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# Advanced Project Management Techniques - I

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## Introduction

This course in project management is intended to improve the prospects for existing project managers and would-be project managers to manage a successful project. The simple definition of “successful” has rarely been defined in specific terms of a given project, but a general definition usually encompasses “being on time and being under budget”. Nevertheless, while this definition may be too narrow to satisfy many PM’s and executives, the project is not “successful” unless you combine these two finite factors with a more than satisfactory end result.

The course is divided into two separate parts, each of which is intended to improve the capabilities of a Project Manager or a potential Project Manager. The first part describes the steps necessary to become a top quality PM, and focuses on the background and education necessary to be considered for a project management role. Once an individual has been considered for this very important position, a PM should take advantage of training and experience opportunities that become available and should also maintain a conscientious effort toward self-improvement. Other items in this first part concentrate on developing characteristics of leadership as well as motivational skills that will improve the PM’s efforts to ensure that your project team will work closely with you so that the project’s goals will be met.

The second part of this course deals with the actual fundamentals of managing a project so that a Project Manager and every team member are performing at an optimum level. This section of the course covers the multiple functions of the project, including the activities necessary to ensure that engineering, equipment and construction meet the quality objectives of the project. This portion of the course describes techniques to obtain optimum scope and design parameters as well as how to maintain schedule and cost controls. Examples are given of solutions to problems that are encountered as the project unfolds. The PM is made aware of the subtleties that are available to resolve seemingly difficult issues.

In almost all projects the Project Manager and project team members will develop and utilize some core principles. One of those core principles is that the burden of assuring the finite factors in addition to the end result is primarily the responsibility of the PM. The Project Manager not only needs to know what to do, but also “how to do it” and what to do when a difficult situation presents itself. Invariably, the solution is not begun until the PM and/or the project team members recognize that a problem exists. It can then be resolved with training and experience,

each of which is an equally valuable commodity. As you will discover by reading and studying this course, having personal discipline is very important to a Project Manager. Another sometimes difficult lesson for most PM's to learn is that you can't possibly be everywhere and do everything yourself, so learn to delegate authority by investing your trust in others and discover in this course what you need to know to have a successful project.

## **Course Outline**

### **A. Qualifications for a Project Manager**

1. Background/Education
2. Experience/Training
3. Leadership Qualities
  - a. Direct Company representative
  - b. Indirect representative
4. Motivational skills
  - a. Maintain Unity
  - b. Maintain Integrity
  - c. Strive for Excellence

### **B. Direct Project Responsibilities and Functions**

1. Scope of Work
  - a. Understanding Client Requirements and Goals
  - b. Assignments and Communications
  - c. Communicating with Executive Management
  - d. Preparing Executive Summaries
2. Developing a Budget
3. Scheduling – Understanding Time vs. Costs
4. Engineering and Design
5. Procurement
6. Construction
7. Cost Control and Cost Correction
8. Startup
9. Closing – Achieving Success and Avoiding Failure

## **A. Qualifications for a Project Manager**

### **1. Background/Education**

Having a college degree is certainly beneficial, but by no means mandatory, to your success as a Project Manager. Depending on the type of project in which you become involved and the overall responsibility that you are given, a specific college degree may or may not be a requirement. Not having a degree in this era, however, may hinder your prospects for future advancement, whether the degree is in engineering, engineering technology, science, or even a non-science degree such as business. This is particularly true if you are considering the role of Project Manager as a stepping stone within your company or primarily as a potential highlight on your resume.

If you had attended an engineering school, for instance, you may have been led to believe that there are four major engineering curriculums: Civil, Chemical, Mechanical, and Electrical. Possibly you have come to the conclusion that a Project Manager must have one of those major educational backgrounds in order to be considered for a project management position and to function successfully. As you gain in wisdom and maturity and your experience broadens, you may come to realize that there are many subordinate academic studies within the primary areas of study: Piping has become a very specialized and distinctive academic entity. Included in this very important area of formal study are pneumatics (compressed air, instrument air, etc.), hydraulics (lubricants and synthetic fluids, pumps, cylinders, drives and the like), and many variations of these two categories. Civil engineering can run the whole gamut from ground water intervention to architectural support for 100-story office buildings.

Petroleum engineering and chemical engineering are cousins. Chemical engineering and chemical engineering technology have now been sub-divided into numerous categories, many of which now fit into such social engineering parameters as petrochemicals, pharmaceuticals, and even cosmetics. Consider an electrical engineering graduate; electrical engineering can be sub-divided into several categories, including power generation, visible and solid-state motor controls, telecommunications, and electronics where transistors control everything from televisions and satellites to automobiles and airplanes. Items that are “state-of-the-art” one year are practically obsolete one year later. Today’s technology lists hand-holds of every variety, automobiles that potentially drive themselves, and a treasure-trove of automatic devices that weren’t even on the radar thirty years ago. If you are

under thirty years of age, you are probably not aware of such names and terminology, for instance, as PC Junior, Commodore, and keypunch operators.

In addition to a background in engineering or computers or some other technical field, many PM's today acknowledge that a background in business and/or finance is equally as important as engineering and technology in becoming a valuable project management tool. Whether or not you have a degree in industrial management or business administration, your value to the project will become abundantly clear as you process the many cost factors involved throughout the project. Your ability to weigh the costs and expenses versus the timelines and calendar challenges of the project is a significant aspect of nearly all projects throughout their duration. While you may have to rely on so-called financial experts to provide you with many of the necessary details, this financial understanding will give you the wherewithal to make decisions in a timely manner. In addition, financial knowledge will also give you an edge in negotiations with team members, suppliers, contractors and many others who may be involved in the project.

## **2. Experience/Training**

In my case, for example, I was transferred from the steelmaking plant, where I had begun my career, into the large corporate engineering group, and was placed in the Project Management section. Looking around that first morning at the others in that section, I was struck by their ages and seeming experience. Of the fifty or so men – no females among them – spread out over parts of two floors, less than a handful were under the age of fifty-five. Most had been at least division managers – I had been an Area Manager – and several had even been Plant Managers. I learned over the next few months that, not only had they been inexperienced when they had been transferred into this division as Project Managers, but also most of them were lacking the fundamental skills and techniques of Project Management.

However, on the first day of my new career as a PM, at about 10:00 a.m., I was assigned to two projects that management believed would fit my background and qualifications. One was at a company plant in Salt Lake City, Utah, and the other was at a plant in Houston, Texas. Management suggested that I prepare to meet the project team in Salt Lake City on Tuesday morning, and that they would like me to meet with the project team in Houston on Thursday. I immediately learned three valuable lessons that all PM's should prove to find beneficial:

- a. Always have a suitcase ready.
- b. Have the ability to make your own travel accommodations, even if you have your own administrative assistant or the company has a travel department.
- c. Get a passport and always keep it in your possession. Even travel to Canada usually requires a passport.

My company gave me the opportunity in the second month at my new position to attend a two-week project management training program at a nearby university. The diversity of the people attending this program as well as the many types of company, institutional and organization projects that they were representing was a true revelation. There were men and women representing many different industries and organizations. Furthermore, some valuable project management concepts were presented and developed, and every attendee was asked to participate in the program discussions. While there didn't seem to be a major effort to explain how we should manage a project, there was a concerted effort to prepare us to manage ourselves as Project Managers. Two of the most valuable concepts that were presented and that stayed with me throughout my PM career were:

- a. Keep accurate daily records
- b. Maximize use of your time by establishing your daily project priorities

One of the exercises that comes to mind involved being in a plane crash that occurred in a desert area. All of the passengers were survivors, and we knew that there would be an attempt to rescue us, despite the fact that we would be in a large desolate area where the temperature might exceed 100 degrees F. Each of us was given a list of twelve items from which we could make up a survival kit, and we had to rate each item on the list from highest to lowest in importance and priority. Not one person in the program selected the most important item on the list as Number 1, which turned out to be a small magnifying glass. The second most important item on the list was a basic wrist watch and nobody got that one either. There were no cell phones or any other communication systems available. We also had to plan our daily activities in order to be found and rescued as soon as possible. Many in the program moved in different directions, while others stayed at the crash site, which was the correct thing to do.

### **Keep Daily Records**

The function of keeping accurate daily records is basic to any PM. There are numerous ways in which you can accomplish this. For the more detailed PM, you might consider

the use of a Franklin-Covey Daytimer to record meetings and attendees, phone numbers and conversations, and other items of particular interest to you that will serve as your reminder as to what was said and done on a specific date. These notes will save you much time as references and will jog your memory as you recall those activities. Also rest assured that those notes are valid in a Court of Law, should the need ever arise. With modern technology and the advent of tablets, smart phones, and software for every occasion, such things as speaking your notes and making an album of progress photos is easier than ever. Many project teams today utilize software programs such as Asana and Tracker that not only list the tasks for each project group, but also recognize which tasks have been determined to have greater priorities. Incidentally, utilizing a tape recorder or turning your cell phone into a listening device in project meetings is not usually a good practice for many reasons, including the obvious fact that recording devices may inhibit conversations and limit ideas to potential problem solving. Nevertheless, keeping concise notes of meetings, whether by the PM or a project team associate is essential.

