PROJECT MANAGEMENT

A SYSTEMS APPROACH TO PLANNING, SCHEDULING AND CONTROLLING

HAROLD KERZNER, Ph.D.

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Preface

With the approach of the 1980's, more and more industries are adopting project and systems management philosophies in order to more efficiently and effectively control resources. This book was developed to provide an on-hands approach toward learning the necessary tools and techniques by which activities can be integrated throughout an organization, regardless of the organizational size or project complexity.

The book is addressed not only to those undergraduate and graduate students who wish to understand the contributions to modern management theory and practice resulting from project management applications, but also to those functional managers and upper-level executives who must, either directly or indirectly, provide their continuous support to all projects.

The first three chapters of this text provide the framework and theory for understanding project management in action. Chapters four and five describe the role of the individual in project management, and chapters six and seven discuss the most common problems, their cause and cure, that exist in this turbulent environment. Chapters eight through twelve contain the basic tools for scheduling and control. These last five chapters can very easily be converted to a "how to" manual for almost any company wishing to enter into the world of project management.

At the end of each chapter are problems and case studies covering a variety of real-world situations. Rough drafts of the text, together with the case studies and problems, have been tested with great success on some two hundred MBA students at Baldwin-Wallace College and over three hundred participants in project management seminars. Their helpful comments have led to the fruitful revision of many sections of this text.

Grateful acknowledgement is given to Ronald I. LaFleur for use of material developed in his project management workbook. Valuable criticisms and contributions were made by many colleagues. In particular, Roy Loring and Dr. Erwin Weiss have provided considerable comments on how to present the information to individuals not already engulfed in the world of project management. Special mention needs to be given to Dr. Dieter E. Wassen for his contin-

uous support and encouragement for the development of training literature for project and systems managers.

I am also indebted to Warren Willits for his invaluable contribution of time and effort for the art work presented herein. To Shirley Lemmeyer and Ruth Harwood, I owe many thanks for their typing of the manuscript and for maintaining order during this undertaking. Finally, I should like to express my sincere gratitude to my wife, Gail, for proofing the several revisions to the text, and for her companionable encouragement during the many hours I was in seclusion.

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1
Overview of Project Management

1.0 INTRODUCTION

The wonderful world of project management is relatively modern in that it is characterized by new approaches to management restructuring and the adaptation of special management techniques. Twenty years ago project management was confined to the Department of Defense contractors and construction companies. Today, the concept behind project management has spread to virtually all industries, including defense, construction, pharmaceuticals, chemicals, banking, accounting, advertising, law, hospitals, state and government agencies, and the United Nations.

The rapid rate of change in both technology and the marketplace has created enormous strains upon existing organizational forms. Alvin Toffler, W.G. Bennis and other authors, have commented on the breakdown of bureaucracy and its ultimate replacement by such temporary management systems as project management, which are highly organic and can respond rapidly to an ever-changing situation.[1]

The unique nature of these temporary management systems as task forces for project management tends to separate them from the parent organizational structure and to alienate those managers in the parent organization who are responsible for organizational equilibrium.

Project management has long been theorized by corporate managers and academics as one of several approaches to organizational forms of the future, designed to integrate complex efforts and reduce bureaucracy. Fortunately, there were managers, such as William C. Goggin, board chairman and chief executive officer of Dow Corning, who in 1967 was willing to "take the bull

1. Alvin Toffler, *Future Shock.* (New York: Random House 1970); and W.G. Bennis, "Post-Bureaucratic Leadership," *Transaction,* July-August 1969, p. 44.

by the horns" and respond to environmental pressure, fearing that the organizational problems would become worse instead of better:[2]

Although Dow Corning was a healthy corporation in 1967, it showed difficulties that troubled many of us in top management. These symptoms were, and still are, common ones in U.S. business and have been described countless times in reports, audits, articles and speeches. Our symptoms took such forms as:

- Executives did not have adequate financial information and control of their operations. Marketing managers, for example, did not know how much it cost to produce a product. Prices and margins were set by division managers.
- Cumbersome communications channels existed between key functions, especially manufacturing and marketing.
- In the face of stiffening competition, the corporation remained too internalized in its thinking and organizational structure. It was insufficiently oriented to the outside world.
- Lack of communications between divisions not only created the antithesis of a corporate team effort but also was wasteful of a precious resource—people.
- Long-range corporate planning was sporadic and superficial; this was leading to over-staffing, duplicated effort and inefficiency.

