
PROJECT MANAGEMENT INSTITUTE
(PMI)

**PROJECT MANAGEMENT
BODY OF KNOWLEDGE
(PMBOK)**

by
PMI Standards Committee

Approved by the PMI Board of Directors
March 28, 1987

Effective for certification and educational program reviews
September 1, 1987



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Drexel Hill, PA 19026

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Reprint Note 10/2/18: All the following ERRATA have been corrected in the pages that follow.

ERRATA

10/15/87

The following errors were noted after printing. Please note them in your copy.

Page

2-5

Figure 7 Project Management Matrix Model
“Contracts and Procurement”

C-10

Add after **Review**:
“**Schedule**: A display of project time allocation.”

C-11

Substitute for **Workload**:
“**Workload Review**: Review of planned work demands on resources over time spans versus acceptable limits on their availability.”

E-7

Delete repeated text relative to **Risk Factor** and **Risk Identification**

G-2

Replace the word **Project** with the word **Procurement** in the following numbered terms: 1.b.1, 1.d.1, 1.e, 1.e.1, 2.a., 2.a.1, 2.b, 4.b.5, 4.b.6, 4.b.8

FOREWORD

Managing projects is not new, simply because establishing a project as a means to an end has been around since man's early history. Projects have always been managed, for better or for worse, depending to a large extent on all of the skill, intuition, and luck that the manager could muster at the time.

However, in recent years there has been a growing recognition that management, and particularly project management, is a special skill that can be codified and learned. Project management skill is quite different from the technical skills that are so often associated with most projects.

Indeed, there are aspects of all projects which are outside the scope of these technical areas, yet which must be managed with every bit as much care, ability, and concern. That is, these non-technical areas must be well managed if the project's objectives are to be met with optimum economy of resources, and with maximum satisfaction to the participants or "stakeholders."

Formal recognition of project management is clearly evident in the construction industry. However, it is also evident in a number of government agencies as well as the aerospace, research and development, manufacturing, pharmaceutical, electronics, and many other industries. Unfortunately, "project management" may mean different things to different people, and certainly there are differences of opinion as to what is, or what should be involved.

This is part of the valued diversity in this new and dynamic profession. As a result, however, effective communication is difficult, especially where modern, complex, multi-disciplinary contributions are called for.

The Project Management Institute (PMI), a non-profit professional organization dedicated to advancing the state-of-the-art in project management, has contributed to the effort of developing and distributing this revised Project Management Body of Knowledge to the Profession, in the hope that it will advance and improve the effectiveness of communications among the many technologies involved in project management.

A project management profession, united across the many industries and technologies that use the concepts documented in this PMBOK, has a tremendous potential for improving the efficiency with which resources are used and hence the quality of life enjoyed by the citizens of our society. This unity can only be achieved through effective communications based upon a mutual understanding of a documented and accepted body of knowledge that serves as the basis for developing the profession.

R. Max Wideman
Past Chairman
PMI Standards Board

PREFACE

The original Project Management Body of Knowledge (PMBOK) was developed in 1983 by a committee chaired by Mr. Matt Parry, past Chairman of the Board, and a Fellow of the Project Management Institute (PMI). The special report that published this original Body of Knowledge was the first of the annual "Special Summer Issues" of the *Project Management Quarterly* (now *Journal*), and provided the cornerstone on which the entire PMI professional program has been built.

After all, a defined, published, and accepted "Body of Knowledge" is essential as a guide to the development of a certification exam, and also serves to define what should be taught in a formal educational program. It also serves as a set of criteria for evaluating a formal educational program for accreditation purposes.

It stands to reason, then, that any change to the PMBOK must be developed with great care, for such changes will of necessity create a domino effect of changes in the entire professional program of the Institute. Nevertheless, Project Management is a very young, dynamic, and developing profession, and any effort to describe and define the knowledge necessary to function adequately and be recognized by one's peers as a Project Management Professional must change to reflect the current status of the profession.

Changes in the Body of Knowledge will require corresponding changes in the certification program (both the examination and the recommended study materials), and in each accredited project management graduate degree-granting program. In this way the PMBOK actually provides the standards for all facets of the PMI professional programs.

Mr. Max Wideman and his Standards Committee worked on the PMBOK revision presented in this publication for approximately two years prior to its presentation to the PMI Board of Directors at their Spring Board Meeting in March 1987. This revision was formally approved by the Board on March 28, 1987, and was published in reduced format to meet the legal requirement for wide distribution in *The PM NET work*, an insert in the August, 1987 Special Summer Issue of the *Project Management Journal*.

This current publication is made available in enlarged format to provide a document that is easy to

read and work with, and one that can be updated easily, quickly, and economically as the profession continues to develop.

This document constitutes the official Project Management Institute Knowledge standards, and is used to define the minimum knowledge that an individual must possess to be considered by the Institute and his or her peers as a recognized Project Management Professional. This revised PMBOK becomes the official basis for certification exams and for the review of formal, degree-granting graduate education programs on September 1, 1988.

This publication can be purchased through the Executive Director's Office in Drexel Hill, Pennsylvania. It will be updated periodically as the profession develops through the issue of additional and modified pages to be inserted into this document. Study guides and resource materials are also planned for publication over the next several months as this new PMBOK becomes accepted and used by the profession.