### **Establish Priorities**

There is really an art to establishing project priorities in order to maximize use of your time with your daily activities. Let's suppose that hypothetically your project involves a backup diesel generator, and that you have five phone calls to make after your morning progress meeting with your project team or project group. One of these calls is to the State Environmental Organization that is concerned about some of your design calculations, one other call is to an equipment supplier, one is to your Lead Mechanical Engineer, another is to one of your construction contractors who is looking for a delivery date for the equipment, and your last call is to a local utility. Logic and experience will tell you that the order of the phone calls has to be: (1) Lead Mechanical Engineer (2) Environmental agency (3) equipment supplier (4) contractor, and (5) the local utility. While this sequence of calls may become fairly obvious, things don't always go as planned. Some of the responses may not be immediate, while others may have a negative connotation that will require follow up phone calls, or even visitations or meetings. Nevertheless, planning your daily activities is nearly as important as planning the project.

In this hypothetical case, the Environmental Department is concerned with the amount of carbon emissions that are escaping from the diesel generator that is being specified and purchased for the project. Your first call will be to the Mechanical Engineer who was responsible for the generator specification, and the engineer assures you that the proper filtration system has been specified to meet environmental standards. Your next call is to the Environmental Agency with your

assurance that the emissions control system will meet their standards. The third call is to the generator manufacturer to ensure that the emissions system is an integral part of their generator equipment, and that all equipment will be delivered as per the schedule and purchase order. You can then call the contractor – or better yet, have your Construction Manager make the call – to assure the contractor that the equipment will be delivered as required and there will be no extra work involved. Finally, the local utility can be notified that the diesel generator will become part of the project, and that no additional utility requirements will be needed by them.

### **Seek Formal Training**

Hopefully, part of your early training would have been participating in Project Management seminars and conferences, or even being sent to a college or university with a summer curriculum for Project Management training. The school may have a two-week program, but pressing commitments in your company might limit you to be there for only the first week, so cram as much as you can into that first week. Whether you are attending a school or a seminar, you will quickly learn how much you have to learn about Project Management as well as how much effort is required to become a top PM. These courses usually focus on what basic tools can be utilized by you as a practitioner rather than you as an individual Project Manager. They are varied because, as you will quickly learn, there are PM's in nearly every business or industry – manufacturing, road building, banking, healthcare, and even horse racing.

And yet there's no substitute for hands-on experience. Some of the best experiences a Project Manager can receive will be the ability to visit a facility similar to the one for which you are responsible, either in your own company or in that of a competitor's company. While visiting that of a competitor may be a little more intricate and involves a certain amount of diplomacy, the rewards can be great in the long run. You will see firsthand the arrangement of the overall facility, the interaction of the adjoining facilities that are required, potential space limitations, and other features that possibly neither you nor your Client(s) had considered. In addition you may be able to discuss with those personnel that are in charge of the operation some of the problems and other subtleties associated with their facility. Also be willing to have others on your project team accompany you on this visit so that you gain their perspective. Sometimes you may determine that visiting more than one similar facility is necessary to gather sufficient information and understanding. Often the supplier of equipment similar to that which you plan to purchase will make the necessary contacts to arrange for a visit of this type to occur.

As your experience level increases, your ability to prioritize the various project functions as well as your own daily objectives will improve. In order to fully understand project priorities, you will have to know the ultimate financial goal of your project, especially as it applies to a late finish. You should be in a position to evaluate how a one month, or a one week, or even a one day delay will affect your company's bottom line. Knowledge of this aspect of the project will allow you to determine the effects of slight, or even major, schedule changes in design, procurement, or construction. In addition you will have the ability, if the need arises, to either tap into the contingency fund, or even go beyond that and justify a request to executive management for additional project funding.

### **Maintain a Professional Attitude**

Although the life of a Project Manager can become very strenuous at times, you are expected by those around you – peers, supervisors, contractors, etc. – to maintain a certain mental posture at all times because you are a **Professional**. Kudos, when they come are great, but don't count on being verbally rewarded; remind yourself that you are expected to perform at a high level and to produce results. After all, you may have been selected for this position as a promotion, since your reputation was that you are a quick thinker and a strong decision maker who was probably one of the better engineers or financial personnel in your current field. In most cases the first two characteristics were probably true, although your credentials in your specific field may have been only slightly above average. Nevertheless, your background and education have enabled you to comprehend complex situations and make determinations that allowed projects to move forward with a minimum of schedule interruptions.

While you and everyone around you will consider you a consummate professional, you must always draw the line between your own self-confidence and your unwillingness to compromise. Often you and your Client or Boss, or even one of your peers, will have a difference of opinion. Keep in mind that you are usually dealing with a matrix organization wherein nobody is under your direct authority. You must be willing to listen to any team member's opinion or argument and be prepared to give them your point of view on the subject. If your viewpoint is convincing, it will be accepted. If not, keep discreet notes of what has transpired and back off. Remember that no one is born with humility and that it must be developed. Even though you may not be lacking self-confidence, there is almost always at least one occasion during each project when you will be required to humble yourself. Embrace the challenge.

Not only willingness to give concessions or to compromise is a good character trait, but you are also preparing for future situations that might occur. Just as life is temporal, so is your current project. Suppose you encounter a situation such as the following:

Two adjacent transfer systems were side-by-side. One system would be receiving very heavy plate products from another area of the plant by special trucks, while the second system was transferring individual plates into a mill for further production. Once the second system had been emptied, the process would be reversed. The functionality for performing this operation, while still maintaining continuity as well as traffic flow and personnel safety, seemed to be an enigma and had been discussed at all levels of the company for about a month. After hours of contemplation, suddenly you had a vision as to how the problem could be solved, and you told the Client representative about your solution just before a very large and important meeting. During the meeting the Client representative explained “his” method for solving the dilemma. You might have seemed astonished that you were left out of the equation, but you said nothing and routinely carried out your PM duties.

Certainly this type of situation has occurred to a PM at least once in his or her career. As for the project, it was a great financial success. The Client representative, basking in the aftermath of his success, had enough influence to strongly suggest that the PM be given the assignment as PM for the next project, which just happened to be the largest project in the company, even though he was an outside consultant. Knowing when to be humble and display your loyalty often results in greater future opportunities.

### **3. Leadership Qualities**

**What does being a Project Manager mean?** Very simply, being a Project Manager means being a project **LEADER**. You have earned the position of Project Manager, and you have been given an assignment. Now you must take that assignment and make it your mission. A Project Manager who operates with a clearly defined mission will have an obvious advantage over another PM who cannot embrace a leadership role and doesn't envision a clearly defined mission. This in no way implies that you are to become a project dictator. Remember, as often as is necessary under the circumstances, that the Master of the project is the Client (Owner/Vice President/Technical Director/etc.). In spite of your near autonomy in most cases, you

still answer to him/her, and must understand the boundaries and limitations under which you can function.

However, as the Leader of the project, you have certain responsibilities as well as specific duties. Some leadership qualities which you are expected to exhibit include:

- a. Enthusiasm
- b. Sincerity
- c. Initiative
- d. Flexibility
- e. Empathy by showing concern for others
- f. Interest in other's opinions
- g. A teachable spirit
- h. Willingness to sacrifice your ego

As was stated earlier one character trait that a true Leader must develop, because nobody is born with it, is humility. A second character trait of equal importance that must be developed by a quality Project Manager is discipline. In the course of a project, a Project Manager will call for many meetings and will attend most of those meetings. A good example of discipline is being on time for every meeting in which you are participating. This attitude will resonate throughout your project organization and will establish a path for others on the project team to follow. As has been said many times and in many ways, "your attitude determines your altitude." An even better approach is to be early for these meetings, especially those that you have called. Being even a little early to a meeting communicates to others that their attendance at the meeting is important, that you value their time, and that your humility does not require you to make a grand entrance.

The manner in which you acknowledge others' ideas, whether you always accept them or not, is also very important. The way that you interact with your peers as well as your clients and supervisors goes a long way toward determining your attitude. You may be looking at the "big picture", but your teammates will determine the success or failure of the project by how well they perform their individual tasks. Thus, paying attention to the smallest detail is as important to you and the project as it is to them. As far as your project team is concerned, there is no insignificant task, and this is both a concept and a general philosophy that you must adopt.

Anyone who is in your position as the leader of the team must remain strong and exhibit an air of confidence at all times. A negative, or defeatist, attitude is not only a danger to your position as a Project Manager, but also becomes a burden to your everyday well-being. Those defeatist attitudes that you must try to avoid as a Leader

include harboring resentment, giving in to discouragement, engaging in self-pity, or even engaging in self rejection. Remember that you are the “go to” guy or girl for many people on your team, and your attitude will reflect their feelings toward the success of the project. This by no means implies that you are to micro-manage your project, but you as the Project Manager must keep a steady hand on the wheel, and be prepared to take action should your project lose its steam or begin to change its course.

There are two different categories under which a Project Manager can represent the company for whom the project is being performed: as a Direct Representative or as an Indirect Representative.

#### **a. Direct Company Representative**

In this category you are an actual employee of the company that is implementing the project. There are several ways that you can benefit from this arrangement. One way is that you might be blessed with a Project Team over which you have substantial control. In this case you would have all the necessary project groups under your direct authority, including Engineering and Design, Cost Control, Procurement and Construction Management answering directly to you. This scenario is quite likely if the project is of such a magnitude and has such financial incentives as to make the Project Team concept viable to Executive Management. The real dilemma with this concept is twofold: most companies have streamlined their workforce and rarely employ a staff of this nature because of the standby costs involved; and, secondly, this caliber of personnel is more commonly found in the engineering companies and consulting firms that typically perform this work for a variety of companies. Nevertheless, should the financial benefits to the company for whom you are working be warranted, this concept is a strong possibility.