Goggin was typical of the new breed of executive which emerged in the late sixties and early seventies, and was characterized as an individual who was flexible enough to accept change and readily willing to adapt to an ever-changing environment. This adaptation required departure from the traditional business organization form which was basically vertical and which achieved successful unification of efforts through a strong superior-subordinate relationship.

1.1 PROJECT MANAGEMENT GROWTH

The growth of project management has come about more through necessity than through desire. By definition, project management can best be described as the planning, scheduling, directing and controlling of company resources for a relatively short-term project which has been established for the completion of specific goals and objectives. Furthermore, project management utilizes the "systems approach" to management through the use of functionally controlled personnel (vertical hierarchy) assigned to a specific project (horizontal hierarchy). Project management restructuring permits companies to:

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2. William C. Goggin, "How the Multidimensional Structure Works at Dow Corning", *Harvard Business Review*, January-February 1974. Copyright © 1973 by the President and Fellows of Harvard College; all rights reserved. p. 54.

- Accomplish tasks which were not effectively handled by the traditional structure.
- Accomplish one-time activities with minimum disruption of routine business.

The major reason for the slow growth of project management can be attributed to the lack of acceptance of the new management techniques which were so necessary for success. This inherent "fear of the unknown" acted as a deterrent force for managers wishing to change over. The major problems identified by those managers who attempted the new system all revolved around conflicts in authority and resources. Three major problems were identified by Killian:[3]

- Project priorities and competition for talent may interrupt the stability of the organization and interfere with its long-range interests by upsetting the normal business of the functional organizations.
- Long-range planning may suffer as the company gets more involved in meeting schedules and fulfilling the requirements of temporary projects.
- Shifting people from project to project may disrupt the training of new employees and specialists. This may hinder their growth and development within their fields of specialization.

Another major concern was the fact that project management required that upper-level managers relinquish some of their authority through delegation to the middle managers. In several situations the power positions were controlled by middle-management even more so than by upper-level management.

Despite these limitations, there were several driving forces behind the project management approach. According to John Kenneth Galbraith, these forces stem from "The Imperatives of Technology." The six imperatives are:[4]

- The time span between project initiation and completion appears to be increasing.
- The capital committed to the project prior to the use of the end-item appears to be increasing.
- As technology increases, the commitment of time and money appears to become inflexible.
- Technology requires more and more specialized manpower.
- The inevitable counterpart of specialization is organization.
- The above five "imperatives" identify the necessity for more effective planning, scheduling and control.

3. William P. Killian, "Project Management–Future Organizational Concepts," *Marquette Business Review*, No. 2, 1971, p. 90–107.
4. John Kenneth Galbraith, *The New Industrial State.* (New York, The New American Library, 1968) p. 25–28.

As the driving forces overtook the restraining forces, project management began to mature. The importance of establishing project management objectives soon became clear. Managers realized that the objective behind the project management approach was in the best interest of the company. The objective of project management has been defined as an attempt to make the most efficient and effective use of the resources of

- Manpower
- Equipment
- Facilities
- Materials
- Money
- Information/Technology

so that company objectives and goals can be achieved

- Within budget
- On schedule
- At the desired performance/technology level

while adhering to the everchanging environmental input factors:

- Legal
- Social
- Political
- Economical
- Technological

Project management must be regarded as a challenge. Project management attempts to achieve project success in spite of such internal and external (environmental) obstacles as:

- Unstable economy
- Shortages
- Soaring costs
- Increased complexity
- Heightened competition
- Technological changes
- Societal changes
  - Consumerism
  - Ecology
  - Quality of work

If these obstacles are not controlled, the results can be:

- Decreased profits.
- Mushrooming of manpower.
- Cost overruns, schedule slippages and penalty payments occurring earlier and earlier.
- Unable to cope with technology doubling every five years or less.
- R & D results too late to benefit existing product lines.
- New products introduced into the market place too late.
- Temptation to make over-hasty decisions that are costly.
- Management insisting on earlier and greater return on investment.
- Greater difficulty in establishing on-target objectives in real time.
- A tougher and tougher job to relate cost to technical performance and schedule during the execution of the project.

