

Project Management

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I. Introduction to Project Management

- A. Purpose. The purpose of this course is to provide the practitioner with the foundational project management principles necessary to effectively meet all expectations with regard to final project delivery.
- B. Definitions. The word “project” is generally used in broad terms and is not necessarily limited to technical fields. “Project” can be defined as an interrelated and essentially non-repetitive set of activities which combine to meet certain objectives. It should be emphasized that the basic tasks in conducting a project such as collecting data, estimating costs, regulatory considerations, etc. are not new. What is new and unique to each project, is the context, i.e. client, team members, physical conditions, constraints, etc. “Project Management” is the process of applying human and other resources as required to produce a completed project design or construction activity within the established goals of time, budget, and quality. Through careful project management all three of these expectations can be satisfied.
- C. Overview. The manner in which a business organization manages its projects is the key to developing and retaining clients and being a profitable operation. Everyone in an organization is involved, either directly or indirectly, in projects which the organization undertakes. Each person can contribute to the successful completion of projects and derive both tangible and intangible benefits from the organization’s achievements.

All projects, regardless of size, require careful project management. Successful project management spreads throughout an organization and thereby directly contributes to its profitability and success. Conversely, ineffective project management has widespread negative impacts on an organization. Accordingly, project management should be a major focus of an organization’s energies.

How do organizations meet this challenge?

1. Some provide PM education and training.
2. Some prepare PM guidelines/standards.
3. Some convene periodic meetings where ideas and information are exchanged.
4. Some do not have a systematic approach to PM.

Project Management is applicable for all types of project delivery systems, including the traditional design-bid-build, construction management, design-build and turn key.

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PM is applicable to any phase of the project delivery systems enumerated above, including Studies and Reports, Preliminary Design, Final Design and Construction Administration.

Project Management involves operations in the areas of marketing professional services, work planning, contracting, negotiating and project execution.

The biggest and most prominent project management challenges are:

1. Meeting project schedules and/or budgets.
2. Managing and motivating the project team.
3. Time management/integrating project into existing workload.
4. Staffing and resources – Are they adequate?
5. Client maintenance. Periodic communication with the client to discuss work progress, schedule and forecast project outcome.
6. Dealing with internal (firm) management and reporting project status on a regular basis.
7. Quality Assurance – Quality control
8. Marketing and business development. Insure that these activities are maintained on a business-as-usual basis.
9. Fee negotiation/collection. Keeping track of out-of-scope items for which additional fees are justified.
10. Other challenges such as environmental constraints, regulatory agency requirements, permitting, etc.

The biggest project management complaints include:

1. Adequate staffing/staff problems such as level of competence
2. Lack of time/workload constraints
3. Leadership issues/firm management
4. Compensation – recognition/reward for achieving project goals
5. Inadequate resources/support
6. Budgets – project budget inadequate to produce a quality project, on time.
7. Training issues
8. Client expectations/satisfaction
9. Responsibility without commensurate authority/lack of control
10. Lack of information-communication issues.

The products of effective project management are:

1. Happy, satisfied clients, customers and constituents. Effective project management means that project goals with regard to time, budget and quality are met. This is the activity closest to the firm's clients who continuously receive the results, positive or negative, of the way their projects are managed.

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2. Profitability. Projects are profit (or loss) generators.
3. Reduced likelihood of client dissatisfaction, disputes, and exposure to liability claims.
4. A great on-the-job arena for teaching, mentoring and learning. Individual or corporate technical and non-technical skills can be enhanced during the project.
5. A setting is provided in which existing technical and non-technical methods can be improved and new approaches developed.
6. A forum is provided in which individuals and the organization can identify future needs of their clients and stakeholders.
7. The generation of new projects with existing clients, customers, and constituents as a result of their satisfaction with the firm's performance and the future needs assessment described in item 6 above. Effective PM earns the trust of the entities being served, which is a vital part of earning the privilege of serving them again.
8. The source of ideas, experiences, and references in the form of satisfied clients, for earning the opportunity to provide similar services or products to new clients, customers, or constituents.
9. Personal satisfaction through team achievement.

II. Building the Team

A. Selecting Staff and Allocating Resources

On many projects, particularly in Florida, the project team will have been selected as a result of the Request for Qualifications/Request for Proposal (RFQ/RFP) process. In these submittals, team members are identified and their qualifications are made known. If a firm has been selected following the RFQ/RFP process, key members of the project team can, usually, only be changed with the consent of the owner/client.

A typical project staffing plan is shown in Figure 2-1.

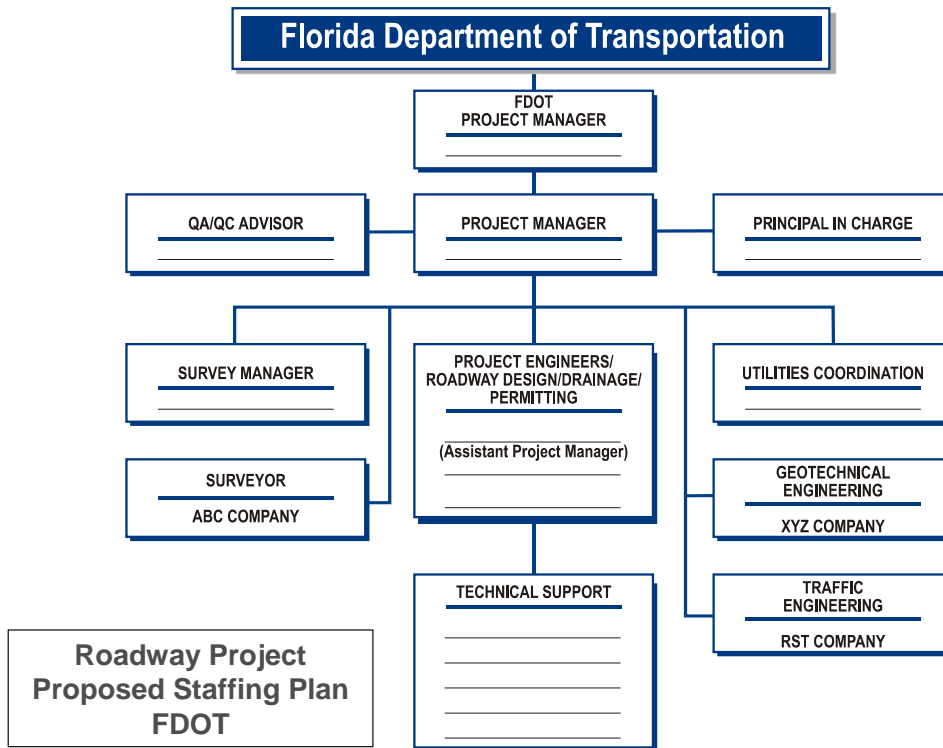


Figure 2-1

The project team that has been identified constitutes a commitment by management to the owner or client that these resources will be allocated to the project. The actual manhours to be assigned to each team member will be discussed in a later section of this course.

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In developing the project team certain guidelines should be followed which are:

1. The project team should include professional and technical support personnel and/or consultants having expertise in all areas of discipline associated with the project.
2. If the project is for an owner/client for whom the firm has worked on previous projects, it is usually desirable to assign the same project manager and key personnel that were used on the previous projects. Often, a comfort level and trust has already been established between the owner and the key members of the project team.
3. There is some advantage in keeping project teams intact over several projects. This serves to strengthen lines of communication and increase the level of expectations between team members.
4. The project team members should be compatible and have previous demonstrated ability to function within the framework of a team.

B. The Project Manager

Historically, the success of most firms can be attributed to the concept of strong project management. The Project Manager position is the cornerstone of this concept.

The Project Manager should have demonstrated ability to organize and administer projects, work within the framework of the firm to successfully complete various types of engineering assignments, market professional services, work with clients to assure their satisfaction and conduct him or herself in a professional manner.

The Project Manager has complete authority over the administration and management of all assigned projects with the advice and consent of the Principal in Charge. The PM is responsible and accountable for the success of assigned projects. The primary responsibilities of the PM, in reference to specific projects, are quality, schedule, profitability, and client satisfaction.

1. **Minimum Requirement.**
The following minimum requirements are deemed necessary to be a Project Manager.
 - a. **Education:** A baccalaureate degree from an EAC-ABET accredited program. A master's degree in engineering or an MBA is desirable but not mandatory.
 - b. **Licensure:** Licensure as a Professional Engineer in the jurisdiction in which the project is situated.
 - c. **Experience:** A minimum of four years of progressive engineering experience in addition to the four years required for licensure.