A more likely scenario in this category is what is termed a *Matrix arrangement*. Under these guidelines, certain individuals in each necessary project group who are employed by your company may be assigned to your project, although their direct supervision would come from an Area Manager of that particular company group rather than yourself. In addition those assigned to work with you to implement your project might well be working on two or three other projects or assignments. In this scenario the company will not feel the need to employ additional personnel, and you as the PM will be faced with the situation whereby you will need most of the skills that you have developed as a Project Manager in order to ensure that your project will be a success.

In either of these two scenarios, they are more common whenever a company is attempting to bring a new facility on line that will complement an already existing facility that has proven to be very profitable. In this situation, the entire project may be profit driven due to a strong domestic and/or global market, and timing is critical. Consequently, the schedule is of greater importance, and the overall cost of the project assumes lesser importance.

## **b. Indirect Representative**

Perhaps you are a Project Manager from an outside engineering firm or an outside consulting firm with a strong track record for managing successful projects of the type for which you are being hired. In this instance your firm may be supplying the various engineering and design groups as well as other support groups for the project. In this situation you will be in a good position to “make things happen” because your firm’s reputation as well as its bottom line are at stake. In this case the communication barriers are not as cumbersome and the potential rewards are greater. However, the risks can also be greater. Your deliverables are expected to be on time and your billings should be in line with your preliminary estimates. Here again you will probably be dealing with a Matrix organization, and your choice for key personnel to become a part of your project team may not necessarily be the choice of your supervision. In this scenario, the pressure by your Client to perform may be greater, although your lines of communication may be easier and more direct.

There may be occasions, as an alternative to the above scenario, where you may be a private consultant who is being hired as a Project Manager. In this case you have no direct or indirect affiliation to either the Client or the firm or firms being retained to supply necessary personnel. In this scenario the burden will fall entirely on you to maintain closer communications with all pertinent groups, to quickly ascertain and report any variations from the norm, and to assure your Client that the project will still be on time and within budget. You will necessarily have to spend more time with the engineering firm and its lead managers to keep their engineering and design groups on track and to avoid their wasting time and money on questionable issues that don’t bring positive results. There are two ways to do this, particularly in the formative stages of engineering and design: (1) schedule weekly meetings with the lead managers and group leaders, again at a set time for no more than one hour, and utilize a printed agenda as often as possible. If circumstances prevent you from attending the meeting, notify the firm immediately and offer an alternate time and date for another meeting, (2) maintain a small office at the firm or firms where you

can receive and answer questions as well as resolve any problems or issues on a regular basis. This simple but highly personal action should keep your project moving in the right direction.

#### **4. Motivational Skills**

Whether you are an in-house or outside (contracted) Project Manager, and irrespective of your affiliation with the various project groups and personnel who are assisting with your project, you must be able to motivate the individuals and/or the supervisors involved. In general, this means that the Project Manager must stay positive throughout the project, maintaining a strong personal discipline, and avoiding any negativity. A negative attitude which would illustrate a lack of discipline might include such incidents as browbeating, entering into short-tempered arguments, or – worst case – telling on someone or calling that person out in front of peers and/or supervisors.

The quickest way to lose the respect and control of your project group and, ultimately, your Client is to perform in an immature manner. Should you have a disagreement with an individual over a performance failure that is egregious enough to get your attention, plan to meet with that individual and his/her supervisor, keep the meeting confidential but cordial, and maintain an open mind. You may determine that your concern was misplaced or, conversely, that there was a complete misunderstanding by the individual of your intentions. Resolve the issue at the meeting without creating any ill will or rancor. Should your concern be serious enough in your opinion to jeopardize the project and to warrant replacement of personnel, discuss that issue in a separate meeting with the group leader and/or your Client's representative.

##### **a. Maintain Unity**

Some things that will aide your situation in this regard include the following:

- a. Communicate on an individual basis
- b. Answer their questions as concisely as possible
- c. Promise to get the answer if you don't have it readily available
- d. Be willing to look at options and alternatives
- e. Be prepared to give a project update to any and all
- f. Hold short meetings as frequently as necessary
- g. Show an interest, no matter how large or how trivial the topic

- h. Avoid minor controversies and be prepared to make decisions
- i. Be positive and upbeat and never be critical of the company

Nearly all of these fall into the category of maintaining a good line of communications with all involved parties, from the Client to the last draftsman. **Never assume understanding that has not been explicitly verified; never take anything for granted!** There is the story of the national furniture company that had developed a revolutionary design for an ergonomic stackable chair. They retained a project manager in Alabama to oversee the manufacture of a prototype chair, and to then assist them in bringing the chair to market. The prototype was shipped to a manufacturing facility in Taiwan, where about 200 of the chairs were to be manufactured as marketing and sales demos.

A few weeks later the Project Manager and the Client's VP traveled to Taiwan to view the results of the two hundred chairs that had been quickly manufactured. The chairs looked great, the chrome-plated chair frames were perfectly formed, and the chairs stacked very neatly and compactly. They were even more comfortable than the furniture company had expected. There was just a small problem: where the original seat and back of the prototype had been processed, the polyethylene injection port had left a hole in each part about the size of a quarter. The Taiwan manufacturer, being an expert in copying American products, had copied each piece exactly as it had been received, which naturally included the holes. The PM learned a valuable, but costly, lesson that day. As the PM, you must take the time to assure that all project team members are aligned with the same mission-critical details.

## **b. Maintain Integrity**

Your performance as a person of character, accepting the responsibility of your position and avoiding any backstabbing will gain your respect and reward you with a more loyal project group. There will likely be occasions when situations will occur which you had not planned, potentially costing your project time and money. There is even the likelihood that your client has become aware of the situation and is critical of your performance. The common approach by a consternated project manager might be to voice your criticism and to blame others. While some of this may be justified, you risk losing your project team's confidence in you if the situation is not properly managed.

Your course of action in a situation of this type is to determine what went wrong, accept responsibility, apologize to your client and/or respective management, and assure all parties that the situation will not occur again. That will be a good beginning

to restoring the confidence that was placed in you, but the conclusion will be your follow up actions in quickly resolving the problem. While actions of this type understandably require a great deal of discipline, the amount of respect that a Project Manager will receive following an incident of this type is immeasurable.

### **c. Strive for Excellence**

There has probably never been a perfect project, and in spite of all your training and experience, your chances of becoming the first Project Manager to manage a project in such a manner are remote. There was a great football coach more than fifty years ago who told his professional team to “...strive for perfection every day. You will never become perfect, but you will achieve excellence.” He instilled this thought in his players so often that they came to believe his words. And they did achieve excellence, five times over an eight-year period.

In case you hadn't heard this story before, the coach was Vince Lombardi and the players that he was talking to were the Green Bay Packers, including Hall of Fame Quarterback Bart Starr. The year before Mr. Lombardi arrived in Green Bay, the Packers won one game and were about to lose their franchise. Mr. Starr was a last round draft choice (in those days the National Football League had a seventeen round draft) and a third string quarterback on that one-win team. Three years later the Packers won the National Football League championship. They went on to win four more NFL championships, including the first two Super Bowls. Mr. Starr was named the Most Valuable Player in Super Bowls I and II. Mr. Starr along with several of his teammates from that one-win team are now in the NFL Hall of Fame. Mr. Lombardi is also in the NFL Hall of Fame, and the Super Bowl trophy is named in his honor.

The correlation between playing a football game and managing a project is similar in many respects. The Owner/General Manager/Head Coach represents the Company/Organization/Client that provides you with the stadium and the uniforms to play in, the pads and helmets to protect you, the finances to see you through to completion of the game and the season. You are the Project Manager, the quarterback, the 17<sup>th</sup> round draft choice, who was selected by the Head Coach to lead the team, your Project Team. You may have experienced some success at another level, but now you are being asked to call the plays and lead your team to victory in the big leagues. Even though you have been given a “game plan” by executive management, you will have to overcome setbacks and use your options (ingenuity) to achieve victory (success).

You may not win the Super Bowl, or even every game that you play, but everyone should have the confidence in you that the project will end in a victory.

## **B. Direct Project Responsibilities and Functions**

### **1. Scope of Work**

#### **a. Understanding Client Requirements and Goals**

Congratulations! You have just been assigned as the Project Manager for one of your/that company's most important projects. Your Boss/Client has chosen you over other PM's due to your track record, which includes past performances, character, experience, training, and intangibles that seemed to make you most suitable for the leadership position.

Now, however, your first personal objective is to meet with the Boss/Client and his closest aides to determine precisely what they hope to accomplish with your project. Perhaps they have preliminary drawings or sketches, have chosen a tentative location for the new project, and have received a commitment for the maximum funding necessary to implement and complete a successful project. This early stage of the project is extremely important to understand their long-term goal, and requires your experience and training in interrogation, discussion of options, and precise note-taking.

