
- Refine strategies for planning and running future projects.
- Understand the changes in company process that will improve acquisition, Pre-Construction Planning, construction, and project completion for all projects.
- Disciplines the company to identify successes and celebrate the positive outcomes.
- Open opportunities for future work.

The Process

Project review is a two-part process. The first part is an in-house review by the project team and other company personnel involved in the project. The second part is a review by the Project Manager and the customer.

Project Team Review

The purpose of the project team review is to give the company's personnel an opportunity to review and assess its performance and clear up any loose ends that remain.

Participants

Depending on the size and complexity of the project and the structure of the company, the participants in an in-house project review could include:

- Company president or CEO
- Operations manager
- Project Manager
- Chief estimator
- Project estimator
- Safety director
- Job superintendent or foreman
- Purchasing agent
- Drafting manager
- Fabrication shop foreman
- Material handling coordinator
- Sales personnel
- Office manager
- Accountant

Agenda

The Project Manager should prepare and distribute a well-organized meeting agenda to all participants well ahead of the day of the meeting. It should include:

- Date, time, and location of the meeting
- Outline topics of discussion

The Turnover Meeting or Pre-Construction Planning Meeting agenda can be used as the outline for the meeting. When the ***Planning for Profitability, Your Guide to Successful Pre-Construction Planning*** book is used for the project, it is an excellent agenda for the Post Project Review to analyze the successes and failures of the project.

Company management should require all project team members and involved company personnel to attend the review. Management should also require everyone to prepare for the meeting by reviewing the agenda and gathering whatever information and suggestions they wish to present.

Conducting the Meeting

In conducting the meeting, the Project Manager has to establish an atmosphere that allows the project team to meet the objectives of the review. To do this:

- Encourage frank, open discussion
- Emphasize importance of team spirit in analyzing the project
- Welcome all constructive criticism
- Avoid accusation and blame
- Do not permit polarization or domination of the meeting among small groups or individuals

Make sure that what the project team discusses and decides is accurately recorded and later distributed so that it can be used in company planning and in preparation for the review meeting with the customer.

Sample Questions for Consideration

Among the questions that can help guide discussion and analysis of the project are the following:

- How did final costs compare to estimated costs?
- What major assumptions were used in estimating the job? Were they accurate?
- What major variances occurred? What caused them?
- How did labor productivity compare to the estimate?
- What factors influencing labor productivity should be considered in future planning?
- Did the project follow the original schedule?
- How good were company relations with:
 - Project owner
 - Design professionals
 - Prime contractor
 - Subcontractors
 - Other trades on project

- Suppliers and manufacturers
- How well did the prime contractor treat your company in terms of:
 - Scheduling
 - Payment
 - Coordination with other trades
 - Material handling facilities
 - Change orders
 - Safety
 - Backcharges
 - Other
- Did the project team follow through with goals and procedures established in Pre-Construction Planning, particularly those for:
 - Fabrication
 - Material handling
 - Shop drawings
 - Labor productivity
- What were the project team's overall strengths and weaknesses?
- What should the project team do differently on future projects?

Follow-Up

Following the in-house review, make sure to:

- Distribute copies of minutes to all attendees.
- Use the minutes to prepare for the review meeting with the customer(s).
- Formulate a summary of the key lessons learned and recommendations so the CEO and the operations manager can incorporate the findings of the review into the company's policies and procedures, as appropriate.

A sample ["Project Close-Out Review" \(Figure 40.1\)](#) can be found at the end of this manual.

Project Review with Customers

Among the objectives of reviewing the job with customers are to:

- Give the customers an opportunity to review and assess the company's performance.
- Obtain feedback on the company's performance.

- Demonstrate the company's interest in the customers' satisfaction.
- Maintain or repair customer relations.
- Clearly state the company's interest in doing future work for the customers.

Normally the project team has more than one customer on the project. In addition to the project owner, there is the design engineer or architect, and the construction manager or prime contractor. The owner, design professionals, construction manager (if any), and prime contractor may agree to a joint meeting to discuss the project. Other situations may require a meeting with individual companies or groups.

All review meetings with out-of-house companies or individuals should be high-level executive-to-executive summit meetings. This means that the mechanical contractor's president or CEO should accompany the Project Manager. Other members of the project team should be included only if the agenda demands it.

Agenda

In proposing a review meeting, clearly state in writing the purpose of the meeting and recommendations on who should attend.

Emphasize that the meeting will be a frank and open discussion of the project and a forum for exploring ways for the company to improve the quality of its service. If the meeting is with the prime contractor, encourage the invitation of the job superintendent or foreman and chief inspector. A project owner should be asked to invite the architect and/or engineer and construction manager.

Document the discussions and distribute to all participants.

Conducting the Meeting

As with the in-house review, you should establish an atmosphere that is conducive to real progress and direct the discussion so that it touches on all important points. Do this by:

- Inviting the customer to be frank in his criticisms and comments and clear the air of any concealed problems or dissatisfaction.
- Requesting recommendations for avoiding the types of problems that may have occurred on the project.
- Asking for the customer's comments on the performance weaknesses identified by the project team in its review.

Use a checklist of general topics to make sure that nothing is overlooked. A sample ["Project Review with Customers Meeting Agenda" \(Figure 40.2\)](#) can be found at the end of this manual. Among the topics:

- Did the project meet the needs and expectations of the owner?
- Cooperation on the jobsite
- Scheduling
- Correspondence (adequacy, clarity, tone)
- Safety
- LEED process
- Shop drawing presentation
- Was BIM effective?
- Submittal data processing
- Change orders (pricing and presentation)
- Quality control
- Operation and maintenance manuals
- Clean-up
- Punch list completion
- Project close-out
- Warranties and guarantees
- Commissioning
- Other

When the discussion of the project is finished, express your company's interest in doing future work for the customer. Request information on available opportunities for construction and/or service work and review the company's capabilities, experience, facilities, and personnel. Finally, thank the customer for:

- The opportunity to work on the project
- Assistance in reviewing the project
- Consideration of the company for future work

Immediately following the review meeting, send a letter of thanks to the customer. Be sure to distribute pertinent notes from the meeting to other members of the project team and help your company's management to incorporate the customer's suggestions, as appropriate, into its policies and procedures.

In situations where logistics would make a Customer Review Meeting difficult or impossible, a ["Customer Survey" \(Figure 40.3\)](#) can be sent instead.

It is important to obtain a review from subcontractors and suppliers, as well. A ["Subcontractor Survey" \(Figure 40.4\)](#) and ["Supplier Survey" \(Figure 40.5\)](#) can be found at the end of this manual and can be sent to each subcontractor and major supplier on the project.

Sometimes written surveys will elicit useful comments or suggestions that may be difficult to state in person. Remember, though, that once a customer, subcontractor, or supplier is asked for feedback and suggestions and they answer, they will likely expect some kind of answer or action in return. Unless you are prepared for the answers, don't ask the questions.

A company's growth and improvement rely on learning from its successes and its mistakes; project review makes that possible. By showing an interest in learning, the company also demonstrates to its customers that it is a professional organization that is serious about offering the best possible service. This type of demonstration is sometimes enough to earn the company a second opportunity to prove itself, even after completing a project that is less than completely successful.

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