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- d. Affiliations: Membership in technical or professional societies such as NSPE, ASCE, etc. while not mandatory, is desirable as a measure of professional commitment.

2. Skills

The successful Project Manager should be skilled in several non-technical areas consisting of the following:

a. Leadership Skills

- Ability to evaluate situations and make sound decisions with regard to project administration
- Ability to make good professional judgments
- Recognize the difference between responsibility and authority
- Be able to lead by example and thus motivate team members
- Developing a professional and personal career plan.

b. Management Skills

- Time management – ability to manage both personal and team manhour requirements and integrate them into total workload.
- Ability to know where (and when) to delegate authority.
- Ability to supervise project activities, the project team and sub-consultants.
- Organizational- ability to arrange project activities/tasks in an orderly manner.
- Mentoring – The PM should be able to mentor less experienced team members to enhance team building and professional career advancement.
- Ability to prepare the project management plan and set up the project for implementation.
- Ability to implement the PM plan once prepared.

c. Communication Skills

Communication skills are probably the most important attribute to which a potential project manager can ascribe. Many firms complain that young engineering graduates lack the ability to communicate, either verbally or in writing and, accordingly, offer communication seminars for their employees. Communication skills include:

- Verbal – one-on-one, public speaking, public presentations, telephone conversations
- Writing – correspondence, reports and studies, specifications
- Listening
- Personal appearance
- Computer – E-mail, web

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3. Roles of the Project Manager

The project manager has four key roles during the execution of a project. These major roles include: Project, Marketing, Technical, and Business as will be discussed hereinafter.

a. Project Role

- Project leader – The PM is the project leader and is responsible for making all of the key decisions connected with the project. These include both technical and non-technical decisions. As the project leader, the PM decides what ought to be done to produce a quality project, on schedule, and within budget. The PM is responsible for the proper completion of all project tasks, whether done personally or by a delegated individual.
- Multi-talented/disciplined – The PM should possess a superior ability in management functions and should have a working knowledge of several engineering disciplines. This is not intended to mean that the PM be competent in all disciplines, but that he or she has the ability to know how to integrate all disciplines into the project in a properly sequenced manner.
- Empathetic – The PM should have the ability to understand the feelings, motivating factors, thoughts, goals and objectives of all members of the project team and to guide and direct these elements into a success project.

- Experienced and qualified – The PM should have experience and qualifications commensurate with the project's size, scope and magnitude. He/she should be able to direct how things will be done, who will do them and when.

b. Marketing Role

- Repeat assignments – The PM should always be cognizant of the fact that good work will usually always achieve more work. Thus, client satisfaction is an important function of project management.
- Scope creep – the PM must have the ability to recognize when project activities are drifting into areas not contemplated in the original scope of work and to inform the principal in charge for advice and direction.
- Additional and/or Special Services – The PM should be able to recognize when additional and/or special services, not in the original scope of work, are required and provide the proper justification to both the principal in charge and the client for resolution.
- Client Involvement – the PM should continually perform maintenance marketing activities by keeping the client involved both during and

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after completion of the project. Activities include: assuring the client that your firm can satisfy all of their technical needs; asking the client for new leads and for projects; requesting a letter of recommendation; follow-up with the client after the completion of a project, client participation with the firm in seminars, excellence awards, papers, etc; and maintaining social/professional relationships.

c. Technical Role

- Quality Assurance/Quality Control – The PM shall have the primary responsibility for the technical content and accuracy of all project work and shall insure QA/QC throughout the duration of the project.
- Specialize on certain project phases – one of the criteria that enter into the selection of a PM for a given project is that the project involves elements that are within the expertise or areas of discipline of the Project Manager. In these specialized areas, the PM is expected to play a major technical role.
- Monitor Deliverables – the PM has primary responsibility for the quality and timing of all project deliverables. The PM shall ensure that delivery dates are met and that no schedule “slippages” occur.
- Oversee the Projects – the PM is responsible for coordinating all work packages, tasks, and work remaining to be completed. He/she shall ensure that all work elements are integrated into the project.
- Manage sub-consultants – The PM shall manage and coordinate the work of all sub-consultants and ensure that their schedules are met and budgets not exceeded.

d. Business Role

The project manager’s business role includes three main elements, which are:

- Client Management
- Financial Management
- Project Administration/Communications

The effectiveness of the PM in fulfilling these roles determines, to a great degree, the profitability of the PM’s firm and is a measure of the PM’s value to the firm.

III. Planning the Project

A. Project Management Plan

Every project, regardless of size, should have a written project plan prepared by the project manager and shared with project team members, including consultants. The plan should be drafted, discussed, and redefined before any other significant work is done or resources expended on the project. If the project was generated as a result of a qualifications based selection following an RFQ/RFP process, the project plan, including developing the scope, developing tasks and work breakdown structure, can be drafted by expanding upon the “Technical Approach to the Project” that would have been included in the RFP. After the project manager completes the draft project plan, he or she should invite all key members of the project team, including consultants, to a “kickoff” meeting. This working meeting should focus on understanding, refining, and committing to the project plan. Any revisions or refinements to the draft plan should be made at this meeting. Soon after the “kickoff” meeting, each key team member should receive the revised project plan plus other pertinent documentation of the meeting as may be appropriate. As the project proceeds, the project manager should update the plan and keep the team informed of the project status.

B. Project Plan Format

The project plan should provide a disciplined approach to addressing the breadth and depth of project activities that will occur. Most experienced project managers will develop project plans based on their experience on previous projects which were similar in nature to the current one for which the plan is being developed. A representative outline for a project plan includes the following components:

1. **Scope.** The project scope describes, in detail, exactly what the project entails in terms of what work is to be performed, i.e. an expansion and upgrade of an existing wastewater treatment facility, four laning an existing two lane road, etc. The description can be in either narrative or graphic form (bar chart, CPM, etc.) or both. On most projects, a brief scope of work is provided by the client and the project manager must provide the detailed scope. This section should identify any new or unique aspects of the project. The scope section should also contain a list of the work products or deliverables that are to be provided to the client as a result of the project.
2. **Purpose.** The project plan should explain the purpose of the project from the perspective of the client and the results that they expect to achieve. The proposal (RFP) that was submitted and the contract that was executed in the process of securing the project should be reviewed to ensure that the salient features of each document are incorporated into the project plan.

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3. **Approach.** The approach to the project will usually have been described in the technical approach section of the RFP. Using the approach, the techniques and tools to be used on the project can be identified. If new methodologies will be needed, how they might be obtained or developed should be investigated. The approach needs to be in sufficient detail to accurately estimate the manhours that will be required for each project task.
4. **Schedule.** The time schedule for each project task and for the entire project should be developed using one or more of the project time management methods which will be presented in Section 5 of this course. If a detailed schedule is not feasible in the early stages of a project, identify milestones by name and date. This might be applicable on a phased project where Phase I is to investigate design alternatives and Phase II is to design the selected alternative. However, two separate project plans might be preferred even for this scenario.
5. **Budget.** Once a time schedule has been determined for each task, the project budget can be established. On most projects a lump sum fee will have been established by assigning manhours for the various categories of personnel to the individual work tasks and applying the respective hourly rates and mark-up for overhead and profit. This will be a lump sum contract fee which will not change unless the project scope is expanded (or reduced). Accordingly, the budget presented in the project plan is simply a “tweaking” of the previously developed contract price. Many times a project manager, in preparing a project plan, will reduce all estimated manhours by a factor (say 10%) to provide a “cushion” for contingencies. Thus, a PM will have some leeway in controlling scope “creep” and the team will have an incentive to complete tasks at the reduced manhour level (even though they have no knowledge of the reduction).
6. **AQ/AC Plan.** Quality Assurance – Quality Control has previously been mentioned as one of the most prominent project management challenges. The project plan should state at exactly what stages of the project quality reviews are to be made and which team member will make them.
7. **Project Team.** Prepare an organization chart (staffing plan) showing each member of the project team and their relationship to other team members. Each person’s task(s), responsibility, and authority should be described. All of this information will have been developed during the RFQ/RFP and/or contract negotiation process. It will only be necessary to expand or update the project team as necessary to include all project tasks. Finally, once the project team has been finalized, labor and expense budgets should be assigned to tasks and individuals. Microsoft Excel (Spread Sheet) software is an excellent tool for this task.
8. **Location.** The project plan should indicate where all of the project work assignments are to be completed. This would include offices of multi-office organizations, consultants’ offices, offices of other entities, including the client, sites where presentations may be made and field locations.

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C. Work Planning.

The work planning process involves four (4) basic elements, which are:

- Research
- Intelligence gathering
- Planning
- Development (Implementation)

Each of these activities is essential in meeting the established goals of time, budget and quality.

1. Planning process experience has shown that projects are typically “pulled” in three potentially conflicting directions, which are:

- Provide quality
- Meet schedule
- Stay within budget

The purpose of the project plan is to provide a disciplined approach to the project that will circumvent these conflicts.

This is achieved by:

- Planning the work
- Working the plan

The process involves a plan for each phase of the project and may include any or all of the following phases depending on the size of the project:

- Initial work plan (RFP)
- Contract work plan
- Basis of design memo work plan (10%)
- Final design work plan (30%)
- Final project work plan (100%)

2. Forces influencing good planning. Often planning is influenced by forces which affect the manner in which the project plan is developed and implemented. The experienced project manager will be familiar with these potential exigencies and be able to plan for them. Forces influencing good planning include:

- a. The firm’s management. The firm’s philosophy with regard to project planning can have a great influence on the quality and content of the project plan.
- b. Other departments/offices working for the same client. Many times large firms will have more than one department and/or office working for the same client. It is important that a standardized planning process be developed

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so that the client receives the same “standard of care” from each department/office.

- c. Experience and qualifications of individuals. Obviously, these elements will vary from project team to project team and it is essential that the experience and qualifications of each project team be tailored to fit the specific needs of that project.
- d. Project team personalities. The project manager needs to be aware of the idiosyncrasies of the individual team members to ensure that the team members can function as a group.
- e. Project sub-consultants. They can have an effect on the planning process to the extent that they have worked on previous projects with the firm and are familiar with the procedures that are required or they have not previously worked with the firm. In the latter instance, a greater planning effort will be usually be required.
- f. Approval agencies. Knowledge of the agencies that will have to approve and/or permit the project is critical to the ultimate implementation of the project. These agencies will have a great influence on project planning in such areas as schedule, budget and scope.

IV. Project Management Software

A. Introduction

In recent years, project management software has been developed that will enable the project manager to plan, monitor, and control projects and to create professional graphics and reports utilizing computers. The software is appropriate, especially if the CPM or any other network methods are to be used. On even a small project, a large amount of manual effort would be required to create a network, apply the CPM, and then periodically update the network and the critical path during the project.

A survey of project managers randomly selected from the membership of the Project Management Institute, conducted in 1998, found that Microsoft Project is by far the most frequently used computerized project management tool. ACEC, in a subsequent survey in 1999, confirmed that finding. Primavera Project software was a distant second place and the third most frequently used computerized project management tool was Microsoft Excel, a general purpose software product. Based on research conducted to date, it appears that project managers use all of the project management tools for essentially the same basic functions: planning, scheduling, tracking and controlling their projects. They also use the tools to varying degrees for budgeting and analysis.

B. Benefits of computerized project management.

The use of computerized project management tools enables project managers to manage and administrate projects far beyond their written or verbal capability. The benefits include:

1. Creating project schedules efficiently
 - Basic project planning
 - Creating and viewing GANTT, PERT and calendar charts
 - Creating schedules
 - Manipulating tasks
2. Increased cost control
 - Working with resources
 - Assigning costs to tasks and resources
 - Cost control for the PM: handling the overall project budget
 - Cost control for the Consultant: controlling design team costs
 - Cost control for the Contractor: labor, plant and material costs
3. Monitor and control the project
 - Identifying the critical path and slack time
 - Creating baseline and tracking progress
 - Adjusting resource allocations
 - Changing working time and calendars
 - Working with time-phased “task” fields

V. Creating Schedules

A. Constraints

Each project has constraints that create scheduling roadblocks. An experienced project manager will recognize these situations and plan the work so as to overcome or mitigate their impact. While there are many situations that can influence project schedules, some of the more common ones are discussed hereinafter.

1. Arbitrary changes to the project scope by higher authorities. Many times, a client will decide to expand (or contract) the work and issue a change order to effect the modification. Changes in project scope will always affect the schedule and require staffing and manhour adjustments to the project team.
2. Partial or full utilization. Will the project team be totally dedicated to the project or will the skills of some team members be required on other projects as well? If some team members are to be partially utilized, it is important that they be integrated into the project schedule at the exact time their expertise will be needed.
3. Labor requirements versus labor pool. Is the firm's labor pool sufficient to accommodate the manhours required for the project? If not, the project manager needs to consider outsourcing some of the work, authorizing overtime or adjusting the schedule commensurate with the available labor.
4. Other projects and client priorities. Many times another project will surface or a client's needs intensify to the extent that project schedules need to be adjusted. Just as the projects on which the firm is engaged need to be prioritized so do the staffing and manhour allocations for a particular project need to be altered.
5. Client and regulatory review and approvals. This is probably the single biggest constraint that can affect a project schedule. When preparing a project schedule it is often difficult to predict just how long it will take for jurisdictional agencies to review and approve a project. Here again, an experienced project manager will be high up on the learning curve and be able to more closely predict approval and permitting times. He or she also is likely to have a good rapport with the jurisdictional agencies and be able to gain early reviews (and approvals).

B. Benefits

Good project scheduling results in many benefits to the firm, including:

- Increased efficiency. A project that is properly scheduled will be produced more efficiently, since there is no wasted effort and time.
- Provides a measurement tool. A properly scheduled project provides management with a good measurement of resources for use on future projects of a similar nature.

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- Improved quality. It is a proven fact that good scheduling improves project quality by avoiding duplication of effort, redundancy of activities and multiple levels of management.
- Improved client satisfaction. Clients are always pleased when schedules are met or shortened. Many times this will lead to future work assignments.
- Increased profit. This is directly related to increased efficiency. A project completed within or under budget will result in greater profits for the firm and recognition (sometimes in the form of dollars) for the project manager.

C. Time Management Methods

Three different project time management methods are recognized as being acceptable project scheduling techniques. They range from simple to moderately complex and the project manager should utilize the technique most appropriate to the project situation. Generally, projects of significant scope, magnitude and complexity will require more sophisticated scheduling techniques. The three methods are:

- Chronological list
- Gantt (bar) chart
- Critical Path Method (CPM)

1. Chronological list.

This two-step method is by far the simplest project time management technique. First, the tasks that need to be accomplished are listed in approximate chronological order and second, estimated times required for each task are listed. The most obvious positive aspect of this method is its simplicity. A major disadvantage of the chronological listing method, particular for projects with many tasks that overlap each other, is that the interrelations among tasks are not shown, nor is the extent to which tasks overlap. However, for relatively simple projects, the chronological listing method is often adequate and the most appropriate project time management method.

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2. Gantt (Bar) Chart

The Gantt or bar chart project time management method provides a means of showing task overlap and a graph of the project where tasks are listed on the y-axis and elapsed time on the x-axis. Four steps are involved in the preparation of a bar chart, the first two of which are identical to those in the chronological list method. The third step is to estimate the start time for each task and the fourth step is to draw the bar chart. Figure 5-1 is an example bar chart.

An advantage of the bar chart is its graphical nature, which aids the understanding of various users. A second advantage is that the chart depicts task-overlap which aids the project manager in assigning resources.

A major disadvantage of the bar chart method is that actual interrelationships between individual tasks are not shown and therefore, critical tasks cannot be identified.

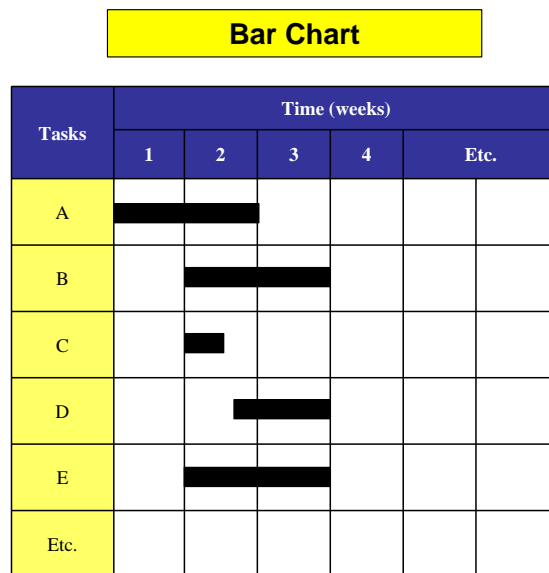


Figure 5-1

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3. Critical Path Method (CPM)

As previously mentioned, while bar charts display overlap among project tasks, they do not show all interrelationships, nor do they identify critical tasks. The Critical Path Method, which was developed in 1956 by the E. I. DuPont Company, does not have these deficiencies. CPM is widely used in planning and managing both design and construction projects in the construction industry. A CPM diagram is shown in Figure 5-2.

CPM application consists of the following five steps:

- a. List tasks that comprise the project. Keep tasks small and, when in doubt, partition them further. Tasks can be reaggregated later, if appropriate.
- b. Estimate elapsed time for each task. Select the appropriate time units, such as workdays, calendar days, etc.
- c. Identify interrelationships among tasks i.e. which tasks must be completed before others can be started.
- d. Draw the network. A network is two or more nodes – representing tasks – connected by directional branches.
- e. Determine critical path and minimum project completion time. The critical path is that sequence of tasks that cannot be delayed if the project is to be completed in a minimal amount of time

Persons using CPM on a regular basis will soon become familiar with the terminologies used in its application, such as: earliest start/finish time, latest start/finish time/ duration, float time, etc. Computer software programs are usually used in preparing a CPM network for a project. These are particularly useful in updating a critical path analysis during the course of the project.

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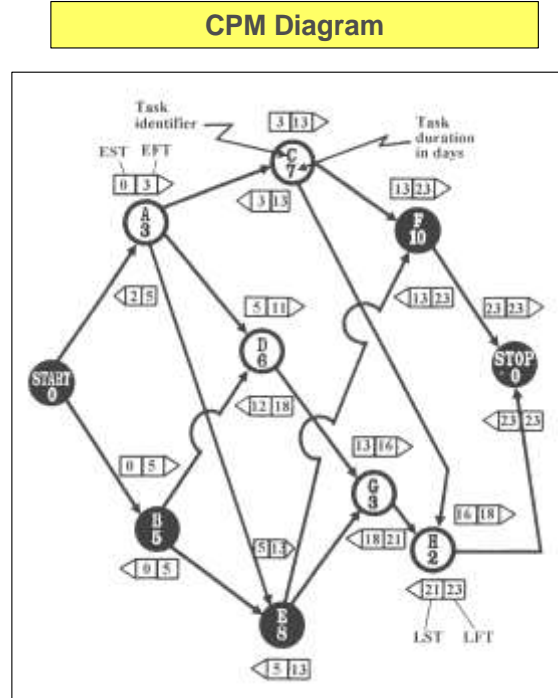


Figure 5-2

4. Summary

The principal value of all three project time management methods presented above is that they require that the project be done on paper before it is done in reality. Project time management methods steer project managers away from thinking that activity is progress. A good project manager works out the project map and then begins the project journey. To just start the journey often results in a decrease in efficiency and profits and a reduction in quality.

D. Managing the Scheduling Process

A successful project manager knows how to manage the scheduling process because that is the key to project profitability. Some steps that a project manager can take to achieve scheduling goals include:

- Be a proactive manager – take the initiative in accomplishing every project task and assume an active interest in all project activities.

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- Sequence a flow chart – always be cognizant of the order of project activities. Know what has to be done and when it needs to be accomplished and by whom. Maintain project continuity.
- Determine the critical path of all project activities.
- Follow up and take corrective action. Be able to recognize if a project is becoming “troubled” and take whatever action that may be necessary to develop a recovery plan.
- Avoid common scheduling mistakes by:
 - Allowing ample time for QA/QC
 - Being aware of the firm’s total workload
 - Avoiding poor sub-consultant management
 - Eliminating the team’s workplace barriers
 - Allowing no schedule slippage
 - Knowing how to manage the construction schedule

E. Overcoming Schedule Problems

A recent survey of senior project managers reported that the most challenging aspect of their job was meeting schedules/budgets. There are several ways of addressing schedule problems which include the following:

- Provide a realistic schedule – one that is doable. An unrealistic schedule will only frustrate team members and lower morale.
- Frequently publish the schedule for the team so that they are continually aware of project status.
- Provide early/late start and stop dates as targets for the team to meet.
- Hire schedule-driven sub-consultants and make them aware of your expectations with regard to the project schedule.
- Be cognizant of the work group’s total workload. Often, team members have other work commitments which also have schedule requirements. Be sure that manpower resources are sufficient to meet all man-loading requirements.
- Communicate manpower staffing requirements to the principal-in-charge and/or upper level management.
- Provide ongoing project QA/QC so that errors and/or omissions do not tend to “multiply”.
- Stay focused throughout the duration of the project. Eliminate distractions.

VII. Budgeting Projects

A. Issues

There are many issues connected with project budgeting which affect a firm's business philosophy and its position in the marketplace. These issues include:

1. Firm objectives. What are the firm's objectives with regard to a project or a category of projects, i.e. wastewater treatment, water supply, bridges, etc.? If the firm desires to focus on a particular project (or category) their project budgeting should be competitive in nature.
2. Cost for the project is fixed. Sometimes a client will have established a fixed cost (budget) for a project. In this instance the question becomes: Can the firm produce the work within the allowable budget?
3. Firm's cost structure compared to that of competition. Are the firm's competing for the project generally within the pricing structure of our firm? If not, do we still want to compete for the work?
4. Message and/or image. Does the firm want to impart a particular image or send a message in connection with a specific price proposal (budget)? If so, the budget needs to reflect the message/image intended.
5. Current and projected mixes of work, fees, and profits. Are these somewhat balanced throughout the firm? If an imbalance exists, will this project exacerbate the situation?
6. Flexibility of pricing environment. Is the pricing marked rigid or is there some "wiggle" room on pricing?
7. Cost to produce this specific job in terms of salary and overhead. Does the project require special skills where higher than usual salaries will apply or where higher than usual overhead costs be encountered?
8. Follow-up service. Will products be specified where, due to their life cycle curve, follow-up professional services will be necessary? If so, are these costs reflected in the budget?
9. Marketing cost. How much did it cost to secure this project? If a standard amount of effort was required it would normally be covered in the firm's overhead rate. However, if an extraordinary amount of effort was required, the cost may want to be recovered as a "soft" cost in the budget.

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10. Can a loss on this job be sustained? Is the job important enough in terms of corporate image, message sending, etc. to undertake if at a break even (no profit) or even a loss?
11. Are there economic or other factors that might affect production, completion, or our payment on this job?
12. How sophisticated is the client? If we are dealing with a knowledgeable client, the cost of client liaison should be minimal. If a great deal of client “hand- holding” is required, the project should be budgeted (priced) accordingly.
13. How much will raising or lowering price affect demand for our services by this client? How important is price on this job to this client?
14. Can other firms in the area immediately offer the same service to this client?
15. How will raising or lowering price affect profitability and the firm’s “bottom line”?
16. What promotional strategies can be used to redefine this service to create a competitive advantage?
17. What are the time requirements for the project? Does the firm have the resources to staff the project or will outsourcing be required?
18. Is this service essential in order to secure future work? Many times a yes answer to this question will affect project pricing.
19. Where is the project located in relation to the work center that will produce the design? If the project is in a remote locale, appropriate allowances should be made for travel, site visits, etc.
20. Are we providing a special or unique expertise for this project for which compensation should be increased?

B. Why do we need a budget?

Budgets for planning, design and other projects typically performed by consulting firms are usually prepared as part of the process of negotiation between the firm and the client, owner or customer. The contract or agreement between the consulting firm and the client or owner typically “locks in” the contract amount, which has been derived based on the budget prepared by the consulting firm. Budgets are necessary for the following reasons:

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- Clients require a budget because it forms the basis for the contract price in the agreement.
- It is the project manager and team members' road map. By cross checking budgeted person hours versus actual the PM and the team can get an accurate picture of both project progress and profitability.
- It is a measure of project success.
- Consulting is, first and foremost, a business and budgeting is an important element of any business.

C. Budgeting – a team effort

While the project manager is responsible for preparing the project budget, input is required from many project participants, including: individual project team members, discipline and department managers, sub-consultants, other offices or specialties which may be involved, and clients. The PM needs to ensure that all project elements and activities are included in the final project budget.

D. Elements of a project budget

The following components comprise a project budget:

1. Direct labor – This is the raw labor cost which is the actual hourly rates paid to the various categories of personnel times the actual hours they will work on the project.
2. Benefits – also known as fringe benefits which include vacation time, sick leave, holidays, seminars, etc. Depending upon a firm's personnel policies, this will usually amount to a factor of 10% to 12% of salary costs. Often fringe benefits are included in the overhead factor.
3. Overhead – Includes all costs other than direct labor costs such as: non-chargeable salary costs, marketing, principals of the firm, etc., payroll costs such as social security, unemployment insurance, workers compensation, insurance such as employee health insurance, professional liability insurance and general office insurance, rent, utilities, telephone, entertainment, etc. Overhead costs generally range from 140 to 160 percent of direct labor costs.
4. Direct reimbursables – These costs include the cost of extraordinary travel, printing, copying, etc.
5. Sub-consultant costs – These are costs billed to the client and paid directly to sub-consultants on the project such as: geotechnical, environmental, specialty professionals, etc.
6. Contingency – This is seldom used in structuring a fee proposal unless the base contract might result in some contingent project activities.

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7. Profit – This is the financial gain that the firm expects to receive on this project. Typical profit percentages range from 8 to 15 percent of project costs. A typical project budget will be presented in Section VII of this course.

E. Establishing a Budget

There are certain fundamental steps required when establishing a project budget. An experienced project manager will:

1. Research previous projects which are similar in nature to the one for which a budget is being prepared.
2. Discuss and clarify the owner's scope of work. Have a thorough understanding of exactly what is required, the time constraints and any special conditions.
3. Review past project budgets. Ascertain if actual costs were over or under budget and, if so, the reason for the overage (or surplus).
4. Discuss the project with experienced PMs in the office to obtain their view of the project.
5. Review team members' estimates
6. Know your sub-consultants and, hopefully, have experience in working with them on previous projects.
7. Study your firm's production history. Know what to expect in terms of allocation of resources and effort.

F. Overcoming budget problems

As previously mentioned, a recent survey of senior project managers by the Project Management Institute revealed that the biggest PM challenge was meeting schedules and budgets. There are several proven methods to overcome budget problems which are discussed hereinafter:

1. Use zero-based budgeting – Evaluate each proposed item (task) on its merits with regard to the project at hand without considering any previous project budget.
2. View the budget from the perspective of both beneath and beyond an indicated price.

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3. Provide a budget for both profit and contingency. In other words, be prepared for unforeseen occurrences during the project.
4. Communicate the budget to all team participants to make them aware of budget targets and expectations.
5. Use highly motivated personnel who have a proven record of performance.
6. Challenge average employees to achieve a superior performance. Merit bonuses are an excellent way to motivate employees.
7. Understand that “S” expenditure curve which measures job costs versus elapsed time. Always keep the actual curve below the curve which was projected at the beginning of the project.
8. Avoid commodity clients – clients who are just looking for the cheapest price without regard for technical competence and expertise.
9. Recommend getting rid of poor clients – or ones that do not understand the value of professional service and who do not pay promptly. The firm can spend a great deal of time and resources on this type of client and achieve little or no return.

VII. Project Accounting

Consulting engineering firms generate most of their revenue by selling time as opposed to selling products – offering services rather than producing goods. Although it may not be their only reasons for existence, consulting firms must make a profit. Discussion in this Section will be limited to project accounting, since that is the primary factor which determines profitability and the basis on which consulting firms operate.

A. Profitability Factors

Certain factors critical to the profitability of a consulting firm are time utilization rate and expense ratio.

- U = Utilization Rate (Chargeable Rate or Billable Rate) is the amount of time (converted to dollars) actually charged to clients for work on projects divided by the total time (converted to dollars (P) including non-chargeable time. U is always less than 1.0 because not everyone can be working on client projects 100% of the time.
- R = Expense ratio is the non-salary costs of a business that are not billed directly to clients (Social Security, insurance, rent, utilities, etc.) divided by the total payroll cost (P) as described under “U” above. $R = S/P$.

The preceding terms will be defined further including why they are critical to the profitability of a consulting firm and who in the organization has primary control over U and R. Obviously, raising U and decreasing R should increase profitability.

Table 7-1 reflects an income statement for a hypothetical consulting firm and will be used to describe the terms commonly used in the industry.

Table 7-1
Year to Date

| Year to Date | |
|----------------------------|-------------|
| Total Revenues | \$1,800,000 |
| Less reimbursable expenses | 100,000 |
| Less outside consultants | 500,000 |
| Net revenues | 1,200,000 |
| Less direct labor (P – P') | 400,000 |
| Less nonreimbursables | 10,000 |
| Gross Income | 790,000 |
| Less overhead (S – P') | 600,000 |
| Net income before taxes | \$190,000 |

Pre-tax profit as a % of net revenue = 15.8%

Overhead ratio = $O = (S+P')/(P-P') = 600,000/400,000 = 1.5$

Multiplier = $M = 1,200,000/400,000 = 3.0$

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A review of each line item follows:

- Total Revenues – money paid to or due to the consulting firm
- Reimbursable Expenses – expenses such as printing, travel, etc. billed to the client and paid to or due to the consulting firm.
- Outside consultants – similar to reimbursable expenses
- Net Revenues – revenues generated by in-house staff
- Direct labor – raw labor cost charged to projects
- Non-reimbursables – expenses incurred as a result of projects, but for some reason, are not billable to the client. Many times these occur because the project manager forgot to include them in the fee proposal. Permitting application fees are a good example.
- Gross Income – income after project expenses are accounted for, but before overhead.
- Overhead – overhead = $S + P'$ where S is non-salary costs not billed to the client such as Social Security, insurance (worker's compensation, unemployment insurance, professional liability insurance, liability insurance, etc.) rent, utilities, telephone, entertainment, etc. and P' is the sum of all salaries and hourly pay not billable to clients such as vacation, sick time, holidays and non-chargeable salaries such as for office staff, marketing, corporate office, etc. overhead ratio = $O = \text{overhead/direct labor cost} = (S + P')/(P - P')$. The overhead ratio is “burden” on direct labor which has to be “marked-up” to recover overhead.
- Net Income Before Taxes – this represents profit. In most consulting firms profit will range from 10-15 percent of net revenues.

B. Sensitivity Analyses

Profitability is sensitive to overhead. Referring to Table 7-1, assume overhead increases 10 percent from \$600,000 to \$660,000. Then pre-tax profit drops \$60,000 or 31.6%! Overhead increases go directly, dollar for dollar, to and come off of the “bottom line”.

From the previous discussion of “overhead” we found that $O = (S + P')/(P - P')$. Following derivation we get $O = (1 + R - U)/(U)$. Figure 7-1 shows the relationship between O , U and R . Consulting engineering firms tend to operate centered around $U = 0.600$, $R = 0.500$, and $O = 1.500$. These three typical values exactly satisfy the above equation.

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O, U, & R Relationship

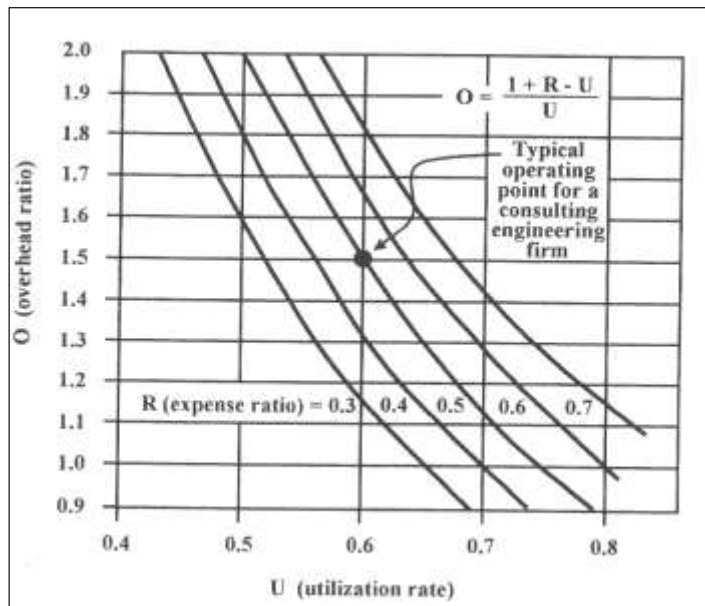


Figure 7-1

Using the chart we can see how O is affected by U and R. For example, assume R remains constant, but U drops one percentage point from 0.60 to 0.59 (a 1.7% drop). This will result in a rather large ($\pm 4.0\%$) increase in O.

Note how this affects the profit of the firm where income statement is shown in Table 7-1.

- O increases from 1.500 to 1.542 (2.8%)
- Then overhead increases from \$600,000 to \$616,800 or \$16,800.
- Pre-tax profit drops by \$16,800 from \$190,000 to \$173,200 an 8.8 percent decrease
- Thus, a 1.7 percent decrease (1 percentage point) in U causes an 8.8 percent decrease in pre-tax profit – about five to one!

A similar example where R increases by one percentage point (50 to 51 percent) will also result in an increase in O, but not as drastically as for an increase in R.

The personal, project and organizational management implications of the impact of time utilization rate and expense ratio are these:

- Top managers should monitor R, the expense ratio, very closely since they control most of it.

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- Top managers and all staff control U by virtue of the time accounted for on each employees' time sheet. Time utilization is usually tracked on a bi-weekly basis for the entire organization to the nearest 0.25 hours. All time legitimately worked on projects must be charged to appropriate job numbers assigned to client's jobs.

In summary, consulting firms must be profitable. The income statement show profit and factors leading to it. Overhead goes to the bottom line where it impacts profit. The absolute value of overhead is determined by the overhead ratio, which is a function of the utilization rate and the expense ratio. A slight increase in U or decrease in R will cause a significant increase in profit with profit being more sensitive to U than R.

C. The Multiplier

“Multiplier” is a common term in the consulting industry and is one measure of a firm's efficiency. Multiplier can be defined as the net revenues divided by the direct cost of labor (chargeable cost) used to produce the revenues. Referring, again, to Table 7-1, the multiplier for the hypothetical firm is 3.0. (Net revenues of \$1,200,000 divided by direct labor cost of \$400,000). The multiplier is the factor that the salaries charged to projects must be marked-up to cover total salaries, overhead, taxes and profit. In other words, the consulting firm buys labor wholesale at the raw labor rate and sells it to clients retail, at the marked-up or multiplied rate.

The multiplier is one measure of cost competitiveness between consulting firms. Assuming a particular project requires a relative fixed number of hours and that raw salaries are similar between firms, the smaller the multiplier of a given firm the less charge to the client and the more cost-competitive the firm will be. Most consulting firms try to keep their multiplier as low as possible, but, in today's marketplace, with the increasing cost of overhead items such as professional liability insurance and healthcare (medical) insurance, it is very difficult to reduce the multiplier. Thus, while it is difficult to reduce overhead by decreasing the expense ratio (R), overhead costs may be reduced through improved utilization of time and personnel (U). Of course, another way to reduce the multiplier is to reduce the profit expectation. Since this impacts the bottom line of the income statement, most firms are reluctant to take this action and simply try to stay “lean and mean” insofar as overhead costs are concerned.

D. Summary

This Section has presented the project accounting tools necessary for the project manager to monitor, control and administer a design project as will be discussed in Section 11 of this course. It should be noted that there are numerous computer software programs, such as WIND 2, which are specifically tailored for the architect-engineer-planner industry. Most all of the consulting engineering firms utilize these programs for their financial operations. Data provided includes income and expense statements, job cost summary data for each project and even tax-filing data. Most firms will obtain this data monthly, but more frequent distribution can be made, if desired.

VIII. Quality

A. Definition

Quality in engineering is a measure of how well engineering services meet the client's needs and conform to governing criteria and current practice standards. The usefulness of this definition is that it stresses the concept of "meeting requirements" rather than opulence or superiority. For example, if a sheet metal shed is used to house a pump station, in lieu of a reinforced concrete enclosure, it may be a quality project if it meets the expectations and requirements of the principal participants. It should also be noted that quality does not mean perfection. Perfection is not expected of the technical professional. However, the professional and his or her organization are obligated to exercise ordinary professional skill and diligence and to conform to accepted industry standards. This is often referred to as "the standard of care."

B. Stakeholders

If "meeting requirements" is included in the definition of quality, the logical question is "whose requirements"? This gives rise to the notion of stakeholders.

"A stakeholder is an individual or organization having a significant interest in the results of another individual's or organization's actions and activities." An engineering organization is likely to have many and varied stakeholders including: stockholders, employees, internal units, clients/customers, public at large, host community, and other independent units. See Figure 8-1. The functioning and overall satisfaction of an engineering organization's stakeholders is critical to that organization's success. The organization's planning process should include identification of its stakeholders and focus on developing mutually beneficial relationships with the stakeholders that are crucial to its mission.

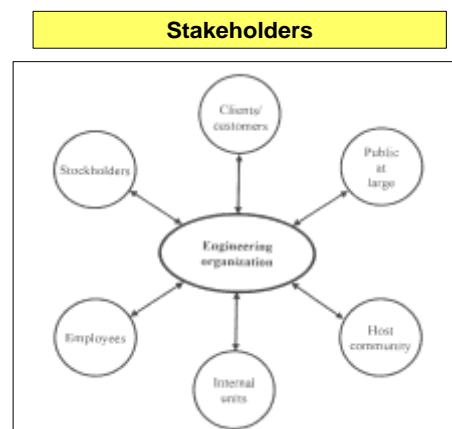


Figure 8-1

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C. Delivering Project Quality

In Section 1, maintaining quality assurance and quality control (QA – QC) was mentioned as being one of the biggest and most prominent project management challenges. In Section 2, it was stated that one of the technical roles of the PM was primary responsibility for QA – QC. Section 3 included a section on “The Project Plan” which covered the QA – QC Plan. Practically all A/E firms have established guidelines for developing and implementing an effective QA – QC program.

Delivering project quality involves the following principles:

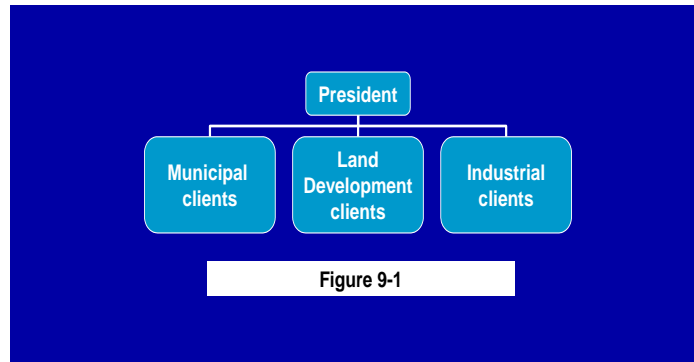
- Continuous improvement in every process for planning, production and service.
- Total employee involvement in every aspect of the project.
- Concentration on prevention, not correction. Cease dependence on mass inspection. Quality comes not from inspection, but from improvement of the production process.
- Enhance firm – client relationship. Continually stress the value of quality to the client and the fact that price should not be the only consideration.
- Client satisfaction. Establish a constancy of purpose that declares to the client the firm’s intention of staying in business by providing a professional service that will improve the quality of life and have a market.
- Implement problem-solving teams. Teams made up of professionals in design, engineering, production, and marketing can contribute to improving product, service, and quality.
- Continuously review and improve the procedures which have been established for the firm’s QA – QC program.
- Measure the success of the firm’s QA – QC program on a regular basis. The following metrics might be used:
 - Percent of projects completed early, on-time, and late
 - Percent of projects completed under and over budget
 - Number and/or dollar amount of liability claims
 - Expense ratios and project multipliers
- Recognition. Recognize individuals and/or project teams when quality objectives have been met and project delivery has been on-time and within budget.

IX. Client Relations

A. Organizational Structure

Organizational structure can be defined as the formal system of working relationships that both divide and coordinate the tasks of multiple people in groups to serve a common purpose. Of the four basic organizational structures: functional, regional, client, and matrix, only the client organizational structure will be briefly discussed in this section.

The client structure, which is the choice of organizational structure for many consulting firms, is illustrated in Figure 9-1. As evidenced, it is most responsive to client types or categories.



At its highest level, the organization is partitioned to reflect its various clients – in this case municipal, land development, and industrial clients. The structure of the organization explicitly focuses the professional and support staff on clients. A functional or regional structure may be used at secondary and lower levels. A variation on the client-based structure is establishment of a temporary office in or near a client’s office to effectively carry out a major engineering project. This strategy may result, during or after completion of the project, in establishment of a new regional office. The principal advantage of the client-based organization is the excellent potential it offers for meeting the needs of the client.

B. The Client Relationship

At the conclusion of Section I the products of effective project management were listed. Of the nine points which were presented, five of these mentioned “clients”. Clients are obviously vital to a firm’s existence and the manner in which the firm deals with clients is extremely important. A typical firm’s marketing effort may be broken down as follows:

| | |
|--------------------|-----|
| Client maintenance | 85% |
| Replacement | 15% |
| New Growth | 10% |

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Total

110%

The client maintenance, or 85% segment, is the portion in which the project manager has a significant role. It is the project manager and/or the principal in charge who maintains client relationships and communicates with the client on a regular basis.

Effective ways to maintain good client relationships include the following:

- Complete each assignment on schedule and within budget and achieve a quality product.
- Communication. Maintain frequent and regular communication with the clients to inform them of project status and any unforeseen problems. While this can often be done verbally, it is good practice to follow up in writing in order to produce a project record. Normally, periodic invoices for payment should also be accompanied by a written progress report.
- Client Recommendations. One of the most effective ways to secure new work (clients) is to be referred by an existing client. Constantly seek to maintain client relations in a manner that will encourage referrals. Also, if a project has been completed to the client's complete satisfaction, do not be afraid to ask for a letter of recommendation.
- Client Diplomacy. Also remember that you, as the client's consultant, are acting as the client's principal. Many times, the information and discussion between the client and the consultant are privileged and not meant to be disclosed to the general public or the media. If you are in doubt about releasing information, consult with the client first.
- Negotiation. Usually, at some point in every project, it will be necessary for the project manager to negotiate professional fees, scope of work, schedules, additional work, etc. with the client. The PM should learn good negotiation skills and develop good negotiation techniques.

X. Contracts

A. Overview

A contract is an agreement between two or more parties to do something. They are formally set forth in writing and enforceable by law. Contracts for professional services are usually between a consulting firm and an owner or client in which the consulting firm agrees to provide certain professional services within a stipulated time and the owner/client agrees to compensate the consulting firm a specified amount. All of the terms and conditions of service are included in the contract documents.

Generally, consulting firms are involved in contracts with three categories of clients, which are:

- Governmental clients including local governments (city and county), state government and federal government. Included in this category is work for government agencies and bureaus.
- Clients in industry such as manufacturing, chemical, petroleum, processing, etc.
- Private sector clients such as developers, builders and entrepreneurs.

Many consulting firms have their own contract forms which they have prepared with the assistance of their attorney. Also available are standard printed contract forms produced by the Engineers' Joint Contract Document Committee (EJCDC) and the American Institute of Architects (AIA). In reality, most consulting firms who sign contracts for professional services will do so on contract forms prepared by the client/owner. For example, virtually all governmental clients including city, county, state and federal governments have their own contract forms. Similarly, many industrial clients utilize their own contract documents. Many consulting firms will be familiar with these documents as a result of previous work assignments with these entities. When signing a contract for professional services using documents with which they are unfamiliar, the consulting firm should always have the documents reviewed by their legal counsel and obtain an opinion on the extent of liability that they are incurring. Sometimes negotiations with the client can amend contract provisions in order to mitigate liability.

The consulting firm should be aware that the signing of any contract for professional services with an owner/client results in certain risks to the firm. Most firms try to minimize these risks by obtaining professional liability (errors and/or omissions) insurance and by adopting preventive practices which will be discussed hereinafter. Firms doing business in the governmental or industrial sectors will be required to carry certain minimum amounts and coverages of professional liability insurance as a condition of employment by these entities.

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B. Preventive practices

All consulting firms should establish and adhere to programs to minimize liability, particularly that incurred as a result of negligence. The following are suggestions for reducing the liability exposure of a firm.

1. Incorporate practice either as a straight incorporation or as a limited liability corporation (LLC). Incorporation places a legal barrier between the firm's principals and the mask of legal liability.
2. Limit practice to "safer" disciplines. Avoid high litigation potential areas of service such as hazardous waste, geotechnical, structural designs, and construction inspection. Consider sub-contracting areas of service having higher litigation potential. It should be noted that some firms see higher litigation potential areas of service as an opportunity to increase profits because of the greater risks involved.
3. Set up separate corporations for areas of service having higher litigation potential. This protects the parent or main corporation.
4. Maintain currency and competence of all professional and technical support personnel by establishing both formal and informal continuing education programs.
5. Use standard or "known" contract forms whenever possible. Have non-standard contract forms reviewed by legal counsel.
6. Utilize tested legal language in contracts and agreements. Avoid words and/or phrases which can lead to contract conflict or worse.
7. Develop, maintain, and use written guidelines for both technical and non-technical areas of operation. In addition to reducing the likelihood of negligence, the use of written guidelines will be helpful in defending against claims of negligence.
8. Document everything such as meetings, telephone calls, field inspections, and conversations. Supplement written documentation with photographs, videotape, sketches, etc.
9. Accept primary responsibility for use of computer programs and models and for their correctness and appropriateness of use.
10. Separate facts and opinions when preparing letters, memoranda, reports, and other forms of documentation.
11. Employ only sub-consultants that maintain liability (both general and professional) insurance.

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12. Promptly respond to requests for information or decisions from clients, sub-consultants and other parties involved in project matters.
13. Limit project comments to knowledgeable persons – in most cases either the project manager or the principal-in-charge.
14. Avoid having a financial interest in a project.
15. Use peer review. As an alternative, the use of team building or a partnering approach might be more productive.
16. Accomplish projects/tasks correctly initially. To have to redo work is not only counter productive and more error prone, but also profit eroding.
17. Sign reports in corporate name only.
18. Constantly communicate with the client/customer. Once a project is underway, ongoing communication, usually from the project manager, is essential. Failure to communicate sows the seeds of conflict and litigation, as liability claims records will show.
19. Place liability-limiting provisions in contracts, if possible.

XI. Monitoring and Controlling

A. Executing the project work plan.

Section 3 addressed the project plan and its preparation. Once the contract has been executed and the notice to proceed given, it is up to the project manager to execute the plan. How well he or she does this will have a direct bearing on project profitability. Some guidelines have been developed to assist PM's in this endeavor and are presented herein.

1. Properly initiate the project. Start with a "kickoff" meeting to be attended by all key personnel and all sub-consultants. State exactly what is expected from all parties and the timetable for all deliverables.
2. Staff the project. Ensure that the staff that was committed to the project is not recommitted by management to another project. Also, be sure that staff is available pursuant to the schedule. For example, when, in the course of a project, the schedule calls for the structural design to commence, be sure that the staff structural engineer or structural sub-consultant is available and ready to proceed.
3. Communicate the contract and work plan to the project staff and the sub-consultants. With regard to the contract, they need to know exactly what was agreed to by and between the firm and the client/owner and, with regard to work plan, they need to know what is expected from each of them.
4. Effectively manage each phase of the project. For example, if a project consists of preliminary design, final design, bidding, and construction phases, then each phase should be managed as though it were a separate project. It is not likely that an entire project will end up profitable if one phase of the project was extremely unprofitable.
5. Produce a profit on each deliverable. This is an extension of item 4 above. Manage the project so as to make each phase (deliverable) profitable.
6. Beat the schedule for each deliverable. It stands to reason that, if a deliverable (phase) of a project is completed ten days ahead of schedule, the actual manhours expended on that phase will be less than the manhours that were budgeted.
7. Use the contingency not the budgeted profit. Some contracts may contain an amount for contingencies in addition to the stated profit. Where budget overruns occur, the project manager should first allocate them to the contingency amount before "eating into" the amount budgeted for profit.

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8. Both the client and sub-consultants are team members and they should be treated accordingly.
9. Communicate and build relationships with approval agencies. Every consultant knows how permitting can affect project schedules and completion dates. It is incumbent on the project manager, principals, and even staff of a consulting firm to establish and maintain relationships with both management and staff of the various permitting agencies. It is remarkable how much easier it is to obtain permits or rapid requests for additional information (RAI's) when a rapport between the consulting firm and the approval agencies has been established.
10. Avoid expensive closeout costs. Expensive project closeout costs occur for a variety of reasons. Often, if a project is under budget as it nears completion, staff is aware and knows that there is a "reservoir of manhours" available to which time can be charged. Some project managers, usually the inexperienced ones, have a difficult time knowing when a project is complete and they belabor final completion wanting to be sure that every "i" is dotted and "t" crossed. At some point, a project manager has to deem a project to be complete and tell everyone to "put your pencils down". If for whatever reasons project closeout costs appear to be getting excessive, the project manager must be able to recognize that fact and take whatever corrective action that may be necessary.
11. Learn how to manage project changes. An experienced project manager should be able to anticipate and even expect project changes during the project. He or she should have plans, in advance, to effect project changes for each scenario of change that might occur. Project changes need to be integrated with the base project with a minimal loss of time and effort. It is the project manager's responsibility to see that is accomplished.
12. Understand how to manage different personalities. Each team member has their own work ethic and the project manager must be able to direct that into a team effort. It is only through teamwork that the project goals with regard to quality, schedule, and profit will be met.

B. Project Administration

Project administration involves the management and direction of the non-technical aspects of the project. This is the area of activity that will most likely, determine the success or failure of the project team to meet the project goals. As discussed in Section II, it is essential for the project manager to have good communication skills and his or her development of a good communication plan is necessary in order to properly administer the project. Some suggestions for achieving effective project administration include the following:

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- Distribute the work plan to all team members and sub-consultants
- Review the contract and work plan. Cross check work items in the contract with those in the work plan to ensure that there are no omissions.
- Require good project documentation from all team members and sub-consultants.
- Conduct effective and efficient meetings
- Manage by weekly time sheets and project progress reports. Ensure that progress is commensurate with time charged to the project. Require accountability for time charged.
- Distribute weekly project-to-date reports to all applicable parties
- Periodically review project team members' performance. Evaluate strengths and weaknesses and offer constructive comments where needed

C. Client Management

In Section IX, client relationships of a general nature were discussed. This subsection focuses on client relationships of a specific nature relative to a project. Normally, this relationship is between a client and the project manager. Some precepts for successful client management are:

- Understand that the client has number one priority. It is the client who is paying the bills and, therefore, deserves the focus of attention.
- Educate the client. Most clients have been involved in engineering projects for a long time and are knowledgeable regarding project protocol. For those few clients that are not knowledgeable, it is the job of the project manager to advise them accordingly.
- Inform the client regularly regarding all aspects of the project.
- Provide services consistent with the accepted standard of care of the profession, not perfection. It is in attempting to achieve perfection that many projects go over budget and/or lead to liability claims.
- Meet the clients quality, budget and schedule expectations
- Develop professional and social relationships with the client.
- Be honest and candid. Tell the client if you are going to miss a deadline and what steps are being take to get the project back on schedule. Normally, when something goes wrong, the client is going to find out about it. So, he might as well learn about it from the project manager.

D. Financial Management

Table 11-1 represents a typical fee estimate/proposal prepared on Microsoft Excel (Spread sheet) for a hypothetical wastewater project. The hourly rates shown are the “burdened” rates which include fringe benefits, overhead, and operating margin (profit). Some firms

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will utilize the actual hourly rates for the various categories of personnel and add the mark-up for fringe benefits, overhead and profit to the bottom line. While the project manager needs to know the line item and bottom line totals in dollars, he or she is primarily concerned with the manhours for each task, since they will be checked against actual hours recorded on the time sheets to determine project status i.e. over or under budget.

(See Table 11-1 on page 44)

The financial management of a project is probably the single most important function that the project manager will undertake, since it involves two of the three goals relating to a project i.e. schedule and budget. Financial management includes the following activities.

1. Review the contract periodically to ensure that the work being performed is consistent with the scope of services contained in the contract and that all contract provisions are being satisfied.
2. Be able to identify problems related to budget and schedule which are the early signs of a “troubled project”. Gain leadership skills necessary to turn a troubled project around and develop a recovery plan for any troubled project.
3. Guard against internally driven increases in scope. (Scope creep). Well-intentioned members of the project team may expand the breadth or increase the detail of portions of the project beyond that set forth in the contract. Where scope creep is client drive, maintain a record of extra work and be able to negotiate scope creep, additional work, and special services with the client.
4. Complete work-in-process on time. Adhere to the project schedule and do not tolerate slippages.
5. Require time to be recorded daily and submitted weekly. Some firms operate on a bi-weekly basis for pay purposes and, accordingly, time sheets will be for a two-week period. There is a natural tendency for staff to not pay a great deal of attention to task and time reporting and it is up to the PM to ensure that both are accurately described and reported.
6. Understand and use the accounting software. This is probably the best tool that the project manager has to determine project status. The job cost summary sheet will provide an instant value of the project multiplier as of the date of the print out.
7. Review weekly (or bi-weekly) financial reports. Track the project budget and corresponding work progress. Compare tasks completed and milestone achieved to the project schedule. If costs incurred are moving

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ahead of the products produced or if critical tasks are or soon will be behind schedule, take corrective action immediately.

8. Have an effective budget and/or schedule correction plan. The project manager should be proactive in getting a project back “on track”. The sooner that corrective action can be taken, the more positive the outcome will be and the risk of reducing project profitability will be minimized.
9. Send invoices within three days from the end of the billing period. Remember that cash flow is the engine that drives almost everything the firm does.
10. Attempt to collect payments within 30 days. This may be difficult on projects in the governmental sector due to the approval process, but 45 days is a realistic goal.

E. Summary

In carrying out project monitoring and control functions, the project manager needs to be cognizant of the fact that he or she knows the location of and controls virtually all project activities. Accordingly, the project manager must be very organized, assertive, and positive – not passive or negative. In summary, what is essential for successful project management? Experienced project managers who were surveyed state the following:

- Communicate
- Create a clear and complete mental image of all project steps before beginning the work
- Minimize surprises and maintain intensity.

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PROJECT MANAGEMENT EXAMINATION

After you have completed answering all of the questions, go back and check your work. Make certain that you have marked only one answer for each question. There is only one correct answer to each question. Make certain that you have answered each question. Any question that is left blank will be counted as incorrect.

A score of 70% is required to complete the course. Failing to achieve a 70% score all your answers will be erased. You will have three opportunities to achieve a passing grade. Failing to score a passing grade on the third attempt will block you from further attempts and your course fee returned to you.

Once you have successfully completed exam you will be able to print out your completion certificate. We suggest you file it electronically or print it out should you be audited by your licensure board for compliance with continuing education requirements. At that time you will also be able to compare your answers to the school answers on questions you may have missed.

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1. A project delivery system that is applicable to project management is:
 - a. partnering
 - b. construction management
 - c. negotiation
 - d. construction administration

2. A project manager who has responsibility without commensurate authority with resulting lack of control is considered:
 - a. a project management challenge
 - b. a product of effective project management
 - c. is not relevant to the project management activity
 - d. a project management complaint

3. The ability to supervise project activities, the project team, and sub-consultants is considered to be:
 - a. Leadership skill
 - b. Communication skill
 - c. Management skill
 - d. Technical skill

4. The key roles that the project manager has during the execution of a project are:
 - a. project, marketing, technical, and business
 - b. project, marketing, quality control and business
 - c. project, client management, technical and financial management
 - d. project leader, client management, coordinating the work packages, business

5. A list of the work products or deliverables that are to be provided to the client as a result of the project is found in the _____ section of the project plan.
 - a. Schedule
 - b. Approach
 - c. Scope
 - d. Budget

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6. The project plan should:
 - a. consider research, intelligence gathering, planning, and development (implementation)
 - b. specifically describe how quality, schedule, and budget requirements will be met
 - c. provide a plan for each phase of the project
 - d. provide a disciplined approach to addressing the breadth and depth of project activities that will occur.

7. The benefits of using computerized project management tools include:
 - a. creating project schedules efficiently
 - b. increased cost control
 - c. efficient project monitoring and controlling
 - d. all of the above

8. The biggest constraint that can affect a project schedule is:
 - a. arbitrary changes to the project scope
 - b. client and regulatory reviews
 - c. other projects and client priorities
 - d. utilization of the project team

9. The scheduling method that identifies interrelationships among tasks is:
 - a. Program Evaluation and Review Technique (PERT)
 - b. Gantt Chart
 - c. Critical Path Method (CPM)
 - d. Bar Chart

10. _____ is not a project budgeting issue
 - a. Direct labor cost
 - b. Firm's cost structure
 - c. Flexibility of pricing environment
 - d. Time requirements for the project

11. A commodity client is considered to be:
 - a. a poor client who should be discarded
 - b. a preferred client
 - c. a client who requires a great deal of "hand holding"
 - d. a client who is looking for the cheapest price

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12. If the expense ratio of a firm remains constant and the utilization rate decreases, the overhead:
- is not affected
 - will decrease
 - may increase or decrease depending on salary costs
 - will increase
13. The expense ratio is usually monitored and controlled by:
- employees
 - principals of the firm and top managers
 - the project manager
 - all of the above
14. One measure of a firm's efficiency is:
- the utilization rate
 - the expense ratio
 - the multiplier
 - its profitability
15. One method of delivering project quality involves:
- conducting a thorough and rigorous QA-QC check at the 100% plans completion stage.
 - concentrating on prevention by improvement of the production process.
 - striving for perfection throughout the project.
 - involving the firm's stakeholders in the QA-QC process.
16. A method to minimize risks and liability involves:
- the purchase of professional liability insurance
 - adopting preventive practices
 - negotiating contracts with the client to eliminate "high liability" clauses
 - all of the above
17. The majority of a consulting firms business is derived from:
- client maintenance
 - new growth
 - replacement business
 - all of the above

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18. The entity primarily responsible for executing the project work plan is
- the principal-in-charge
 - the project team
 - the project manager
 - the client/owner
19. The single most important project function that the project manager will undertake is
- the technical management
 - the financial management
 - client management
 - project administration
20. An early sign of a "troubled" project is when
- costs incurred are moving ahead of the products produced
 - crucial tasks are or soon will be behind schedule
 - the breadth of the project is expanded beyond that set forth in the contract
 - a and b above, but not c

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