At this initial meeting you will learn several peripheral things that will have an indirect consequence on the success of the project:

1. A general description of the project as seen by executive management
2. The company's expectations when the project is completed
3. The person to whom you will report directly, and your personal lines of communication with other management members
4. The frequency and agenda of meetings to update executive management
5. The context, frequency and mailing lists of progress reports
6. Relationships that the company has with various sister companies, suppliers, and contractors

Pay very special attention to this latter item because you, as the Project Manager, are in the very unique position of either fortifying these relationships or else creating unnecessary problems for the company and its management. Not only

are you obligated to have a close and honest relationship with the Client Representative, but you will be well served to develop similar relationships with any personnel who will be directly responsible for implementing the project (the project team) and operating the facility once it is into the startup phase. They may have the critical experience, and even some key personnel contacts, that will provide you with worthwhile guidance along the way. This is not to say that you will not have any options to perform your duties in an objective manner, but only to prepare you further to justify any of the options where management and operations might have a particularly strong interest.

## **b. Assignments and Communications**

You might have noticed that nowhere in the six items above is there any mention of Scope of Work. That is because quality management should be explaining to you **what** they want you to accomplish but not **how** they expect you to accomplish it. The company management has given you, as the Project Manager, most of the information necessary for you to develop the Scope of the project and this is your responsibility. Depending on the size and complexity of the project, and even though you may have enough familiarity with the facility to form an outline of the Scope, this is usually a major task and will require support and input by others. Thus your next objective, and arguably your most important other than understanding what your Client expects to accomplish, is the gathering of personnel that can best assist you in achieving your ultimate goal. Each person, whether selected by you or offered to you, represents a candidate that can determine success or failure. While this phase of building the project team is critical, it is also quite subjective.

In building your team, you should be looking for those personnel that have the same characteristics, but not necessarily the same personality, as you. While you may be seeking a team member that is determined and dedicated as well as competent, you really don't need any "Yes men or women". Conversely, your team members must be flexible and not stiff-necked or argumentative. Team members should be given the opportunity by a Project Manager to express their alternative viewpoints, which the PM will be receptive to hearing. Nevertheless, every team member must understand that you are the decision maker and you will have the final word regarding any controversy. At a very early stage in the project, you will develop discernment for whose ideas and concepts you are willing to accept without too much discussion. You cannot expect to micromanage any aspect of the project, so you must quickly determine which team members you can implicitly trust and which of them will try to fleece you when they can.

Always be prepared to reprimand a team member (in private) or to have a non-performer or a troublemaker replaced.

With this phase of the project firmly in hand, you will now begin to develop a basic outline that should include the following:

1. Location of the facility
2. Environmental requirements
3. Design criteria
4. Equipment purchases
5. Needs of construction, including special applications
6. Individual component and system testing
7. Punch lists, startup and optimum operations
8. Project closing

Whether or not the Project Manager has an official Project Team within his/her direct supervision, the PM is responsible for the assignment of project responsibilities. This implies that the PM will determine which groups, but not necessarily which individual, will be responsible for each phase of the project. For instance the PM will determine the method for designing the project: whether to use in-house engineering services, if available, or outside sources if not. In some cases, depending on the time constraints and or the budget available, a combination of the two resources may be justified.

In another instance selection of procurement services is equally critical. The purchasing group must have the same sense of awareness as the PM, and must be sensitive to the overall objectives of the Client. Essentially every step of the project must be preplanned by the PM to the extent that each responsible member of the project team has a clear understanding of the duties and timeline required.

### **c. Communicating with Executive Management**

On nearly every project with which you become involved, you will have at least one person who will become your Project Mentor. These individuals may be in positions of executive management, may be persons who have gained valuable experience working with the company and/or clients, and may have even been successful project managers. You as the Project Manager should regularly communicate with these individuals and welcome the supervision they provide.

Your functioning as a PM is incomplete without them. Consider this to be an obligation.

There are many ways to accomplish this obligation in today's age of media coverage. Telephone calls are a quick and easy method of communicating, although your list of call recipients must always be approved by your immediate client representative. Even if you receive a direct phone call from someone high in the organization, take any message and clear your response with your Project Mentor. If your Mentor is not available, return the call as soon as possible, preparing your response in a totally truthful manner. Remembering the truth is a lot easier than remembering a half-truth or an outright fabrication. Once you have reached your Mentor, explain your reasoning for temporarily bypassing him or her.

The use of emails is another excellent method of communicating with the members of your project team as well as with your client and executive management. In this case the same rule applies; even if you receive a direct email from someone high in the organization, clear your response with your Project Mentor. If your Mentor is not available, return your email response as quickly as possible, preparing your response in a totally truthful manner, copying your Mentor on any correspondence.

#### **d. Preparing Executive Summaries**

One of your primary functions as "the" Project Manager is to keep your project team, your Client and your Client's management informed of the progress of the project. Your responsibility is to perform this task as detailed as necessary, but as succinctly as possible. Keep in mind that a report of this type is not meant to be an opinion piece, but rather a fact document. If you are asked to give your opinion on a project matter, do it verbally, but don't put it in writing if you can avoid doing so. There are various means to maintain a good line of communications with your client as well as with the various leaders of your project team.

One example of this format is a weekly Project Memo update, which can be patterned after your project schedule. In this type of format, the PM prepares a weekly summary of activities that reflect the progression of the project as it occurs, citing such aspects as the progress being made in specific operational areas and the problems being encountered. A memo of this type will carry more weight with management if it is first reviewed and then signed off by both the Project Manager and the Client Representative. The PM should also include various notes

that incorporate features such as safety and environmental issues. This type of Memo should also include updates from the previous three or four weeks to indicate the level of progress as well as to illustrate any problem areas that may or may not have been resolved.

Another method which has found favor in recent years is the creation of a website dedicated strictly to a specific project. This type of format, while being somewhat more complicated, is generally reserved for larger projects. The initial setup will be more expensive, but the actual maintenance of the site will be relatively inexpensive. The progress of a project can be updated literally every day with input from different key personnel who are members of the project team. In general the team members have a “write only” capability, and don’t necessarily have the option of viewing parts of the project which are not considered their responsibility. Executive management, which is usually described as any member of management that has a vested interest in the progress of the project, will be equipped with a password and “read only” capability, and will have the option of viewing any or all parts of the project for which they have a concern. The Project Manager has the ability to analyze and override any issue on the site which might be considered inaccurate, or even to some degree disruptive, to the overall benefit of the project.

## **2. Developing a Budget**

About half of the time a Project Manager is involved in a project early enough to have some meaningful input into the overall project estimate and its subsequent appropriation request. Just as often company management (the Client) has established the approximate amount of money that its Board of Directors will approve, and has already submitted its request for funds. In the former case the PM will have a Scope of Work with a Budget that can be fine-tuned. In the latter case the PM will have to assemble a Budget from the very beginning, but will have to be very careful and meticulous not to change the appropriation in any significant manner from what has been presented to the Board.

In either situation the PM must develop a preliminary spreadsheet that can illustrate, primarily to the PM’s Client Representative, what the estimated cost of the project will be. There are likely several ways to provide this information, but the simplest and most effective means is to use an Excel format. With this program you can use the vertical column to list all items and functions of the project, normally utilizing no more than a few pages on 11” x 17” sheets of paper. Across

the horizontal row of the Excel spreadsheet, you can list your timeline, whether in weeks or months. A spreadsheet of this type on one or two sheets of 11" by 17" paper is usually satisfactory for no more than a twelve month schedule, while a larger project using a similar arrangement on 11" by 17" will usually cover twenty-four months, but might require several more pages. Expenditures for each month can be summarized at the bottom of the spreadsheet, and total costs for each line item can be summarized at the right hand side of the spreadsheet.

Should the budget estimate prove to be more than what management expects or appropriates, measures will have to be taken by the PM to reduce the Budget by streamlining or reducing the Scope of Work until management is satisfied with the revised budget. The alternative, of course, is for the PM to reduce the timeline and postpone unnecessary auxiliary facilities until a later date when sufficient funds may be available from the company. In either situation the PM must have detailed knowledge of both the estimated cost and the schedule requirements.

Your budget may begin with a land purchase or lease, including an environmental study, and possibly a new road or a railroad track extension. The estimate should include engineering fees, equipment costs and shipping (always attempt to keep shipping costs separate, as this is not a capital expense), utility requirements, construction costs, supervision of erection, and travel costs for members of the project team. Included in construction costs will be such items as trailer rentals and setup, utility fees, sanitation, field office staffing, and possibly new roadways and access ways.

### **Know Your Facts – Don't Guess**

During preparation of a budget estimate, the Project Manager will have to make calculated estimates rather than simply guessing. For instance engineering fees can usually be determined as a percentage of the total project cost. Equipment costs can be determined by a review of similar projects and/or by the use of judicious research and phone calls. The PM can estimate the majority of construction costs by using the same criteria that contractors develop when preparing their bids: volume of concrete and weight of steel versus cost per square foot for main, auxiliary and office buildings; weight of equipment to establish rigging and erection costs; lengths and sizes of piping that an M&P contractor would estimate; and equipment, conduit, trays and cable that an electrical contractor would require. Inasmuch as this would be a budget estimate, the PM should consider a much higher contingency factor, possibly as high as 12 to 15 percent.

There are also several factors which most project managers include in their estimate to cover variable project costs that will occur as the project proceeds. The first of these is called “design changes”, which applies to almost any equipment in your project. This could simply mean that the old version is obsolete, and the new version is faster, has more modern controls, and will give you a higher production rate. On the other hand the manufacturer may not have made any significant changes or improvements, and simply had a price increase with the intent of passing that increase to the buyer.

Another obvious factor to consider is the cost of living increase, which requires the PM to utilize a forward escalation feature in the project estimate. This factor will apply to virtually every item in the budget estimate, and which will vary somewhat depending on the overall length of the project. Since this is a time-sensitive factor, a prudent PM and the project team members will seek commitments from as many potential suppliers and contractors as possible. One specific example of this would be to solicit firm unit prices for building foundations and steel supply as well as placement and erection.

A third factor to consider and include in your project estimate is defined by most projects as “contingency”. This number is usually a fixed percentage of the total cost of all other items in the estimate, and depending on the complexity of the project, can vary from as low as 2.5 to 3.0 percent all the way up to 7.0 or 8.0 percent. However, a well-defined and well planned project should never have a contingency factor greater than 4.0 percent. Although construction costs are often more difficult to estimate and project, these estimated expenditures must be included as you develop your forward escalation and contingency costs.

### **3. Scheduling – Time vs. Costs**

The two most important aspects of any project, other than to assure the Owner of the prospects for getting it right, are schedule and budget. A competent Project Manager will always weigh these two variables on a daily basis in order to ascertain whether or not he/she is providing a truly valuable service to the Client(s). This is never an easy task for anyone, and often creates much controversy within the project ranks. However, you are hopefully being paid well for your services and should never be in doubt as to your ultimate goal.

Regarding your responsibility to meet your Client’s schedule, the objectives of nearly every project are to complete the project within a certain time frame and

to have a financial reserve available for startup and any emergencies. On the surface this may appear to be a routine matter, but often becomes difficult and, at times, nearly impossible. However, a competent Project Manager should be capable of creating and maintaining a quality schedule by using some basic tools. If you can quickly master the fundamentals of Microsoft Project, you will be able to provide a schedule that utilizes a Gantt Chart and can keep you and the Client current with the tasks and activities involved. As you grasp the nuances of MS Project, your ability to furnish additional details, and to even prepare a critical path for your project, will greatly improve.

In the event of larger projects, such as those that might easily exceed \$50 million to \$75 million, there will likely be a need for the you and the Client to hire personnel from outside firms to provide such schedules as Primavera or Timberline in order to provide more specific details. Always keep in mind that the personnel doing those types of schedules would be looking to you and your project team to provide them with the necessary general details. Thus your ability to understand the basics of scheduling and to quickly grasp the fundamentals of your scheduling team, if required, is exceedingly important.

### **Where to Start**

There are several important factors to consider when preparing a schedule. One factor that is not always obvious is to start with the end date. If your Client or Customer has a completion date as the target, use that as your end date, allowing the necessary time for punch list items, equipment startup and system startup. Unless you are dealing with a Federal government project, you are almost always under some schedule deadline. With each of these “end- of-the- project” factors, include sufficient float time as contingencies in the event of significant delays. As you work your way back on your MS Project schedule, follow the same principle of allowing sufficient float time toward each category. The chances are reasonably good that you will have used excessive float time throughout your schedule. In that event first look at items where you feel certain that float time can be either reduced or eliminated. Next look at items in which time is established by you and your project team, such as the time allotted for receiving bids or the time allotted for placing contracts.

### **Scheduling Is a Process**

Establishing a viable schedule is a process that will take several iterations. The main fact to consider when finalizing any initial MS Project schedule is to have most of your float time toward the end. This is when enthusiasm wanes and tedium sets in, or as one infamous sage once commented, “...unforeseen variables occur.” During the formation of your MSP schedule, one of your first duties is to provide a separate list of all the

equipment that you and/or your team will be required to purchase for the project. Once this list is issued, you can meet with your engineering group to assign priorities for preparing specifications, requests for quotations or proposals, and bidders. Needless to say, the longer lead time items and more complex installation will require higher priorities and, ultimately, greater float times in your project schedule.

Include in the equipment list the various vendors who will be bidding, your estimated or budget prices, their pricing and delivery schedule, as well as your estimate and theirs of how long the installation will take. With regard to vendor delivery dates, you must allow a certain amount of float time in your schedule to accommodate any variables that might occur. The higher the complexity of the equipment that is being purchased, the greater amount of float time should be considered. Also, the same general formula applies to equipment being purchased overseas; leave ample time for ocean freight, clearing customs and the port of entry, and overland freight to the project site.

Once you have decided on your major equipment and have placed your purchase orders, you now have the basis for a quality MS Project schedule. You can evaluate the delivery times of the major items and how those dates coincide with your estimates for installation in order to determine which critical path items will need to be expedited. You will also be able to determine other critical issues such as which equipment items you can schedule as “early start” and which items will have a later start date. Regarding any equipment with a long lead time delivery, the PM and the project team may have anticipated a later delivery date. If that were not the case, then you should consider the reduction in float time for that item and/or the utilization of specifically targeted construction overtime for that equipment.

If you and your engineering firm have properly coordinated your project activities, the engineer will be receiving vendor drawings in a timely manner so that the construction drawings can be produced as quickly as possible without overloading the engineers. In an ideal project the release of construction drawings will occur in a manner consistent with product flow. However, that situation rarely occurs, so that there are two main procedures to concentrate on at this point. First, be certain that your engineer has enough time to produce accurate, if not total quality, construction drawings. Failure to do so will prove to be costly as well as time-consuming. Do not permit the constructor to begin his work utilizing preliminary drawings unless you, personally, have reviewed them for reasonable accuracy. After all, you as the PM are the only one responsible for both cost and schedule. Initiate your utility specifications with your engineering group, making

them especially aware of any unusual requirements. At the same time your engineering group will be preparing construction specifications and you will be furnishing them with a list of experienced contractors from which to solicit bids.

Second, and equally important, is the necessity to establish the sequence of your project tasks, which is the next to last step before preparing your project schedule for general publication. This involves a beginning point, which might include such items as choosing a site for the project, securing environmental permits, selecting an engineering firm, and even receiving financial approval of overall costs and ROI (Return on Investment) for the project. In today's world of restrictions and regulations, your chances of successfully maintaining a project schedule will depend on the ability of the Project Manager to multi-task. This simply means that, once the project has been approved and funded, the PM must have a mindset to move forward in as many areas as possible without waiting for all documents to be formally signed and delivered.

### **Still a Moving Target**

Finally, as you begin to incorporate each function into your project schedule, you should now have a fairly concise idea regarding the duration of each task. Keep in mind that at this point everything is still on paper, and nothing is yet cast in stone. You can still alter either the sequence or the duration of each task to best suit your end result. Overlap functions where necessary, avoid unnecessary duplications, and minimize movements by all parties so that projected costs are within your limits. This MS Project schedule now also becomes a useful tool for verifying your project budget by assuring that all items are covered.

Once you as the Project Manager have a viable schedule with which to work, bear in mind that it will probably change every week until the project is concluded. Most of these changes can be managed by the Project Manager in a fairly routine manner. However, there will be a few occasions during the course of the project when you may have to make a decision which could alter not only the time frame but also the end date of the project's completion. In such cases the PM must know how each day's delay will affect the Company's future as well as current bottom line. For such an eventuality there is a general rule of thumb that can be applied by the PM, commonly known as the **60 Percent Rule**. This rule implies that if the potential cost of the delay should exceed 60% of the project's loss in profits over the same time period, then the PM should seriously consider making the expense necessary to correct any lost time in the schedule.

For instance, you may have been made aware by the Client that each day of project delay will cost the Company \$10,000 in lost revenue, or approximately \$1,000 in lost profits. You then learn that a critical piece of equipment is being shipped by general freight, which is included in the supplier's contract and will take a delivery time of one week longer than expected. However, if you ship the equipment by "exclusive use of truck", the equipment will arrive on site in four days at an added cost of \$1,500. If your analysis is that the site contractor is ready to install this critical equipment the moment that it arrives and that the extra three days of shipping could jeopardize the project completion date, then you are justified by your decision to spend the extra \$1,500. In this case the rule of thumb is being applied, because you are spending \$1,500 to save the company a total of \$3,000, or about 50%. However, you might have several options at this point in the project. Quite likely the project team had inspected the equipment at the supplier's manufacturing facility and the PM may feel confident that the installation will go smoothly. Meanwhile you may have had your electrical contractors and your process control engineers perform sufficient preliminary work so that, when the equipment does arrive and is installed, the time saved in startup will offset the late delivery time. Finally, by closely tracking the shipping routes and transfer depots, you may be able to expedite the actual delivery date of the equipment, thus reducing the actual shipping time by one or more days.

Suppose that in another situation you have a site contractor that is demanding a 12-hour workday (ten hours has been the normal workday) and a 6-day work week (five days has been the normal work week) in order to complete a particularly critical phase of the project. If your analysis is that the overtime cost will be an additional \$3,900, but the project schedule will benefit by five days (or \$5,000), then you might want to consider this expenditure as unnecessary since it exceeds the 60% rule. In a case like this, nevertheless, the Project Manager must look at the impact of being possibly five days late with the project, reevaluate activities that can be scheduled concurrently, and look for other ways that can bring the project to completion on the original date. In any event, entering into communication with your Client and Construction Manager as soon as you are made aware of the problem is essential. Having the Client involved when you are in a situation that might delay the final completion date of the project is imperative; management might shed some light on a little known facet of the project that might change your approach. The Construction Manager, on the other hand, may be able to offer an alternative to overtime, such as simplifying the task, or even completing the majority of that particular phase after startup. Even though the final decision rests with the Project Manager, the PM should never be

afraid to look for some guidance. In general, the prudent use of overtime can benefit the project for a myriad of reasons which will be discussed later in this article. On the other hand, abusive use of overtime can be detrimental to any project.

#### **4. Engineering and Design**

Whether the design for the project is being developed by an in-house group or by a contracted engineering firm, the same “rules of engagement” apply. In the first situation you are dealing with what is termed as a Matrix Organization, in which you have no direct authority. Your main “weapons” are communications and motivation. Not only are you required by your position to communicate the philosophies of executive management, but you are also obligated to deal with the individual design managers and design leaders in a forthright and truthful manner. In the second instance, you are working with a Captive Organization which is under contract to provide the necessary deliverables in a timely manner. Nevertheless, your obligations and objectives remain the same, even though your personal influence may be somewhat greater.

In either case the personnel that are working on your project may be working on two or more other projects, have their own priorities, and need to plan their activities and work schedules accordingly. You should be meeting with the design leaders who are directly involved with your project on a weekly basis, giving them a summary of the MS Project Schedule for the items that are to be accomplished by them. These meetings should be brief (less than one hour) and should be agenda-driven. Design associated with site work and buildings, followed as closely as possible by packages for equipment design, should initially take precedence over construction bid packages. Although this latter item is ultimately important, a major factor in project cost overruns occurs when a constructor is in standby, waiting for equipment to be delivered.

The design functions of the engineering group that are an integral part of your project team are comprised of three major deliverables as well as a general support function:

- a. General arrangements and layouts of the facilities
- b. Design bid packages and specifications for equipment
- c. Design bid packages and specifications for construction
- d. Other general support functions

These functions are more specifically described in the following sections:

### **a. General Arrangements and Layouts of the Facilities**

In the case of item a) above, the initial drawings must necessarily be preliminary, mostly based on the experience and knowledge of the Project Manager, the Client, and the design team. This particular portion is actually comprised of three separate areas of design, none of which are in a perfect sequence for construction:

- i. The first construction item is usually the building or buildings, but they can't be properly sized and designed until the equipment is sized and laid out in an orderly manner. This will include walkways, traffic and equipment accesses, office space, and restrooms among other items. The risk in not having most, if not all, of the critical equipment dimensions is that the building(s) will be too small or too large, both of which are costly propositions.
- ii. The second construction item includes the utility requirements such as sub-stations, air compressors, HVAC equipment, and climate controlled buildings. Some of the utilities would be underground, and some would be overhead. Some, such as an electrical sub-station, switchgear, and/or a computer or control room would require large areas as well as strategic positioning.
- iii. Finally, construction drawings for all the process equipment will have to be developed. At this point your engineering team has allowed for such mandatory design features as maintenance access and overhead clearances.

Should building design or utility design begin without some significant equipment information, the same practice of either under designing or over designing becomes a real threat to the project cost. Other than calling on the experiences and knowledge of the Project Team, the first option for gathering this data is to search within the company for similar facilities. If this new facility is to replicate an existing one in some manner, the time the project team will take inspecting and observing those operations will be time well spent.

Another ethical solution to this dilemma would be to engage suppliers of critical equipment for assistance. The Project Manager and the Client may have a clear understanding of the type of equipment needed, and might even have a recommended list of suppliers' names. Most equipment suppliers should be willing to recommend

visitations to existing facilities in other companies where their equipment is being operated. Under normal circumstances those suppliers would make the necessary arrangements for those visits, and also would accompany the PM and team members on those visits. A third option, if all else fails, is to request that any two legitimate vendors who will likely be on the bidders' list submit non-binding and non-proprietary proposals for their equipment that would include basic dimensions and utility requirements. These solicitations would probably occur with no more than a verbal or one-page specification, and should be handled by the Purchasing Department under the authority and direction of the Project Manager

General arrangements and various layout drawings, as well as critical sections through those layout drawings, are the lifeblood of most industrial and commercial projects. Even where architectural drawings may have a more significant role, arrangement and layout drawings will be used to signify the overall footprint of the facility and to provide guidelines for planning and developing the project. This phase of the project is often tedious and is slower to develop than many project managers seem willing to tolerate. One method for accelerating this process, depending on the overall size and schedule of the project, is to divide the master general arrangement into multiple plan views. These plan views can be connected by means of "match lines" and/or "match markings" which identify their locations on the arrangement drawing. These individual plan views can then be developed separately. The obvious advantage is that each plan view can be assigned to a different designer or design group, thus expediting this phase of the engineering function and effectively providing the PM with a better quality product. Although the ultimate responsibility for sizing the equipment and determining the specific requirements of these arrangements lies with the engineering group, the support of the PM in this effort cannot be underestimated.

#### **b. Design bid packages and specifications for equipment**

Given the above information, the engineering group must now put forth a strong effort to develop the necessary bid packages for the critical process and utility equipment (item b above). Having already received a substantial amount of preliminary information for this equipment, they should be able to provide the necessary bid packages, including specifications, in an expeditious manner. In addition the payment terms and the legal structure of the pending contract are usually a combined effort involving legal, purchasing, finance, and project management. An important aspect of the engineering group is securing supplier drawings for use in finalizing facility design as well as providing those drawings as references in the construction bid packages.

As previously noted, finalizing building design is a formidable task when equipment dimensions and utility requirements are not completely known. In those situations the Project Manager should be more inclined to advise his engineering team to go larger rather than smaller. Your experience as a PM has probably illustrated to you in other projects that a project rarely has too much building to spare. The cost per square foot of buildings in the primary bidding stages is usually less than 75% of the cost for an add-on once the building contract has been let, and usually less than 50% of the cost for an add-on once the building is erected.

### **c. Design bid packages and specifications for construction**

Bid packages for construction (item c above) follow the same guidelines as equipment bid packages, using final layout drawings and suppliers' drawings as references. Payment terms and specifications are a joint effort of several groups, including legal, purchasing, finance, and project management. Scheduling of field activities must remain as a unified effort of the Construction Manager and the Project Manager.

Having the equipment suppliers submit their certified drawings requires a concerted effort of an experienced Project Manager as well as the project team. The suppliers that submit certified drawings of their equipment per a contractual date are not usually in the majority. On most projects, and especially on fast-track projects where the construction contractor may be on a time and material contract, the schedule for certified drawings is just as important and unique as equipment deliveries.

### **d. Other Functions of the Engineering Group**

In addition to these major functions, an experienced engineering group will also provide expediting of equipment drawings, inspection and quality control of equipment drawings that are received, and assistance in resolution of problems that may occur when a contractor discovers a discrepancy in the equipment during installation. These items will be discussed later in this section, but the three core functions listed above are described in more detail as follows. As mentioned earlier in this section, there are several auxiliary functions listed below which a Project Manager should demand of a professional engineering group:

- i. Inspection and quality control of equipment drawings - once a firm contract has been let to a supplier, the engineering group has the responsibility to thoroughly review that supplier's drawings to

determine whether the equipment is being manufactured according to design and specifications. In the event that the drawings are not conclusive, a visual inspection of the equipment would also be warranted, and should include the determination that materials such as metals and wiring, and manufacturing practices such as welding and machining meet necessary quality requirements and standards of the project specifications.

- ii. Assistance in resolution of problems that may occur – during the course of regular supplier drawing reviews, specific visits to the suppliers may be necessary. These are generally scheduled by the Project Manager in order to optimize costs and benefits. Any problem areas should be noted in writing and resolved immediately at the manufacturing site. Otherwise an open or contested problem should be communicated to the Project Manager for analysis and resolution.
- iii. Expediting of equipment drawings – unfortunately, most first-time project managers have learned that, unless there is a well-defined incentive clause in the contract, a supplier will often be late with a scheduled delivery of equipment drawings. Thus the engineering group provides a valuable service by recording manufacturing drawing status and expected delivery dates after each supplier phone call or email, and issuing written status reports. Although the PM may make an occasional supplier visit, reliance on the engineering group for this information is imperative.
- iv. Inspection and quality control of installation - once a firm contract has been let to a site contractor, the engineering group has the responsibility to visit that site to determine whether the equipment is being installed according to specifications. Inspection of the construction site should also include the determination that materials such as welding rods, fasteners, piping and wiring meet necessary quality requirements and standards of the project.

All of these above listed activities which are being delegated to the engineering group do not abrogate them from being the ultimate responsibility of the Project Manager. A quality PM is expected to know and understand the generalities, if not the specifics, of the layout better than any designer. Most PM's will make a concerted effort to visit facilities that are manufacturing critical equipment, particularly if that equipment is on the critical path schedule, and form an opinion of the quality of manufacturing and the timeliness of deliveries. A PM's most

important role during the formative stages of design as well as with the ongoing manufacturing is to make the necessary decisions that will keep the project moving without delays. Decision making in the early and middle stages of a project will help to relieve some of the pressure from the late stages of the project and minimize or altogether eliminate panic decisions.