J. Robert Fluor, chairman, chief executive officer and president of the Fluor Corporation commented on the twenty years of operations in a project environment:[5]

The need for flexibility has become apparent since no two projects are ever alike from a project management point of view. There are always differences in technology; in the geographical locations; in the client approach; in the contract terms and conditions; in the schedule; in the financial approach to the project; and in a broad range of international factors, all of which require a different and flexible approach to managing each project.

We found the task force concept, with maximum authority and accountability resting with the project manager, to be the most effective means of realizing project objectives. And while basic project management principles do exist at Fluor, there is no single standard project organization or project procedure yet devised that can be rigidly applied to more than one project.

Today, our company and others and their project managers are being challenged as never before to achieve what earlier would have been classified as "unachievable" project objectives. Major projects often involve the resources of a large number of organizations located on different continents. The efforts of each must be directed and coordinated toward a common set of project objectives of quality performance, cost and time of completion as well as many other considerations.

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5. J. Robert Fluor, "Development of Project Managers" keynote address to the Project Management Institute, Ninth International Seminar Symposium, Chicago, Illinois, October 24, 1977.

1.2 THE NEW ENVIRONMENT

As project management grew, it soon became evident that there must exist some guiding factors which form the basis for the underlying principles behind the project management approach. The first factor was the establishment of the project manager as the focal point for the integrative responsibility. This need for integrative responsibility was first identified in research and development activities:[6]

Recently, R & D technology has broken down the boundaries that used to exist between industries. Once-stable markets and distribution channels are now in a state of flux. The industrial environment is turbulent and increasingly hard to predict. Many complex facts about markets, production methods, costs and scientific potentials are related to investment decisions.

All of these factors have combined to produce a king-size managerial headache. There are just too many crucial decisions to have them all processed and resolved through regular line hierarchy at the top of the organization. They must be integrated in some other way.

Providing the project manager with integrative responsibility resulted in:

- Single person total accountability
- Project rather than functional dedication
- A requirement for coordination across functional interfaces
- Proper utilization of integrated planning and control

The project manager's job was not an easy one. He found himself with increased authority and responsibility, but with very little power. This lack of power forced him to "negotiate" with upper level management as well as functional management for control of company resources, as shown in Figure 1-1. He was often treated as an outsider by the formal organization. Yet, even with these problems and roadblocks, he has managed to survive. J. Robert Fluor has described the new responsibilities of project managers at Fluor Corporation:[7]

Project management continues to become more challenging and we think this trend will continue. This means we have to pay special attention to the development of project managers who are capable of coping with jobs that range from small to mega projects and with life spans of several months to ten years. At

6. Paul R. Lawrence and Jay W. Lorsch, "New Management Job: The Integrator", *Harvard Business Review*, Nov/Dec 1967; Copyright © 1967 by the President and Fellows of Harvard College; all rights reserved. p. 142.
7. See note 5.

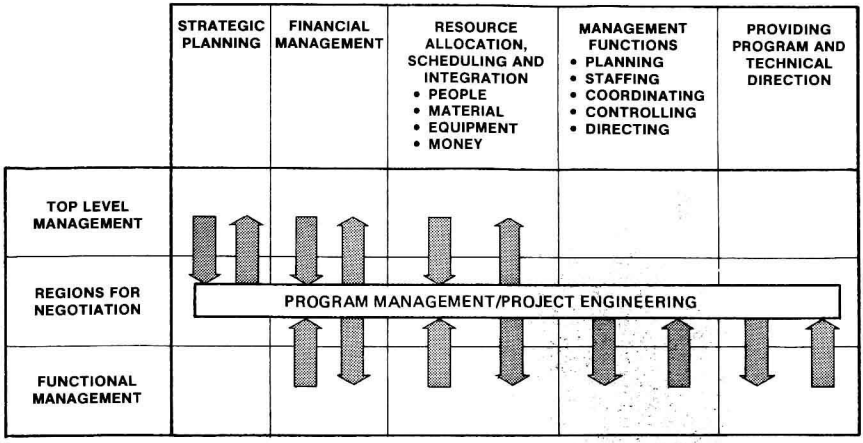

Figure 1-1. The negotiation activities of systems management.