I would like to thank Mr. Max Wideman and his Standards Committee for their commitment and hard work in developing this Project Management Body of Knowledge. I consider it to be a distinct honor to be named his successor in the development of the PMBOK.

I would also like to recognize the many hours of skill and devotion contributed by Dr. Fran Webster, Editor of the *Project Management Journal*, to the task of editing and organizing the sections of this PMBOK in preparation for publication. Finally, my sincere appreciation goes to Mr. Brian Ahman, my Research Assistant, who willingly assumed the enormous task of editing the Glossary from its original form into a format that is at least reasonably consistent with the definitions in the individual sections of the PMBOK.

The willing contributions of these three people, along with all those who contributed their thoughts and ideas to the PMBOK itself, have made this publication possible.

John R. Adams, Ph.D.
Chairman
PMI Standards Committee

PMBOK STANDARDS

Project Management Body of Knowledge of the Project Management Institute

R. Max Wideman
Chairman, PMBOK Standards Board

Early Work and ESA

The concept of standards was first introduced at the Montreal Symposium of 1976. Some effort was made to suggest the possibility of Certification at the 1977 conference, but was rejected. It was not until 1981 that a determined effort was made by past PMI president Matthew Parry, David Aird, and others, by presenting a formal proposal to the PMI Board. This was approved by the Board at the Boston Seminar/Symposium, and the original Project #31 was launched.

The objective was to define the Body of Knowledge of Project Management and therefore to establish project management as a unique discipline and independent profession. After some considerable philosophical agonizing, early discussions by the initiating committee identified that there are five key attributes of a professional body. These would have to exist as prerequisites, if the project objective of establishing project management as an independent profession were to be achieved.

These attributes are:

1. Supporting educational programs by an accredited institution (Accreditation),
2. A qualifying process (Certification),
3. A Code of Ethics, and
4. An Institute representing members with a desire to serve (PMI)

Thus, the project group came to be known as the Ethics, Standards and Accreditation Management Group or simply ESA. The result of the deliberations of a large number of people on several separate committees was presented as a "Baseline Report" to the PMI Board in August 1982. It was published as a Special Issue of the Project Management Quarterly in August 1983.

The Project Management Body of Knowledge (PMBOK) was central to the report. In it were identified six areas of concentration or blocks of knowledge, namely: the Management of Scope; Quality; Time; Cost; Human Resources; and Communications.

These formed the key and unique "functions" of project management, and the report on each was supported by a content set out in a hierarchical breakdown structure.

The PMI Board was quick to adopt the report in principle, including the Code of Ethics for Project Managers. Since the ESA Report provided a logical baseline, its acceptance by the Board provided the impetus for moving ahead with programs for the Accreditation of an educational establishment, and for the Certification of PMI members. Western Carolina University was accredited in 1983 and the first PMI members were tested for Certification in October 1984.

Work on these two programs in particular, together with the certification workshops at the annual Seminar/Symposium, brought the PMBOK under much closer scrutiny. Inevitably, some short comings became evident, giving rise to much discussion within the PMI organization and at round tables arranged for the purpose. At the same time some significant publications in project management became available. These included PMI symposia papers, PMJ articles and PMI handbooks, as well as some public textbooks authored by PMI members.

Project #121 Established

In 1984, the PMI Board decided to establish Project #121 to address these issues. The general purpose of this project was "To capture the knowledge applied to project management by PMI members, to do so within the existing ESA Standards framework and to present it in simple but comprehensive terms." As incoming President Harvey Levine noted in his article in the Project Management Journal (December 1984, p9):

"The intention will not be to re-invent the wheel, but rather to: (1) review the standards in each area of concentration; (2) identify available materials supporting those standards; (3) promote the development of materials to fill the voids; and (4) "tie".

a ribbon around each of the six packages."

"I see as our products: the Standards, a set of Bibliographies, and sets of textbooks, handbooks, and technical papers that can be used for our workshops, certification, and general dissemination to those interested in learning about project management."

No small order! Certainly the PMI Board recognized that this project was possibly the most important and most urgent before the Institute. It also required broad participation by the PMI membership. Consequently, with the enthusiastic help of the PMI chapters, committees were quickly recruited to address the different segments.

PMBOK Credibility

It soon became apparent that if the overhaul of the PMBOK proved to be fairly major, then the validity and credibility of the results must be a concern. This is especially true because it would form the future basis on which the educational and certification programs depended, and on which much time and effort had already been expended.

At the suggestion of the then PMI Director of Education, Dr. John Adams, a special PMBOK Validation Workshop was proposed to take place just prior to the 1985 annual Seminar/Symposium. The workshop objective was "To critique or affirm the work of PMI's Project Management Function Standards Development Committees and to make recommendations for adoption by the PMI Board." PMI's most active and knowledgeable members were invited, and the anticipation of the workshop provided the stimulus for the various committees to produce and present excellent reports.

The workshop was well attended and under the guiding hands of Drs. Frank Stickney and Dave Cleland as moderators, the workshop proved to be an outstanding success. Each of the committee reports underwent close scrutiny by individual workshop groups, and then collectively to ensure an integrated whole. As a result, a number of findings emerged which are described in the following section. Not surprisingly, each of the reports required some modification and updating before presentation to, and acceptance-in-principle by, the PMI Board in April 1986.