## **5. Procurement**

Once your various equipment bid packages have been prepared, you are now ready to work with the Procurement, or Purchasing, Group. They, along with the Client Representative and your Design Leaders, shall have collaborated at your request to form a bidders' list that will meet the project requirements of specifications, cost, and delivery. As the PM you (and your Client), based on past experiences, should retain the right to recommend other bidders or override the selection of any suppliers on those lists with whom you may have had bad experiences, or otherwise may not be qualified in your opinion. However, you must stay objective in this regard, because you are working with other Professionals in this area who may or may not have more experience than you.

There are many factors to be considered while working with a Purchasing Agent, and even an entire Purchasing Department, especially when the time comes for their direct involvement. In the initial phase, which involves the preparation of bidders' lists, your Client, your engineers and you will have the primary responsibility in the selection process. Someone in the Purchasing group may have a preference for including a particular supplier on the list. As long as you are satisfied that the supplier will meet your technical requirements and standards, including that supplier should not be an issue. This should be the normal method of engaging suppliers, regardless of whether the item is large and significant or not.

Once the design packages have been issued to the listed suppliers, bid due dates have been established according to your project schedule, and proposals have been received, there is sometimes a lack of harmony in the final supplier selection process. The Purchasing Group has a set of guidelines that may require them to award a contract to the low bidder. You and your engineers may determine that the product being offered by the low bidder is technically unacceptable. Your Client may prefer one of the higher bidders. For you as the Project Manager, the time has come to put on display your skills and experience as well as your

integrity, emphasizing as objectively as possible your reasoning for selecting the **low, technically acceptable bidder**. By maintaining your objectivity, which might include a series of supplier meetings whereby all interested and dissenting parties are invited to ask questions and to listen to the answers, you will minimize any discord within your project team.

As a further note, your project is too important to accept a promise from a supplier that has never met your particular criteria. Maybe that supplier should not have been on the bidders' list in the first place, but you and your team were fortunate to have learned of the deficiency before a contract was signed. In addition, and irrespective of the successful suppliers' credentials, you will be wise to insert a performance-based retention clause in all significant contracts. This retention usually amounts to a 10% retention on the total contract, not including shipping charges, which are normally negotiated and paid separately. A very important element for the Project Manager to maintain is to ensure that the supplier is paid per the terms of the contract as soon as the project team has accepted the equipment.

### **Purchase Order Follow Up**

After the Purchasing Group has issued a purchase order to a supplier, they are often the group that assists the Project Manager by expediting the supplier and maintaining the original intent of the project schedule. An experienced PM can usually acknowledge that Purchasing has a certain amount of "clout" with suppliers, which often means that those suppliers perform to the best of their ability when the Purchasing Group engages them. Another "friend" of the Project Manager is your Client's Legal Group, which probably assisted in developing the terms and conditions of the various suppliers' contracts. This is particularly true in the event that a penalty-bonus clause has been established in any of the supplier contracts.

In a similar manner your various construction bid packages will be prepared according to your project schedule, and you are now ready to work with the Purchasing Group to select contractors that will perform the field construction. Purchasing along with your Design Leaders, Client, and Construction Manager shall have collaborated at your request to form a bidders' list that will meet the project requirements of specifications, cost, and completion dates. As the PM you (and your Client), based on past experiences, again retain the right to recommend other bidders or override the selection of any contractors on those lists. However,

you again must maintain your objectivity as in the case with equipment suppliers, keeping in mind that other Professionals in this area may have more and/or different experiences than you.

Your options for this critical phase of the project are now quite different from the design and equipment phases of the project. If the project is large and ample funds have been allotted, then you may be better suited to be dealing with general contractors who have the capability to bring in a workforce and sub-contractors that will meet your schedule requirements. In a situation of this magnitude the Project Manager will almost certainly be assisted by one or more Project Engineers who will be given the responsibility for completion of specific site or operating areas. Conversely, the PM may determine that there is a limited budget and will have to work with several specialty contractors. In either case the burden on the PM can be considerable, depending on whether you are working with an experienced Construction Manager in whom you have confidence.

Regardless of your approach, your project efforts will become much more intense after the proposals have been received. As with the equipment proposals, rarely will you receive a proposal that does not elicit a series of objections and questions. The PM must have allotted time for issuing questionnaires and scheduling contractor meetings. At these meetings with all pertinent parties present, you will likely get a consensus of which proposals, whether or not they are the low bids, will offer the most value to the project from a cost and schedule stand-point. These contractor meetings should also be held consecutively whenever possible, occurring in the shortest window available. As with the supplier meetings, never schedule more than one company at a time, and prepare a list of questions which each contractor can review before the meeting.

After the Purchasing Group has issued a purchase order to a contractor, they should be kept in the loop of communication by the Project Manager. An experienced PM can usually acknowledge that Purchasing has a certain amount of influence with contractors as well as suppliers, which gives those contractors the incentive to perform to the best of their ability. The same courtesy should also be extended to your Client's Legal Group, which probably assisted in developing the terms and conditions of the various construction contracts, especially in the event that a penalty-bonus clause has been established in any of the construction contracts.

## **6. Construction**

Most projects of any significant size will usually have a construction manager who will be assigned to the Project Manager. This individual may be a company representative or may come from an engineering and/or construction firm. The CM should be hired early in the process, not only to help set up the project field offices but also because he or she should be a valuable resource for potential bidders. The CM should also be expected to develop an intimate knowledge of the project, especially the schedule, and will assist the PM with the site planning of the project.

As noted earlier, the design packages are to be prepared for release to the various construction bidders, and the PM and the procurement (purchasing) group should have collaborated with the Construction Manager in order to develop a construction bidders' list. Let's assume that, as a Project Manager, you have significant experience in dealing with construction companies in your fields of expertise. However, each project has its own nuances, and each geographic area may have its own set of valid constructors. If your project is quite large (\$100 million or more) and has a high degree of complexity, then your best interests may be served by engaging national construction firms that have served you in the past. Otherwise, your secondary objective in this situation is to stay in the background during the selection process for preparing the bidders' lists. Your primary objective is to evaluate each construction proposal in terms of safety programs, superintendents' experiences, manpower availability and schedule commitments. At some point during the evaluation process, best acceptable price may become an issue. If that number is over your budget, then you as the Project Manager will be required to work with your design group to bring the price in alignment with the budget. However, remember your assignment; the responsibility for negotiating the best final construction price lies with the Purchasing Department and not with the Project Manager.

### **Selection Process**

There are several criteria besides lowest cost for selecting any major contractor and most sub-contractors for your project. Some of these include:

- a. Being aware of resource allocation. Choose construction companies that can multi-task, but your ultimate responsibility is to assure that none of the companies is over-burdened. Short (one hour or less) meetings with an

agenda prior to contract placement to get specific answers to your timetable requirements should suffice to identify and address potential problems in this area.

- b. Determining the level of experience that a contractor might have with the same or similar type of project that you are implementing.
- c. Being certain to receive and review a resume of the contractors' superintendents who will be responsible for the onsite management.
- d. Being certain that any contractor that you might select will be willing to consider a penalty-Bonus clause in the terms and conditions of the final contract. While the clause may not be implemented, the contractors who are willing to accept this clause are at least demonstrating confidence in their superintendents and workforce.

While this latter item may seem to some of your project team or to some management members as unnecessary, a well-crafted clause of this type will give you assurance that the contractors will give you their best efforts. And also remember that the courts have ruled that a company or organization cannot implement a penalty clause unless a corresponding bonus clause is also stipulated.

Placing a Design/Build contract with the same firm minimizes your ability to control the project. Most successful projects maintain engineering separate from construction. This is not to imply that the Project Manager should be looking for an adversarial relationship between the two entities, but rather that this simple procedure might enhance the competitive nature of the project toward a more successful completion. In addition this tactic assures the Client that the PM has made a sound business decision by avoiding any appearance of a conflict of interest. Furthermore, an engineering firm will take a certain amount of pride during its inspection process in knowing that its design practices and standards are being met by the construction contractor, and that it has played a prominent role in the success of the project. Conversely, there will be a line of communication between the construction contractor and the engineering group in order to resolve minor discrepancies, without the necessity for involving either the PM or the CM.

An experienced PM will make the rounds of the jobsite at least twice a day, possibly with the Construction Manager in the a.m. to verify such items as workforce size, priorities, and progress. Resource leveling - the ability of the

contractor(s) to provide a consistent, quality workforce for each critical phase of the project – may be one of the construction issues that might need to be addressed during this inspection. A tour of the facilities in the p.m. with a lead engineer might expose any problem areas which may necessitate some last minute design modifications. In any event the PM must be careful not to interrupt the work flow, but rather denote any potential problem areas that can be quickly resolved as well as to be in a good position to assist in developing the inevitable punch list.

## **7. Cost Control and Cost Correction**

Larger projects may have a Cost Control Associate on site who is responsible to the PM. If that is the case, then you as the PM should expect this associate to provide a detailed report of the costs and expenses incurred on the project and to compare these costs against the original budget plus any financial additions or deductions that have been made. You, and undoubtedly your Client, should expect to receive these reports bi-weekly for the first 90% of the project's duration, and to receive at least updated mini-versions on a weekly basis during the last ten percent of the project.