Fluor, a project manager must not only be able to manage the engineering, procurement and construction aspects of a project, he or she must also be able to manage aspects relating to finance, cost engineering, schedule, environmental considerations, regulatory agency requirements, inflation and cost escalations, labor problems, public and client relations, employee relations and changing laws. That's primarily on the domestic side. On international projects, the list of additional functions and considerations adds totally different complications.

The second key factor was the establishment of an integrated planning and control system which would effectively "marry" the horizontal and vertical units of the company toward better project identification and control. The requirements for the integrated planning and control system include:

- Complete task definition
- Resource requirements definition
- Timetable establishment
- Definition of end item quality and reliability requirements
- Establishment of basis for performance measurement

These two factors, if properly established, result in:

- Assurance that functional units will understand their total responsibility toward achieving project needs
- Assurance that problems resulting from scheduling and allocation of critical resources are known beforehand
- Early identification of problems that may jeopardize successful project com-

pletion so that effective corrective action can be taken to prevent or resolve the problems.

Unfortunately, these two factors are somewhat constrained by the fact that:

- Each project is normally of a finite time duration and exists as a separate entity within the company except for administrative requirements.
- The resources must be scheduled and fitted to satisfy the needs of the project, not vice versa.

The constraints can therefore cause situations which require

- Continuous revision and/or establishment of company and/or project policies, procedures and directives.
- A continuous shifting in organizational responsibilities and possible restructuring.
- An everchanging need for knowledge and skills.

In the project environment everything seems to revolve about the project manager. Although the project organization is a specialized, task-oriented entity, it cannot exist apart from the traditional structure of the organization. The project manager, therefore, must walk the fence between the two organizations. His title is often called interface management and his role can be described as:[8]

- Managing human interrelationships in the project organization
- Maintaining the balance between technical and managerial projects functions
- Coping with risk associated with project management
- Surviving organizational restraints

Organizational restraints have the tendency of developing into organization conflict, often requiring that the top management take an active role in conflict resolution by

- Setting a selection criteria for projects
- Establishing priorities among projects

Conflict resolution, strategic planning and policy formulation become the major responsibilities of upper-level management. The day-to-day operations of the organization rest upon the shoulders of the project and functional managers.

8. David L. Wilemon and John P. Cicero, "The Project Manager–Anomalies and Ambiguities", *Academy of Management Journal,* September 1970, p. 271.

1.3 DIFFERING VIEWS OF PROJECT MANAGEMENT

The individuality of the organizational membership creates an internal problem for the daily operations of a project management structure because of the different ways that project management is viewed. Almost all organizational personnel have different views of project management. Each view is based upon either a traditional, social, behavioral or scientific need. Sample views might include:

- A threat
- A research area
- A new challenge
- A means to an end

Functional and upper-level managers regard project management as a threat because they have had to relinquish some of their well-developed authority vested to them under the traditional organizational structure. Educational institutions, consultants and scientists view this new form of management as a research area. Program managers and project engineers consider project management as a challenge, whereas functional managers tend to view this new structure merely as a means to an end. There are several other views of project management. Problem 1-2 at the end of this chapter lists additional views.

1.4 LEARNING PROJECT MANAGEMENT

The inevitable question concerning the teaching of project management is, "Can project management be learned from a textbook or an academic course, or must it come from on-the-job training?" No academic institution or textbook can teach project management in its entirety. Even in the academic community there exists differing views of project management; business colleges stress organizational responsibility and conflict management; engineering colleges (especially the civil engineering departments) stress scheduling and quantitative tools; and some engineering and business colleges provide interdisciplinary efforts in teaching cost control. Academe must train people to become "generalist" project managers, with the "specialist" training being provided in-house.

This text was developed to train generalists by exposing the individual to the complete gamut of problems and relationships that can exist in a project environment, and are common to all project management, regardless of the industry. The overall theme of this text is to provide an individual with the necessary tools and techniques by which he can find proven, workable solutions to problems that can occur in a project environment. There are four main objectives of this text: