# Executive Control with Flexibility In Managing Capital Projects

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*The original paper was presented to the Project Management Institute's Annual Seminar Symposium in Toronto, Ontario, in 1982. It was written in the context of capital construction projects and its contents have not been changed. It is interesting to note the continued relevance in today's environment.*

**Abstract**

This paper identifies the special need for executive control in project work, defines project management and discusses points of difference from traditional management. The special features of project management, the project manager's personal objectives and fundamental requirements for success, are detailed. Emphasis is placed on the Project Brief and the Work Breakdown Structure. Work Packages are defined by category and essential characteristics as well as how they change through time. Also discussed are scheduling and cash management, the place of construction management and project management services under contract.

## Introduction

Project Management, as a concept, is one of the significant trends occurring in industry in response to such severe pressures as unfavorable economic factors, the inflationary spiral, the magnitude and duration of construction projects, and increased and unpredictable regulatory and environmental requirements.

It enables owners investing in capital works to maintain executive control by dealing through a single entity that assumes overall responsibility for feasibility, schematics, design, procurement, and delivery. Further, it provides the managerial unity required to achieve specific project goals within a functional organizational structure, with minimum interruption to the organization's on-going business.

This paper is intended to enlighten those who may be contemplating project management, or who may be already involved, but are not necessarily familiar with some of its key aspects. Comparison is first drawn between project management and traditional management philosophy. Features of project management are then outlined together with a number of requirements that are fundamental to its success and effectiveness.

Various typical stages in the life cycle of any project are then identified, together with the all-important executive control points between each. Particular reference is made to the 'Project Brief' which is the culmination of the feasibility phase efforts.

The means of detailed project control through a formalized work breakdown structure, and the characteristics and differing types of work packages, are described. Schedule control and cash

management are also outlined.

The paper concludes with discussion of the opportunities to save time and to further extend flexibility by means of Construction Management, and how the whole approach may be established and organized using outside resources to augment those of the owner.

**The Need for Project Management**

Project management is a particular concept of management applied to project-type work. It is a concept which is being widely promoted, although it is not always very well understood by those in need of the service, or even those involved in the many aspects of this form of management. However, as experience is gained and understanding of the concept and the many supportive management techniques improves, so do performance and support, generally. The driving forces arise from the pressure of such factors as unfavorable short-term economic conditions, risks inherent in unpredictable inflationary trends, the magnitude and duration of projects (particularly in construction), and increasing regulatory and environmental requirements, as a result of political pressures.

Such uncertainties make the project management approach particularly appropriate for owners intending to invest in significant capital works. Properly applied, project management enables an owner to maintain both executive control and open options for as long as possible to respond to external conditions.

This is achieved by dealing through a single entity, the project team, which in turn is led by an individual dedicated to the project, or to project work, and identified as the project manager. This team should be established early in the development of the project concept and be given responsibility for the complete project life cycle from feasibility; through schematics, design, procurement; to delivery and start-up. In this way, managerial unity is established early in the project, with the capability of achieving specific goals through a practical organizational structure.

Thus the owner avoids becoming intricately involved with the design and construction specialists and in the very time-consuming details necessary to create new facilities. In short, he is able to continue to concentrate on his primary business with minimum interruption to his own organization.

**Comparison with Traditional Management Philosophy**

It is important to note that Project Management, in the context considered here is a total organizational concept. It includes the coordination and direction of financial, regulatory and environmental specialists, consultants and contractors, together with the owner's and user's staff as members of a project team. It starts with identifying and developing the basic project idea and continues through feasibility, construction and commissioning.

Thus Project Management may be defined as:

The application of modern management techniques and systems to the execution of a project from start to finish in order to achieve pre-defined objectives within limits of time, budget and client satisfaction.

Project management should also be clearly distinguished from Construction Management. Construction Management refers to the direct management of the construction stage and is a valuable major technique which can be used within the project management structure outlined above. As discussed later, it may be used to advantage as an alternative to the general contractor, particularly on large projects where time savings and continued flexibility are required.

The project manager may have specialist skills but he needs to act as, and be looked upon as, the 'general practitioner'. He should bring to the job a background of experience in planning and management of similar projects, as well as general know-how in design and construction. Except for the individual specialists themselves, to whom he should be ready to refer, he should be as knowledgeable as anyone about the economic and regulatory environment, engineering technology, project planning, scheduling and cost accounting, as well as construction.

His job is to interpret the client's requirements to the specialists and direct their efforts to achieving the best combination of the project's key criteria. The key criteria are commonly recognized as scope, cost, time, and client satisfaction. This last item is sometimes overlooked, but is perhaps the most significant, since unless the project is seen to be satisfactory, it will not be recognized as such. On it, hangs the whole reputation of project management and the opportunity for follow-on business, The four criteria *inevitably* come into conflict; and judicious trade-offs with the client's approval, are constantly necessary.

**The Project Manager's Personal Objectives**

The project manager's personal objectives should therefore be to:

1. Attain the willing commitment of people to assigned tasks
2. Achieve the co-ordination and collaboration of different work groups, responsibility centers, and entire organizations, including that of the owner
3. Achieve visibility by placing a high premium on reliability and timeliness of information, and a high cost on unnecessary or irrelevant information
4. Steer the project to completion in an orderly and progressive manner.
5. Ensure that trade-offs between scope, cost and time are satisfactory and acceptable, and are seen to be so.
6. Perpetuate development of personal and professional skills and the potentialities of project participants.

For purposes of comparison, traditional management philosophy and its typical structure as shown in Figure 1 can be summarized as follows:

1. Established on-going the organization's function mainly on a vertical basis
2. A chain of authority exists within the organization from the highest rank to the lowest, through every link in the chain
3. Hence, an employee receives orders from one superior only

4. Strong superior-subordinate relationships exist to preserve unity of command and to ensure unity of purpose.
5. Work progresses within autonomous functional units of an organization.
6. The line and staff relationships are clearly defined.
7. Functional managers have clearly identified finite responsibilities.

Functional managers establish “staff” relationships where collective action is required.

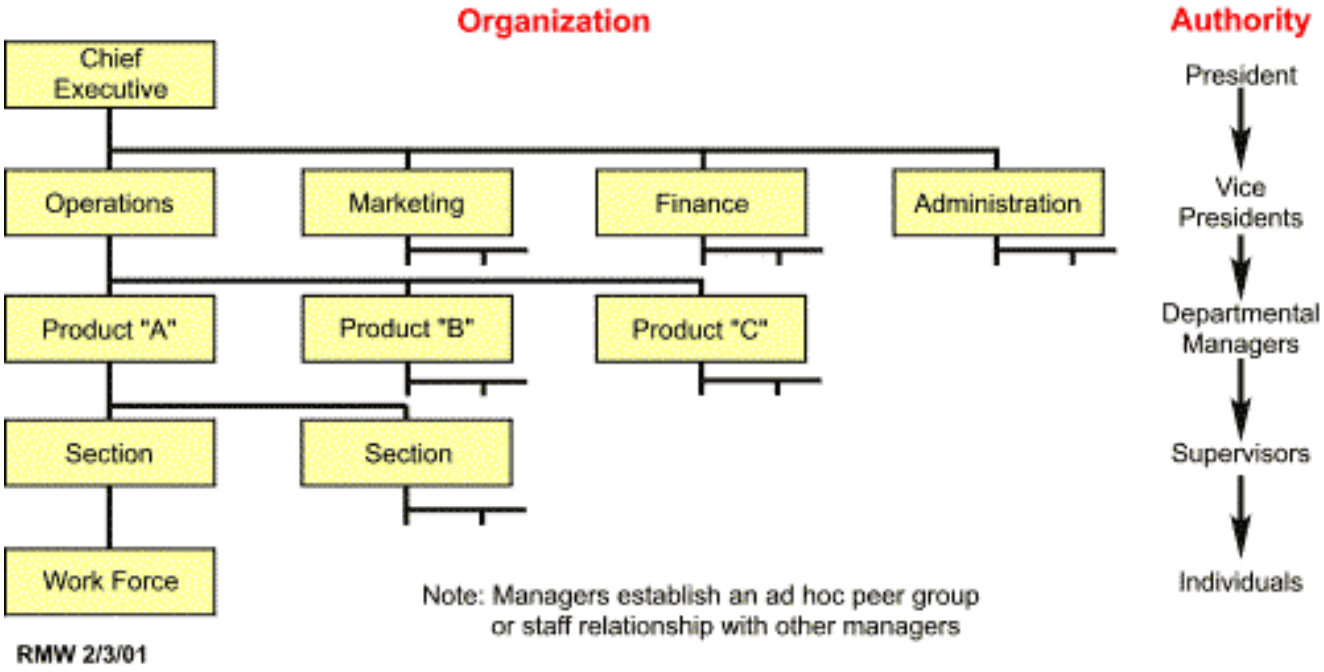


**Figure 1. Typical Functional Organization showing Line Authority/Responsibility**

**Effective Project Execution**

Since the effective execution of a project requires the combined effort of many functional areas acting as a team, new management relationships have to be created within the traditional organization. Successful achievement therefore necessitates cutting across the normal flow of authority, with responsibilities radiating outside any one functional unit. Lack of official cohesiveness means that the traditional management approach becomes unsatisfactory for project work.

The project manager is confronted with the coordination and integration of both human and non-human resources. He must balance concept requirements with engineering limitations and, at the same time, relate the client's functional demands to cost restrictions. However, he does have the advantage of being able to look at the overall project without being influenced by, say, the specialist's bias or contractor's profit motive. His objectives are identical to those of the owner, although he should be able and willing to argue a point with him when he feels it is necessary,

The adoption of an effective project management organizational structure, together with the use of management system tools to manage the project, forces a logical approach to the undertaking. It facilitates decision making and enables management to readily handle its responsibilities. In fact, as a

management philosophy it provides a refreshing way of thinking that allows for temporary changes in an organization's structure and its activities.

**Project Management Features and Requirements**

The project management organization integrates widely diverse disciplines. Indeed, the sheer scope and inherent complexities of today's projects dictate the need for a formally structured project management system. It is necessary for the balancing of such interactive factors as economics, environment, design, construction, and human resources, as well as for synchronizing activities in terms of time, cost, and space. Figure 2 shows the project management concept introduced into a traditional organization

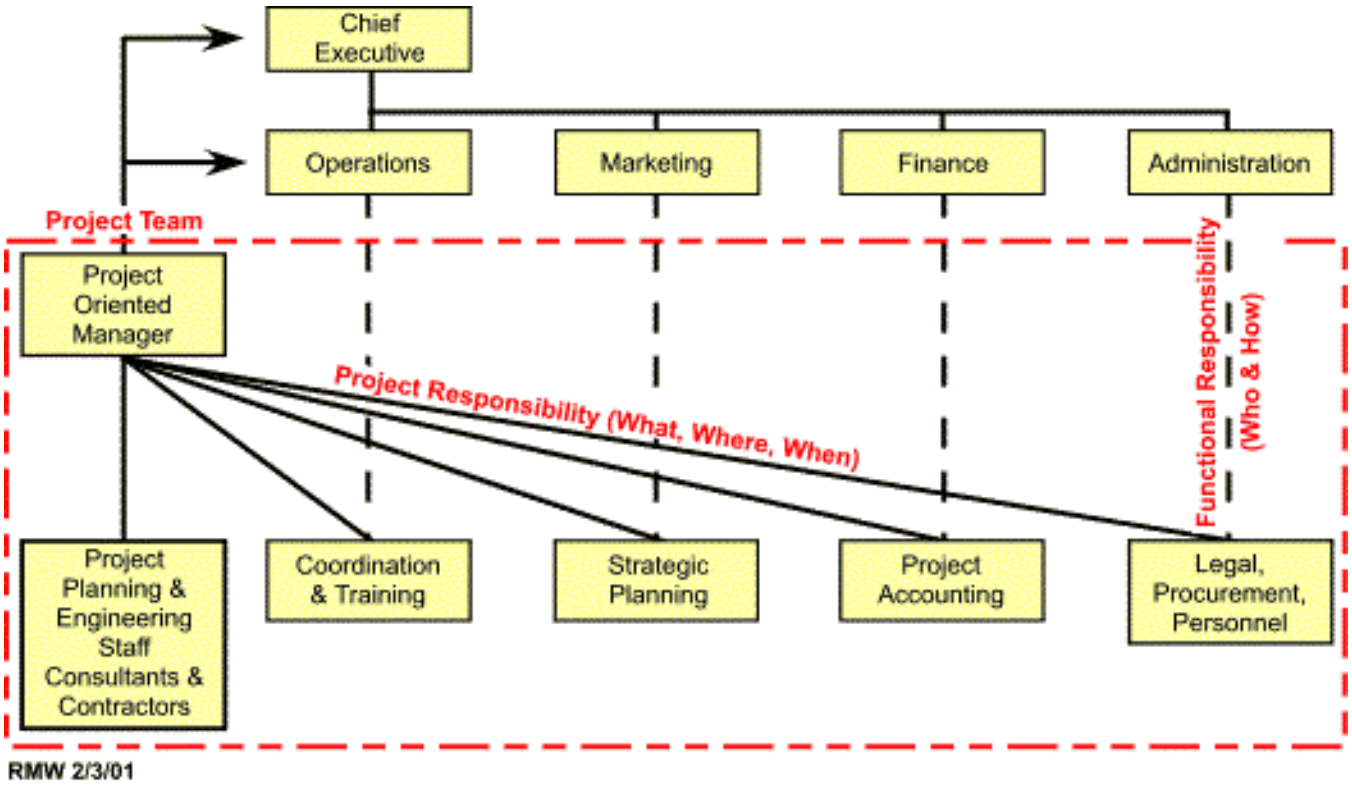


**Figure 2. Project Management introduced into a Traditional Organization**

From Figure 2 it will be noted that certain features set it apart from the traditional function--oriented management philosophy outlined earlier. For example:

1. A central clearing house is established for timely project decisions involving diverse interests.
2. It is directly involved in managing participation by parties normally outside its direct control. It pulls together such diverse activities as feasibility studies, client changes, regulatory requirements, design, construction, startup, etc., all of which are time-phased over the life of the project, and which require coordinated planning, scheduling, and control.
3. Natural organizational conflicts are brought into the open where they can be dealt with.
4. Project requirements of scope, budget and schedule are clearly established.
5. The life of the individual project organization is finite in duration. Personnel directly involved are

introduced to one project, and later assigned to other projects as time progresses.

6. The project team is a professional unit and needs to be managed by motivation, persuasion, and human relations, rather than a simple superior-subordinate relationship.

**Flexibility with Certain Limitations**

Any organization can mold its own project management system to satisfy its existing functional capabilities and unique constraints. However, there are a number of requirements that are fundamental to the success and effectiveness of this approach:

1. The Project Manager must have the necessary managerial authority within his own organization to ensure response to his requirements
2. No major technical, cost, schedule, or performance decisions should be made without the Project Manager's participation
3. He must be identified as the authoritative agent in dealing with outside parties, and be the responsible and single formal contact with them
4. The Project Manager should have a say in the assembly of the project team, and personnel assigned to the project must be competent
5. The Project Manager should have the capability and authority to control the commitment of funds within the prescribed limits of the project, and should actively direct attention to schedule adherence
6. Senior management must clearly demonstrate support for this concept

**Typical Project Stages and the Project Brief**

Through his project management organization the owner achieves real control of the project from the beginning. Typical project stages and the owner's executive control points are shown in Figure 3. It is a distinct advantage if the project manager is appointed to oversee the feasibility study, but even if this is not done, it is essential that he be appointed before the start of any design.

Upon being appointed, his first task is to assemble the available information such as the owner's prime requirements, economic data, design standards and so on. He will then proceed with such other studies, including concept and preliminary drawings, as may be necessary to ensure the feasibility of the project.

The objective is to produce a detailed statement or proposal, which is best referred to as a “Project Brief”. A good project brief will include a statement of project scope, justification, regulatory requirements, preliminary design sketches, procurement plan, schedule, design presentation estimate, cash flow and financial statement. The essential purpose of this disciplined effort is to ensure the best possible level of early decision making and information, and therefore to minimize changes and delays during construction which may then be ten or more times as expensive to implement or correct.

The project brief is also a powerful tool which can be used in support of requests for funding, grants or external financing. It is also useful for early discussions with regulatory authorities and the public.

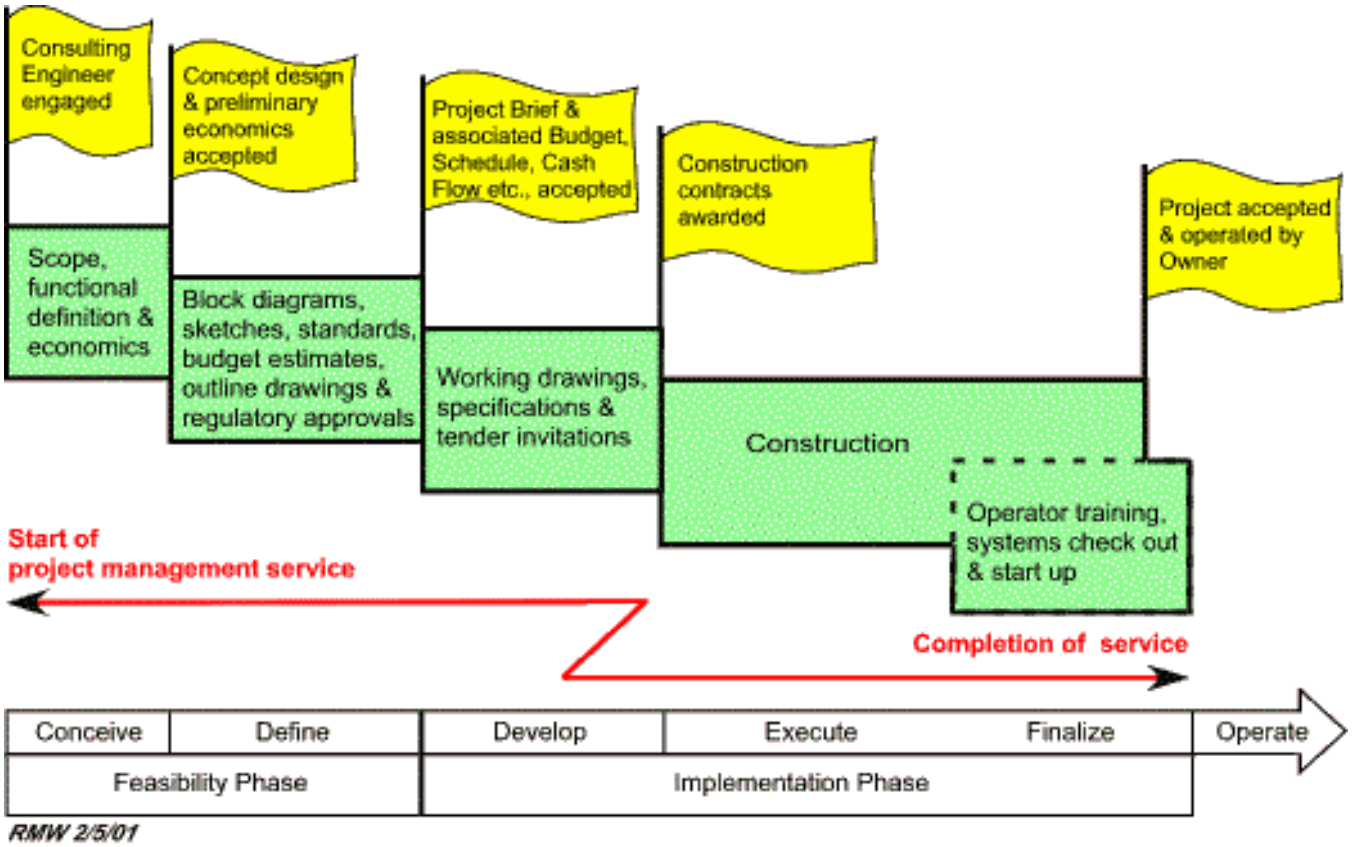


**Figure 3. A complete Management Service over the life of the Project**

However, it cannot be emphasized too strongly that the proper completion of the feasibility phase is crucial to effective control of the large capital expenditures which will follow in the implementation phase. Therefore, sufficient effort and resources should be devoted to the feasibility phase to ensure that effective scope (quality), time and cost (budget) standards have been established for the detailed design and construction.

Upon acceptance by the owner, the project brief becomes a “working bible” from which the project manager coordinates and directs a design and construction team that is the most suitable for that particular project.

**Project Control and the Work Breakdown Structure**

The project control system should be as simple or as complex as the job requires. Larger, tightly scheduled projects may require intricate computerized precedence networks, while smaller jobs may be handled by simple bar charts. In every case, however, the principles of network planning can be used to ensure that the foreseeable becomes routine and the unforeseeable is anticipated early enough to allow corrective measures to be taken with minimum adverse impact.

During its execution, the success of a project is measured by the effectiveness of controls applied to time, cost, and performance. Is the project on schedule, and is it within budget, or is it characterized by continual bottlenecks, overruns, and unexpected crises? Is the project management team able to predict its technical decision points, cash flow demands, schedule and cost performance, or are these

after-the-fact reactions? The real value of the Project Management approach is only obtained if the primary focus is placed on the effective use of the limited resources of time and money during the entire life of the project.

A good project management system uses a systematic work breakdown structure as the vehicle for directing and controlling the project. This technique progressively subdivides a project into its component parts, assigns costs and schedules to those parts, and monitors their progress.

A work breakdown structure is a task-oriented "family tree" of activities which organizes, defines and graphically displays the work to be accomplished to achieve the final objectives of the project. Therefore, a work breakdown structure must:

1. Establish an information structure for describing the project (scope and specifications).
2. Hence, serve as an effective means of communication to integrate the objectives and activities of all the internal and external ,organizations involved in the project.
3. Represent the planning of the project, step by step.
4. Separate sequential. and parallel activities assigned to different organizations and groups who will schedule, measure and control their own performance.
5. Provide a meaningful structure of cost and schedule reporting for the project management team.

**The Work Package**

"Work package" is a generic term describing the unit within the project breakdown structure at the lowest ***developed*** level, although not necessarily always at the lowest ***possible*** level of the system. Integrated cost, schedule and performance data can be summarized from the work packages to satisfy the needs of management at every level of the organization.

A work package describes the work to be performed by a specified organizational unit responsible for its accomplishment. It serves as a vehicle for monitoring and reporting progress, cost and schedule of the work performed by that unit. In order to be effective for planning and control a work package should have the following characteristics:

1. It represents a unit of work at a level where work is-performed; i.e., where possible, it should be identified with a work location and organizational element.
2. It is clearly distinguishable from all other work packages.
3. It has scheduled start and completion dates
4. It has a budget or assigned value in terms of dollars.
5. Its size and duration are limited to relatively short spans of time to minimize the effort to evaluate work in process.
6. It integrates with other work packages and schedules.
7. It represents a level where actual costs can be collected or assigned.

**Don't over do the break down**

Note, however, that a project should not be broken down to such an extent, or contain work packages so

small, that unnecessary administrative effort is incurred in maintaining the information flow. On projects up to, say, $25 million in the construction phase, a minimum work package value of, say, 0.1% is a good rule of thumb. Above $25 million, minimum values should be deliberately set which are compatible with the effort and time available for data collection in the context of overall project objectives.

Since all contract work is also eventually planned and controlled through work packages, it is necessary to identify different types of work packages and their characteristics. All work packages can be categorized into one of three different types:

1. Discrete tasks which have a specific end result or objective. These normally comprise 60 -. 75% of the project work.
2. Level-of-effort tasks which do not have specific end results. These are comprised mainly of the overhead accounts, such as management, administration, liaison and co-ordination. These are characterized by relatively level, time-phased budgets and are not time-limited as in the case of discrete tasks.
3. Apportioned-effort tasks, which can be directly related and apportioned to discrete tasks, such as quality control or inspection. These tasks are in support of the discrete tasks and thus their schedule and budget can be related to the discrete tasks.

During feasibility, work packages may also be categorized by the degree of maturity of work definition:

1. Conceptual work packages are based upon preliminary sketches and thus the estimates of time and cost are based on historical data, experience and judgment rather than detailed "take off" estimates. The scope of these work packages may be large, and the duration relatively long
2. When the Project Brief is presented to the owner for final approval to begin working drawings and construction, the work packages are based upon the final scope of work. The estimate and schedule will be correspondingly firmer, and consequent control will be stronger.
3. Firm work packages meet the requirements of being based upon firm design, firm budgets, and a firm schedule. These work packages should be identified 2 to 6 months prior to performing the work, and can only be revised with the approval of the Project Manager and normally as a consequence of a change order.

**Scheduling and Cash Management**

For schedule control, an integrated network should be drawn to the work package level to monitor and forecast progress. Consultants and contractors should be responsible for providing schedule status and logic, showing work package units for which they are responsible. It should not be necessary for the Project Management team to incorporate into the network schedule, information which is more detailed than the work package level. Progress should be monitored at this level and variances can be investigated through field reports.

A Master Schedule should be developed and maintained for the owner which shows key milestones or events at given points in time. Overall progress is then measured against the Master Schedule.

This schedule should not be changed unless:

1. A formal reprogramming of the entire project or major part takes place.
2. The target schedule and the current schedule become so far apart that recovery is impossible and target objectives become meaningless.
3. Such changes are recognized and approved by top management.

When each work package is budgeted and scheduled, summation and a time scale will provide a cash flow profile. Expenditure profiles corresponding to early and late start can also be generated. Actual expenditures-to-date will provide key inputs for estimates-to-complete and cost variance analyses.

Thus, the project control system not only schedules feasibility, design and construction activities but also assists decision making cost breakdown, and cash flow.

**Construction Management is part of Project Management**

As noted earlier, project management includes the direction of consultants, designers and contractors, together with the co-ordination of the client's and user's staff as members of the project team. Within this structure, the construction management approach may be used to advantage as an alternative to the general contractor, particularly on large projects where time savings are required.

The employment of construction management services, headed by a construction manager who is also a member of the project team under the project manager's direction, makes it possible to "fast track". That is to say, individual trade contracts are awarded in the physical sequence of construction which permit some overlap with the working design effort. Thus overall project time is saved compared to that required to complete the whole design for procurement of all construction work in one tender call.

Obviously all design work must be carefully scheduled and then coordinated with construction, for this method to succeed.

**Project Management Services under Contract**

Because major construction projects are exceptional, one-time or at least infrequent undertakings for most organizations, it is usually impractical to maintain an experienced project manager and the necessary support personnel on the owner's staff. The use of specialized outside services as a temporary extension of the owner's management structure for the duration of the project is much more practical. Outside services are more flexible, usually have access to varied resources, and cost little in comparison to the total project commitment throughout its life.

Such a project management service can assume complete responsibility for the management of a project and for meeting project objectives. A competent project manager, who would be directly responsible for the complete management of the project as defined by the client, would be assigned together with all required staff and services not otherwise available from the client. A typical project organization chart is shown in Figure 4.

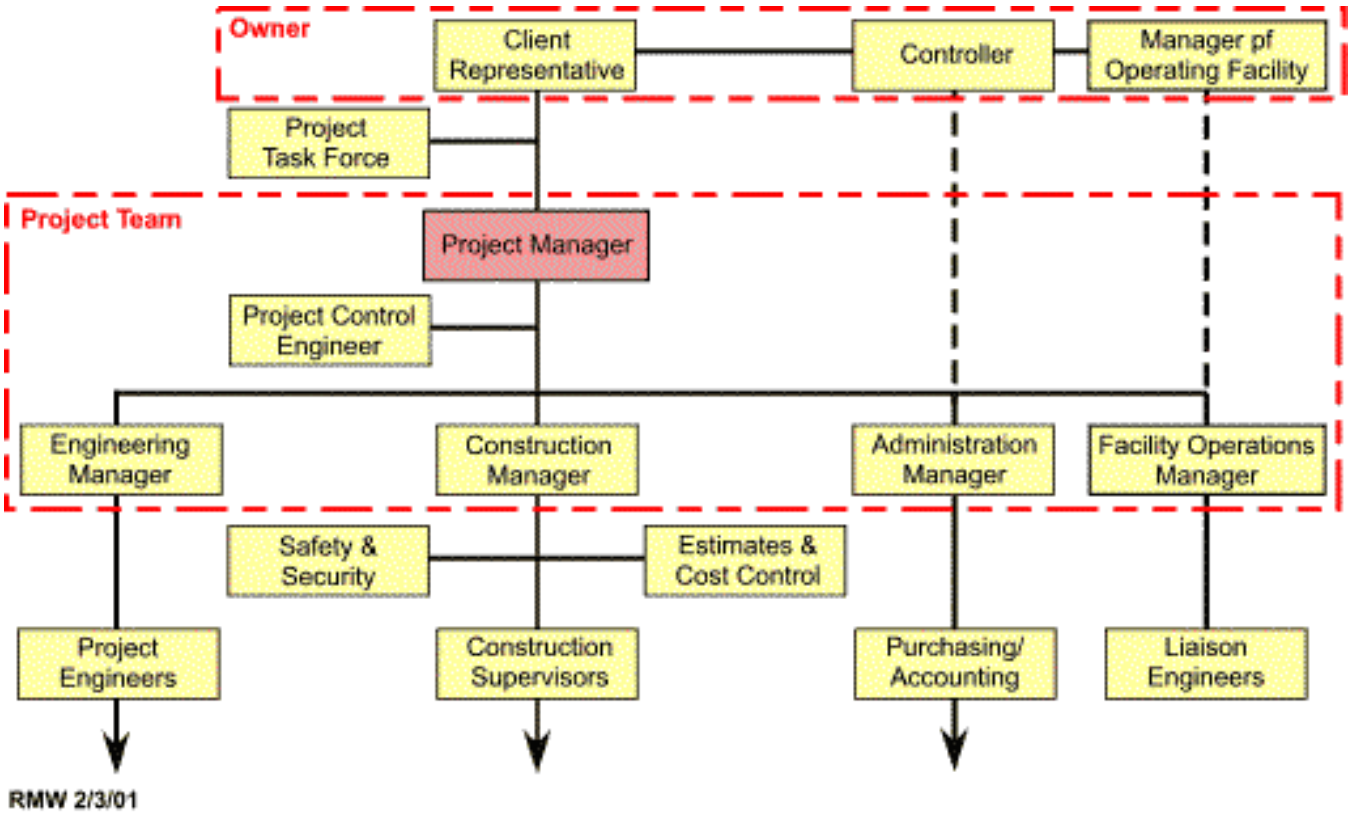


**Figure 4. Senior Appointments for an Engineer, Procure, Construct (EPC) Organization**

This service should commence with the critical first steps of developing the requirements of the concept into a scope of work and be completed with the managing and start-up of the constructed facilities. It should be initiated by a project task force comprising senior representatives from the client and from the home office of the project management service. This task force would establish project organization and policies. It could continue to meet at intervals to confirm commitments and continuously review the status of the project at the executive level, until performance is completed.

## Conclusion

Every construction project of any significance these days involves an ever-increasing spectrum of individual professional and trade skills. Consequently, a project can only be achieved satisfactorily through a comfortable working relationship between very many people, with many different personal or collective objectives. In this brief paper the writer has endeavored to present an overview of project management as a modern approach designed to withstand the vicissitudes of such pressures.

Today's owner who adopts the project management approach to establish a new facility, finds that he avoids becoming directly involved with the time-consuming design and construction details. Instead, the approach enables him to continue to concentrate on his primary on-going profit-making business.