Keeping a critical view of the project's costs are as important at the beginning of the project as they are in the latter stages. As an experienced PM, or even as a novice, you will recognize areas and functions whereby some items may be eliminated, some items will require a reallocation of funds from "known" savings elsewhere. Some equipment items which were either possibly overlooked, or else had to be replaced by more expensive items in order to benefit the overall project, may just have to be funded out of contingency. While utilizing the Contingency Fund to cover project overages may be enticing, this fund should be used by the Project Manager only as a last resort. PM's need to regard this fund as a safety valve, to be used only in cases of absolute emergencies.

As your project becomes active and your original budget actually begins its conversion to collect current expenditures, the PM and Cost Control Associate will have to add some columns to the spreadsheet. The first additional column could be entitled "Expenditures to Date", which is a summation of actual expenditures by the company. This column will take into consideration the actual amount of funds expended to date (actual payroll for in-house personnel, checks written to suppliers, utilities, contractors, etc.). The financial factors in this column are

usually occurring on a daily basis and should also include all travel and living expenses incurred for the project. One of the more significant features of this column is for the Project Manager and his/her Cost Control Associate to determine whether the rates of payments are in alignment with the company's funding of the project. For instance, if the project is completely funded, then the Cost Control team can save money by using a discount factor (usually 2%) in its payment terms. Conversely, if funding for the project is coming from recurring profits from operations, then the team might want to extend contractor and other payments to net thirty days, or even to net 45 days. Extending payments beyond these periods is not a good business practice and is not recommended.

A second additional column would be entitled "Required to Complete". This column should primarily reflect commitments, or promises, to fulfill existing contracts such as any retention being withheld, extra work accepted but not yet paid for, known freight charges not yet paid, used but unbilled payroll, and the like. Financial factors in this category are transferred into the "expenditures" column only as soon as an invoice has been paid by the company, regardless of whether the project team has approved payment.

A third additional column is referenced commonly as "Estimated to Complete." This column can sometimes become loaded with ambiguous numbers, but an experienced Project Manager can keep these financial factors realistic through previous communications with all involved entities. This column might include such financial factors as incomplete engineering drawings, equipment that was promised by the suppliers but never manufactured and delivered, equipment that was regarded as necessary subsequent to the original budget being drafted, or even an extra door or aisle way. The PM should keep in mind that this column is extremely important also for deletions that can be made to the project scope. This is the one column that permits the Project Manager to maneuver the project costs in order to more closely adhere to the original budget estimate.

A fourth and final column would be the summation of the second and third columns, and those numbers would then be compared to the numbers in your original budget estimate. The PM and the Cost Control Associate should attempt to adjust each of these values in an effort to have them more closely approximate the project budget. However, the PM will also have to deal with any additional items that have been added to the initial scope which have proven to be necessary. Consequently, before the PM is required to start cutting away at specific items in the budget, a comparison of the total cost at the bottom of the

new fourth column should be made to the total projected cost of the original project budget.

### **Know Your Budget, Know Your Costs**

By maintaining a close relationship with your Cost Control Associate, you will be in a stronger position to move rapidly and to ward off potential financial pitfalls. Conversely, smaller projects may not be able to support a Cost Control Associate. In this case you may have to wear two hats and keep your own set of financial records, or you may have access to a lower level employee who can at least enter the information that you give that person. That would be at least some benefit to the Project Manager, so that critical financial information can be regularly recorded, and the PM will be able to generate and issue regular reports.

As your project proceeds, rest assured that there may be significant differences in your forecast expenditures versus your actual incurred costs. Equipment and construction expenditures are seldom exactly as you had forecast, and there are usually several reasons for those variations. That is a principal reason why the Project Manager must keep up with “design changes” for engineering and equipment, cost of living increases, which are dependent on the overall length of your project, and the “contingency” factors that all PM’s must control.

You will be either pleasantly surprised or somewhat shocked as the actual costs begin to be recorded. For instance engineering and design costs may trend higher than what you had forecast. That may not surprise you if you have been following the design activities closely, and realize that there have been several scope changes, including an attempt on your part and theirs to reduce overall equipment and construction costs. Remember that you are not autonomous in this venture; you have been working with this team and motivating them to be an integral part of this project, and to be participants in its ultimate success. You have come to believe, and often rightly so, that sound engineering practices will benefit the project in the final analysis. This information can be compared to your forecast budget for a given period of time and can even be displayed graphically (again expenditures vertically and timeline horizontally).

## **8. Startup**

Sometimes these two words, startup and closing, are used interchangeably by both the Client and the management members involved with the project.

However, most experienced PM's are well aware that these two words are not synonymous. As the PM you have allotted sufficient time in your project schedule to test the equipment on site, even though you have undoubtedly had the manufacturer put the equipment through its necessary testing at the factory or shop. Now that the equipment is on site at your project, the manufacturer's representative as well as your own on-site personnel may be dealing with different conditions than what was available in an ideal shop environment. There is little doubt, however, that quality planning by the Project Manager and the project team to prepare for onsite testing and tryout of equipment will save both time and startup costs for the project.

Equipment can be damaged in shipment, particularly if it is coming from overseas. In addition special care must be taken by your construction manager to insure that the installation is in accordance with manufacturer's guidelines, that utilities such as electrical power and instrument air are clean, and that the manufacturer's representative is present for initial startup and testing. Your responsibility at this phase of the project is to acknowledge whether the equipment works as intended, and to communicate with executive management, your engineers, and the manufacturer whether it does or does not.

In the next phase of startup you and your team will be dealing with the coordination of individual equipment as it relates to other equipment on either side. This "systems integration" is the heart of your startup schedule, and may require the input and recommendations of many people on your project team as well as operations personnel in the event that things don't go according to plan. In this event, even though you may be receiving (and recording) advice from all sides, you are still in control of the project and must continue to be the primary decision maker.

This phase of the project is where the relationships that have been developed by you (and your team) and operations personnel are so important. As part of the startup cycle many of these personnel should be present during testing of each piece of equipment, and the manufacturers' representatives who performed the original testing must be available to answer any operations' questions. The interests of the project team as well as operations are well served when this coexistence and continuity exists.

However, irrespective of the efforts that the Project Manager, the project team, and various groups associated with the project may have made, neither the PM nor Executive Management should expect perfection during this phase. Unless

you are duplicating an existing facility, there is never any guarantee that a new facility will start up without any hitches or glitches. The great majority of new facilities, whether industrial or commercial, can expect to go through a “learning curve” which will require painstaking attention to detail in order to achieve a relatively successful operation. There is probably no hard and fast rule as to how long before your facility will achieve this success – some facilities achieve a high degree of success in six months or less, while others may be climbing the curve toward 100 percent operation for close to two years. The simple fact is that, if you have followed the principles and guidelines presented here, you are more likely to achieve complete success earlier rather than later.

## **9. Closing – Achieving Success and Avoiding Failure**

There is almost always some pressure on the Project Manager to close the project in an early, if not orderly, manner. You will undoubtedly have a “punch list” of uncompleted tasks that, in your opinion, require resolution before the project can be officially closed. While you may not be inclined to close out the project under those circumstances, your assignment is to communicate with all involved parties. At this final phase of the project, and although you are dealing with a smaller group of personnel (Executive Management, Operations), their opinions matter a great deal to your future assignments and/or promotions. In spite of the phrase “Failure is not an option!” used in the Armed Services, pro sports, and other environments, failure is still very much an option for the Project Manager. The PM must now utilize all the project management skills and tools that have been developed to make decisions and resolve open issues that will ensure the success of the project. As you reach the final phase of the project, you are obligated to determine the following:

### **Are the Clients satisfied with the results of the project?**

If the above question is answered affirmatively, then your function as a Project Manager is essentially completed. You have fulfilled your obligations, and the pressure is mitigated to the extent that you have a happy Client. You are now able to improve the final details of the project rather than to significantly restructure it, and you are in a position to move forward with the closing documents that are required. There are still some final questions, although of lesser importance, which need to be answered prior to the conclusion of the project:

**Are there any uncompleted tasks which may have a negative impact on the operations at a later time?**

Nobody is asking you to look into a crystal ball, but you especially as well as your engineering team and your construction manager will likely be in the best position to make this call. They must assist you in verifying that all pertinent project drawings are updated and certified. Now that the facility is up and running, and possibly there is a production schedule to be met, your Client probably would not be willing to forego operations in order to achieve total completion. The last thing left for you to determine is:

**Are project funds still available to complete the remaining tasks?**

This is an easy one; if there are still some funds available from the original budget, which you have guarded so carefully to protect, then you should recommend that these tasks be completed by the outside services organizations and contractors that were used to perform the original project and may still be on site. This will enable your Client to capitalize the project to the fullest extent without any interference to the ongoing operations. However, if the decision has been made (by someone other than you) to have local operations and maintenance personnel perform any remaining tasks, then your goal has been met and the time has come for you to sign off and move on to your next assignment.

## Summary

As you may have discovered by navigating this course, having personal discipline and learning to delegate authority are very important characteristics of a Project Manager. The primary goal of this course in project management is to provide existing project managers and would-be project managers with the necessary tools to manage a successful project. In almost all projects, the Project Manager and project team members will develop and utilize some core principles. One of those core principles is that the burden of assuring the finite factors of cost and schedule, in addition to the end result, is primarily the responsibility of the PM. Also the Project Manager is given guidelines and examples of what to do when a difficult situation presents itself. Invariably, the solution is not begun until the PM and/or the project team members recognize that a problem exists. It can then be resolved with training and experience, each of which is an equally valuable commodity.