The first complete PMBOK draft was published for general information and comment by the membership in the Special Summer Issue of the Project Management Journal in August 1986. Suggestions and contributions were solicited and much interest was generated. Much work was still to be done but in the meantime the present status represents a new level of understanding from which PMI's Accreditation, Education and Certification programs can continue to grow.

Consensus and Findings

In the course of Project #121, a significant degree of consensus was reached on a number of basic issues not previously defined. For example: there was unanimity over the need for simplicity and universality within the PMI PMBOK development mandate.

There was also no difficulty in accepting the following definition of a project:

A project is any undertaking with a defined starting point and defined objectives by which completion is identified.

In practice, most projects depend on a finite or limited resources by which the objectives are to be accomplished

It should be noted that the definition of project does not require a long dissertation as to how its objectives are to be achieved. This is intrinsic in the definition of project management! These and other general project management terms are defined in the Glossary of General Terms included under Project Management Framework.

More important, as was discovered in the course of this project, is the definition of the project management body of knowledge itself.

Jim Blethen's committee first struggled with the idea of Concepts in Project Management and concluded in their interim report that nowhere is the organizational management overlay and interface (of project management) discussed. Thus, as Linn Stuckenbruck noted in his report "... it was recognized that it would be desirable to have one of the workshop tracks review the PMBOK from an overview perspective." Not surprisingly, this track attracted a lot of high powered attention, to say nothing of high powered discussion. Indeed, moderator Frank Stickney was moved to observe at the time that he had not seen such hard work done by such a talented and dedicated group in such a true workshop environment in a long time.

As a result of these discussions, two important findings emerged. First, the realization that the original ESA WBS is too restrictive for purposes of representing the PMBOK, especially "... inadequately describing the necessary interdependencies and interrelationships between the six project management functions."

Second, "That there is a need for a special subject area in which the essential project management functions of integration and interface management can be addressed." In fact, the discussions during the workshop became oriented towards refining the overview model or common frame of reference, and it is for this reason that the name "Project Management Framework" has been adopted for this area of concentration.

Project Management Framework

In examining this framework, the original Overview Track first had to establish their terms of reference and answer the nagging question first raised by Peter Georgas's Cost Committee, namely "Why are we doing all this?" The workshop group quickly found the answers as follows

- | | |
|------------------|---|
| Objective: | To establish a systematic Model/framework/structure for the PMBOK |
| Purpose: | To organize and classify
To integrate
To correlate
To store and retrieve
To build on what we have |
| Characteristics: | - Simple
- Logical
- Saleable
- Comprehensive
- Compatible
- Systematic
- Understandable |

In true style, this workshop group then proceeded to schedule and control their track like any other project.

The pursuit of a common frame of reference for project management led to a re-examination of its scope, and the need to put boundaries on the PMBOK. Linn Stuckenbruck proposed a Venn diagram which provides a very clear diagrammatic representation of the place of PM in our business environment. Clearly, the extent of the overlapping circles may vary considerably, and therefore require some guidelines. The overview task group then proceeded to enunciate a set of such ground rules.

These ground rules for defining the project management body of knowledge will prove invaluable to the Institute for setting future policy direction, as well as providing substantial guidance to our PM educators.

Linn's Venn diagram is important from another perspective. It clearly demonstrates that individual PMI members will have significantly different interests according to where they stand in the central circle and their consequent interest bias. This is particularly true as one gets closer to the Technical or Industry BOK circle. As Linn noted, this is not one but a number of circles representing the many different industries, technologies and professional areas which use project management.

Throughout project #121, I received a considerable amount of correspondence. It was thoughtful, lively, often spirited, but always encouraging. Clearly much work still has yet to be done on the PMBOK, but I am confident that it will be done.

In the meantime, I am satisfied that the joint efforts of the many PMI members who have been involved in this project have established a new PMBOK plateau. From this plateau, PMI can continue to launch its many successful programs. For those of you interested in furthering your understanding and skills in project management, I commend it to your careful consideration.

(Note The full text of this article and recognition of the many people who participated in project #121 is published in the 1986 August issue of the *Project Management Journal*)

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THE FRAMEWORK

Part 1 The Rationale

R. Max Wideman
Chairman, PMBOK Standards Board

Projects and PMI

The idea of establishing projects, and the consequential need to manage them, has been around for a very long time. In fact, since early civilization major projects like the pyramids of Egypt, or the Great Wall of China, or more recently, the Suez and Panama canals, have been successfully implemented. In their day, these were prolonged and complex undertakings and no doubt they exhibited many of the "management" difficulties experienced even at the present time.

The essential feature of these projects, indeed of any project, is to bring about change. That projects are designed to create change is not new. What is new is the rapidity with which change is currently taking place and which we may confidently expect to continue to take place.

For example, the marvels of modern electronic communications have made almost everyone acutely aware of the disparities, which exist between and within communities, countries and continents of the world. Improvements in this situation are only going to be brought about by even more and widespread change, often with unprecedented degrees of urgency.

Since our resources are clearly limited, be they global or be they local, we must ensure that such change is brought about as effectively and efficiently as possible.

Through its primary dedication of "advancing the state-of-the-art in the management of projects", the Project Management Institute aspires to improve the effectiveness and efficiency of the management of change for the benefit of all mankind.

The effort to identify and establish standards associated with the Project Management Body of Knowledge (PMBOK) follows naturally from PMI's primary dedication. It represents a major Institute endeavor and is the PMBOK's primary purpose. Secondary to this purpose, but equally consistent with PMI's dedication, is to provide the basis and support for PMI's professionalism programs, which include Accreditation, Education and Certification. These programs are described in other PMI publications.

Project management is unique

Managing a project is different from managing an established on-going enterprise. To mention but a few of the obvious differences

- Life in an on-going enterprise is relatively simple and certain for extended periods of time.
- Relatively large quantities of goods or services are produced per given time period.
- Tasks are generally repetitive, continuous or exhibit substantial similarity
- Roles and relationships are well understood, having developed and adjusted over long periods of time, and
- The work environment is relatively stable.

None of these are true in a project environment. In a sense every project is unique, if only by virtue of its own set of constraints, although indeed there may be many projects of a similar nature. Some typical examples of projects include:

- Launching a new venture
- Developing a new product
- Effecting a change in structure, staffing, system or style in an existing organization
- Turning a poor performance situation into a satisfactory one within a target period
- Designing and producing a new transportation vehicle
- Designing and constructing a building or facility
- Implementing an urban or rural development program

PMBOK Standards

Let us begin by identifying a *project*. Really, it is any undertaking with an established starting point and defined objectives, the achievement of which clearly signify the conclusion of the project. In practice most projects are constrained by limits on the resources available to achieve the required objectives. The whole process of managing such a project is, of course, known as Project Management.

However, project management is merely a catch-all phrase for a number of major sub-functions. It is the

very identification and on-going analysis of these *functions*, which establishes the PMBOK. The representation of the PMBOK as a *matrix* provides flexibility in describing the various function inter-relationships. However, the *function chart structure* contained within each of these functions is presented as a *work breakdown structure*. The major project management functions that have been identified are briefly described below.

Many texts have been written about both traditional- and project- management. Doubtless many more will be written as our understanding continually advances. Here, therefore, we can only touch on some of the basic reasons for including the present range of functions within the PMBOK Standards.

Basic Project Management Functions

The definition of the project's objectives together with all the activities involved in their achievement, and the resources consumed, is known as the project scope. Since the scope of a project has the habit of changing during the life of a project, this gives rise to the need for *Scope Management*.

For a project to be considered effective or successful, certain standards of *quality* must also be stated or presumed. Establishing and maintaining these standards during the life of the project leads to the need for Quality Management.

Since a project is determinate, it is clearly set in the context of a finite period of time. Unfortunately, time is a completely inflexible resource, so that activities must be carefully planned and scheduled. This is referred to as *Time Management*.

Because in our society "time is also money," money is a closely associated resource. Fortunately, it is somewhat more flexible. Nevertheless, it too needs careful managing, so we have *Cost Management*.

Scope, quality, time and cost, form the basic core of project management. However, as yet we have not discussed some of the special circumstances which arise in the *management* of projects.

The Project Life Cycle

To achieve any kind of output or product, an effort is required. In the case of a project, however, the relation between effort and time is very distinctive. To visualize this relationship, consider a curve of effort plotted against time. Clearly the effort starts at zero (before the project has commenced) and ends at zero (when the project has been completed).

In between these two points, the effort-time curve invariably has a very characteristic profile. This may be likened to a pear sliced neatly down the middle,

one half of which rests flat face downwards, with the stem at time zero. The vertical profile is then typical of the time-effort relationship.

Moreover, through the work of contributors to PMI, it has been reasonably established that every project, generically speaking, passes through four distinct *project phases*. These are known collectively as the *project life cycle*. Individually and according to the area of project application, these four phases may be known by different terms, for example: *concept*, *development*, *execution* and *finishing*. This happens to be my preference because the sequence C, D, E, F, is very easy to remember. Others may use successively terms such as Initiation, Planning, Implementation and Termination or Commissioning.

This project life cycle should not be confused with *Facility/Product Life Cycle* or even *Corporate Business Life Cycle*. It is of course related to these other life cycles and these relationships are shown diagrammatically in Figure 1. It may be noted that in the diagram the project phases are further divided into project stages. Thus *stages are subsets of phases*.

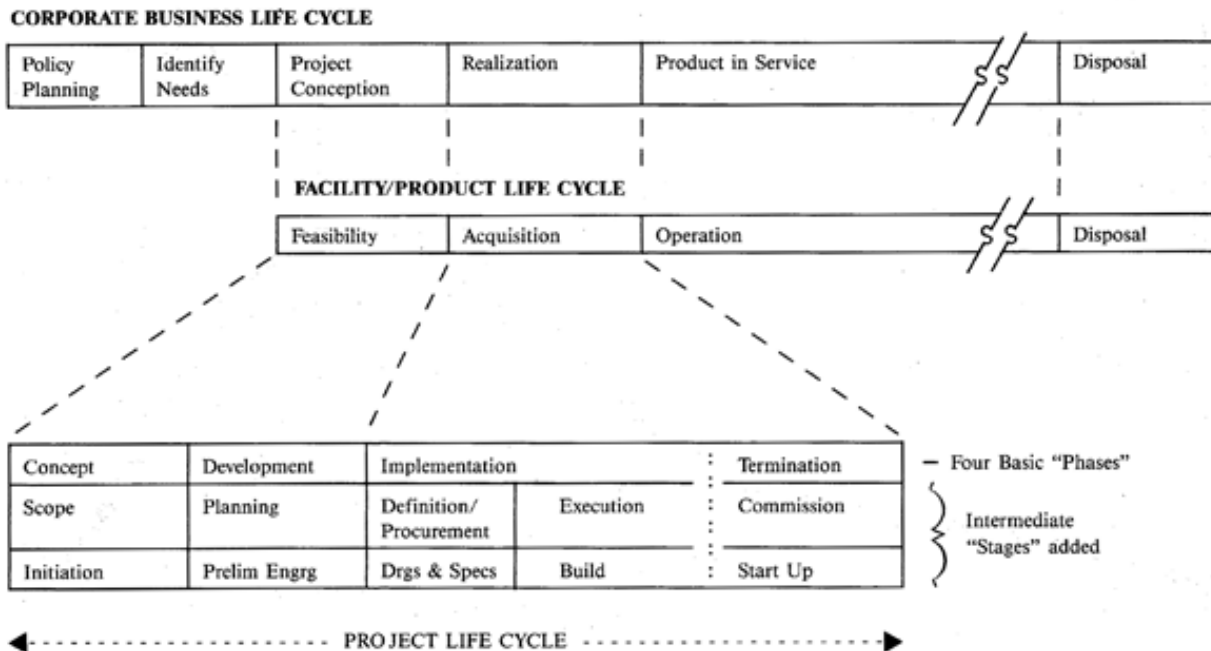
Like the profile of the pear mentioned above, the time-effort curve starts to rise up in the concept phase, tends to level off during development, rises again sharply to a high peak during execution, and then even more rapidly drops to zero in the finishing phase. This typical profile is shown in Figure 2.

This phenomenon is fundamental to the concept and needs of project management. The rapidly changing situation depicted by the time-effort curve through project life cycle places special emphasis and requirements on a number of areas of otherwise traditional management science. For this reason, these areas are considered to be essential knowledge for the effective management of projects.

Other Essential Functions

Projects are achieved through people and their respective skills and abilities. But the number of people and their types of skill varies considerably during the project life cycle according to the level of effort required as we have already seen. Consequently, many of these people are required only for relatively short periods of time. Normally there will be a core group referred to as the *project team*, led by a Project Manager

Indeed, even the project team is required only temporarily. Thus, careful attention must be given to the assembly of people working together effectively through a clear understanding of their respective *roles* and *responsibilities* in a temporary organizational environment. This requires *Human Resources Management*.



**Figure 1: PROJECT DEFINITION –TYPICAL PROJECT LIFE CYCLE
compared with
CORPORATE BUSINESS and FACILITY/PRODUCT LIFE CYCLE**

Often these temporary organizational arrangements take place within a traditional management organizational setting. This introduces the concept of a *Matrix Organization*.

Projects are only launched for purposes of achieving change through predetermined objectives, or at least they should be! Because of the relative uniqueness of every project and the rapidly changing conditions as depicted by the time-effort curve, both mentioned above, the final outcome of every project is always uncertain.

This gives rise to the need for special and constant attention to the forecast final results in terms of meeting the ultimate objectives, including all resources consumed. Based on this forecast, especially if the forecast is unfavorable, it is possible to modify direction by exercising control.

Control is only achieved if all parties to the project clearly understand their respective roles and responsibilities as a result of careful planning and communication. Moreover, the *status* of the project at any given time is only apparent through consistent and accurate *feedback*. Often this feedback can only be fully understood through a proper interpretation of the *project environment*, both internal and external. Responding to the project environment is usually referred to as *Public Relations*.

Collectively, these activities come under the heading of *Communications Management*.

People and communication alone are not enough to

implement a project. It is the service that people offer that is needed to execute the project. It is a common experience that a major portion of a project manager's time must be given over to procuring peoples' commitment to the objectives of the project. In addition, materials and equipment are also most likely required. The *commitment* of these goods and services are obtained through *Contract/Procurement Management*.

Uncertainty was mentioned earlier. Uncertainty is associated with *probability* and *risk*. Prudent management will take steps to mitigate the possibility of a less-than-favorable outcome by reducing the project risk wherever this can be achieved cost effectively. This leads to the need for a comprehensive understanding of the nature of the project in the first place, especially if it is a complex and inter disciplinary project. These activities are identified as *Risk Management*.

Finally, to tie all these PM Functions together, the PMBOK Standards Committee concluded that a further PMBOK section would be required to provide a frame of reference or overview. This section, which is not strictly a project management function, has been given the name *Project Management Framework*. From an educational standpoint, however, it is another subject area in its own right.

Project Management Framework provides the oppor-

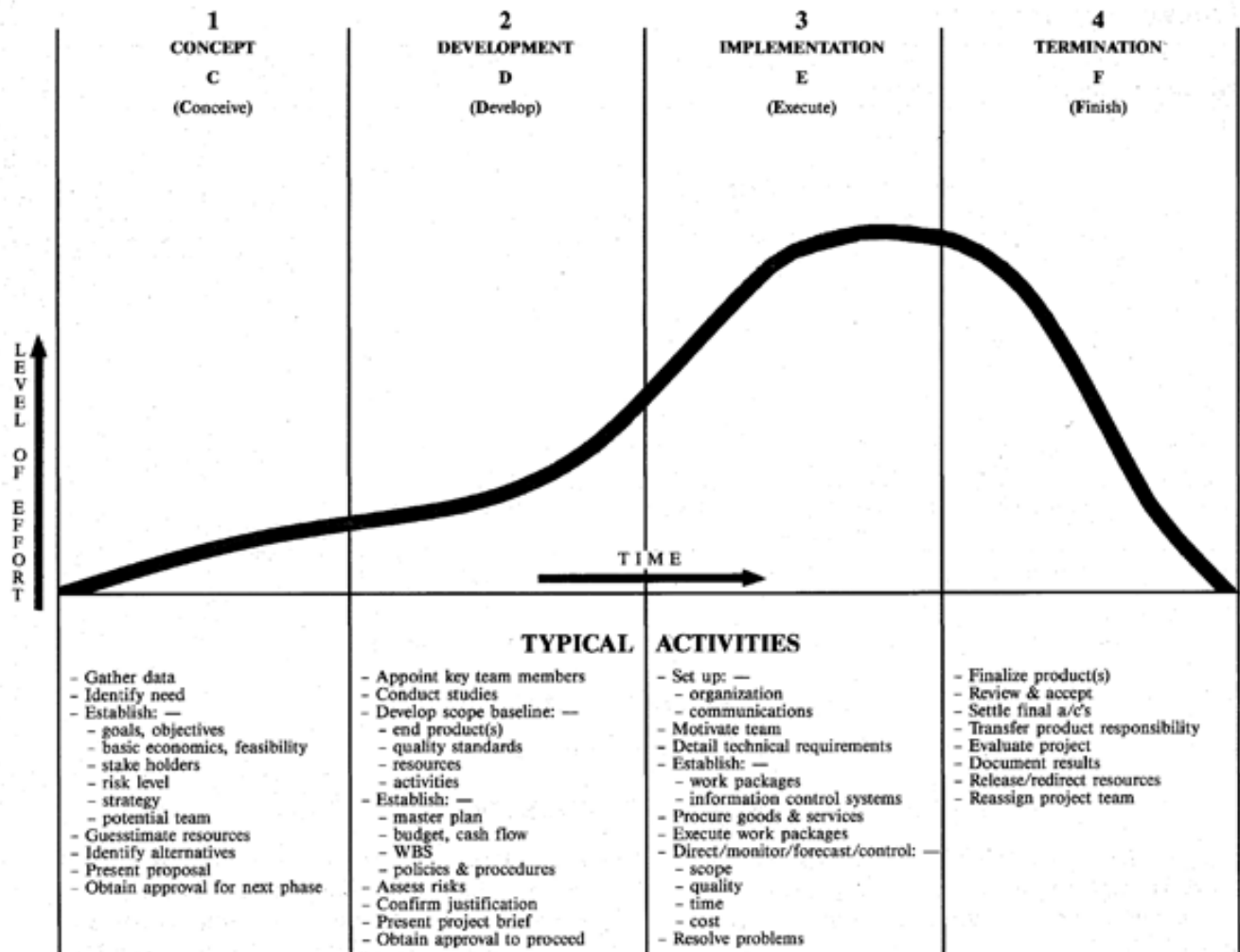


Figure 2: PROJECT LIFE CYCLE – FOUR BASIC PHASES

tunity in which the concept of a matrix can be developed to demonstrate the interdependencies and *interfaces* between the respective functions. It also provides the opportunity to take an overview perspective of a number of other aspects of project management. Examples include the process of control, typical project life cycles, the need for *project integration* and *interface management*, and the place and impact of project management in the various public and private sectors.

It can also be the repository of some general project management background and information as well perhaps as some of the more universal tools and *techniques* of project management.

The PMBOK Setting

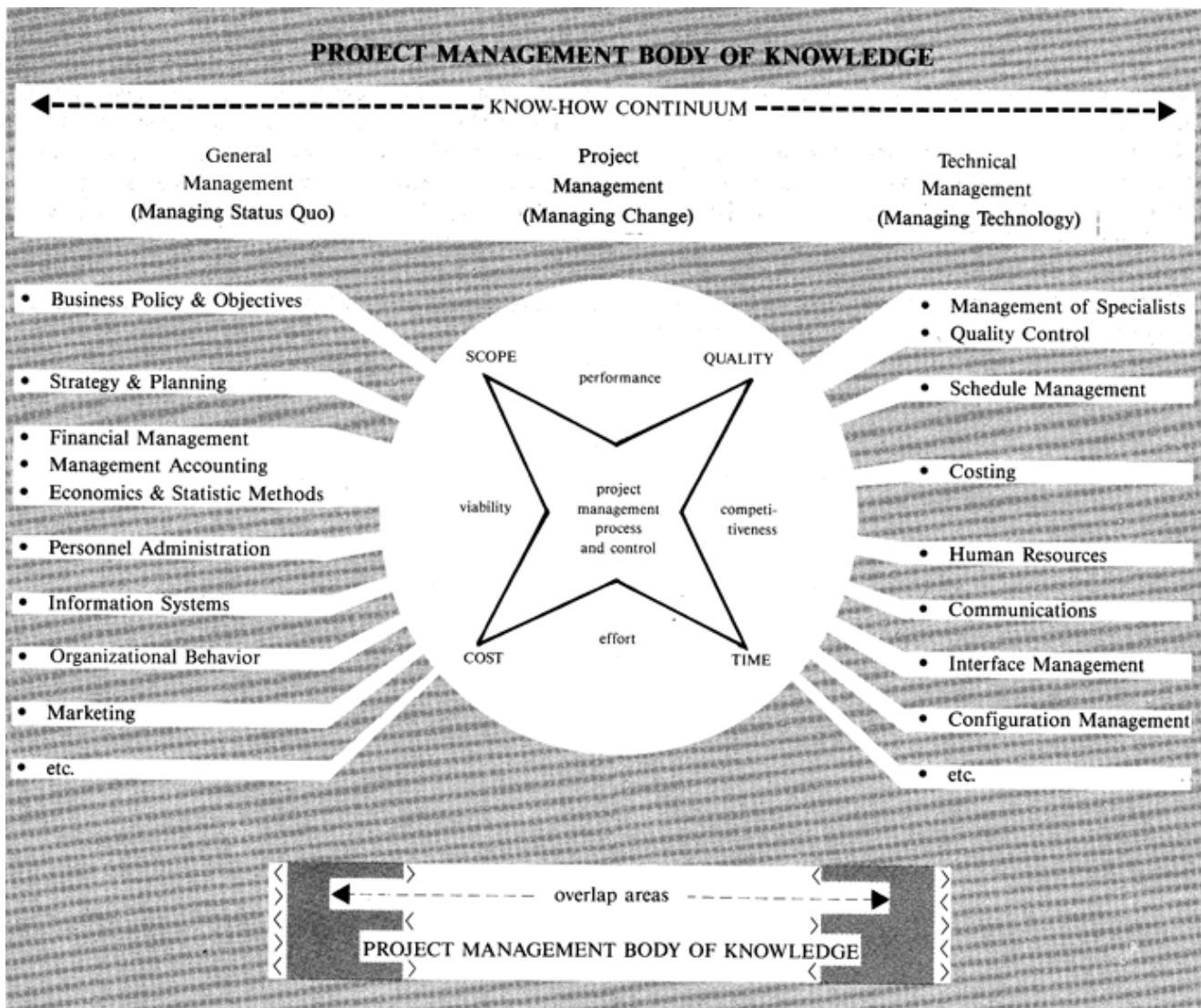
It is possible to depict the environment of project management and its related body of knowledge in a number of different ways. Venn diagrams and three

dimensional matrices or boxes are all feasible. Figure 3 on page 1-5 attempts to show the role of the PMBOK as a vehicle for the creation of change between General Management and Technical Management. The explanation of the diagram is as follows:

The striped gray background represents abstract space. Into this space is introduced the top strip which is intended to portray the whole spectrum of knowledge which is required to successfully conduct industry and business. Of course this includes both the public and private sectors. As the diagram shows, this spectrum ranges from the know-how of general management on the left, through project management, to technical management on the right

The next series of strips immediately below are intended to elaborate on the top strip. The central overlay circle encompasses the process and control that is project management.

The star points to the four key restraints of scope,

**Note:**

The overlap areas infer that the project management staff must have sufficient understanding of the various specialist disciplines to appreciate project requirements and issues. They must also be able to communicate appropriate direction and means of conflict resolution to these specialists in order to reach a successful project conclusion.

Figure 3: The role of PMBOK sitting between General Management and Technical Management

quality, time, and cost. As every project manager knows, these restraints are inextricably intertwined. Scope-quality represents performance, scope-cost represents viability, cost-time represents effort, and quality-time represents competitiveness,

As stated in the note below the diagram, for the project team to function effectively, "PM staff must have sufficient understanding of the various specialist disciplines to appreciate project requirements and issues. They must also be able to communicate appropriate direction and means of conflict resolution to these specialists in order to reach a successful project conclusion." One might add the corollary that, because of their particular bias, specialists frequently

have difficulty in becoming good project managers.

This "sufficient understanding" is represented by the "fingers" which reach from the central project management circle into the areas of general management on the left and technical management on the right. Further, if these fingers are traced horizontally, then each depicts a typical functional management area which itself ranges from the general application on the left to the specific technical application on the right. Perhaps the best example is the strip ranging from Information Systems in general to Communications in particular.

Clearly, the Project Management Body of Knowledge cannot possibly encompass the whole know-how continuum. Nor would it be appropriate because

Project Management has its own unique special area of expertise. This is shown by the white area within the bottom strip in the diagram. The two "overlap" areas of gray on this strip reflect the extent to which this knowledge must necessarily extend into the two areas on the left and right of the diagram.

I would add that the gray area on the left is knowledge that every project manager should have. The gray area on the right, on the other hand, is specific to the technical field. This is what makes an individual project manager a specialist in a given area of application.

Thus, sound project management is what enables general management to come together with technical management for purposes of managing progress and change effectively and efficiently for the benefit of all.

Part 2 An Overview

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Overview of existing PM body of knowledge

This report is a summary of the discussions at one of the individual tracks of the Project Management Body of Knowledge workshop held in conjunction with the 1985 PMI Seminar/Symposium at Denver, Colorado. This particular track was charged with the task of taking an overview perspective of the existing project management body of knowledge. The thoughts expressed in this report were developed as a result of the extensive discussions, interactions, and some consensus among the workshop task members.

This track produced very stimulating discussions, and was a rewarding experience for all the participants. The author apologizes for any liberties, which he may have taken with the thoughts expressed at the workshop. This report is essentially a rethinking of the thoughts coming out of the track meeting plus a number of inevitable after thoughts and revisions that have occurred as a result of feedback from other concerned PMI members.

Introduction

The process of developing and obtaining agreement on the content of the body of knowledge referred to as project management was initiated by PMI as a portion of the job assigned to the Ethics, Standards and Accreditation (ESA) Project. The project members, led by the Southern Ontario Chapter, with Matt Parry serving as the project manager, made tremendous strides in advancing project management as a profession.

They began by recognizing that an accepted "profession" must have a unique, well-defined body of knowledge (BOK) that can be studied and learned through formal education. Their initial efforts left no doubt that there definitely was such a unique body of knowledge. However, defining exactly what should be included in this BOK has proved to be considerably more difficult, and therefore has continued to be an on-going effort.

PMI Project#121, and its workshop held in conjunction with the Denver Seminar/Symposium,

was conceived specifically for the purpose of continuing the process of defining this project management body of knowledge (PMBOK).

During the workshop's planning period it was recognized that it would be desirable to have one of the workshop tracks review the PMBOK from an overview perspective.

This article was prepared to report the results of these discussions that, during the workshop, became oriented towards refining the overview model or common frame-of-reference for the PMBOK.

Status of the Project Management Body of Knowledge

The original ESA Project, in approaching the PMI goal of fostering the professionalism of project managers, has taken the initial step in the definition of exactly what is in the project management body of knowledge. This resulted in a "Baseline" which provides an outline of the PMBOK. The ultimate objective was to extend this outline to provide standards for the profession of project management. This "Baseline Concept" divided project management into the following six basic functions:

- Human Resources Management
- Cost Management
- Time Management
- Communications Management
- Scope Management
- Quality Management

Each of these functions is further broken down into topics and subtopics in the manner of a Work Breakdown Structure (WBS). Each level of the WBS was clarified by glossaries that defined all of the terms used. It was proposed by the ESA Project group that this WBS would provide the Institute and its members with a model or "Baseline" for future discussion and agreement. It was in the spirit of building on this existing recorded effort that the present task group carried out their overview perspective of the project management body of knowledge.

Limitations of the WBS Model

The Baseline Concept provides a one-dimensional model following the branching of a Work Breakdown Structure. It is very appealing in its simplicity, particularly to project managers who feel very comfortable with the WBS structure as a management tool. However, the members of this PJ#121 Workshop Over-view track felt that there was a definite need to review the WBS model and to determine whether there might be other more applicable models. In pursuing this avenue, the track members reached general agreement on the following points:

(1) There appeared to be a need to scope out or put boundaries on the PMBOK. There are obviously large portions of other disciplines that can be directly incorporated into the PMBOK. However, there must be limits if this body of knowledge is to be kept within manageable boundaries. If this body of knowledge is to be recognized as unique to the project management profession, it must not appear to consist primarily of blocks of knowledge and tools appropriated from other disciplines.

(2) There appeared to be difficulties in incorporating some very important real-world aspects of the project manager's job into the six existing project management functions. There is a need for a special subject area in which the essential project management functions of project integration and interface management could be addressed.

(3) There appeared to be difficulties encountered in the use of the WBS model inadequately describing the necessary interdependencies and inter-relationships between the six project management functions. For instance, project schedule, cost and quality (performance) management are not separate tasks or functions; they are integrated functions and the planning and control tools must tie them together and recognize their interdependencies.

(4) There appeared to be a potential for a great deal of overlap and/or repetition in trying to adequately expand each function into the more detailed levels of the body of knowledge. Therefore, the original WBS model was evidently too restrictive for the purposes of representing the PMBOK as a whole.

Scope of the Project Management Body of Knowledge

As noted earlier, the task group recognized very early in the discussions that there was a need to put limits or boundaries on the body of knowledge. It was also recognized that project management is a complex multidisciplinary profession that has considerable overlap into many other disciplines and professions. The degree of overlap is also greatly dependent upon which particular industrial sector, field or other application is using the project management approach. The three major points of overlap are in the areas of:

- (1) General management
- (2) The technical area(s) in which the project is involved, and
- (3) The supporting or service areas which are also crucial to project success. This overlap can be depicted by a Venn diagram in which each circle represents a particular body of knowledge and the shaded areas represent the overlaps (Figure 4).

The four circles will have considerable overlap, but how much depends on the ground rules set to determine the scope of the PMBOK. In order to develop some logical ground rules, it is useful to determine what kinds of knowledge are in each of the bodies of knowledge that impact on project management.

Considerable controversy can immediately be generated concerning what portions of the general (or business) management body of knowledge should be included in project management. There is no argument, however, that the general management body of knowledge consists of the following types of knowledge:

- Business policy
- Business strategy
- Planning and controlling
- Financial management Accounting
- Business economics
- Information systems
- Organizational behavior
- Organizational development
- Staffing
- Personnel development
- Marketing and sales
- Problem solving
- Decision making

The question that must be answered, therefore, is what portion of these areas of knowledge should be included in the PMBOK?

Supporting or service disciplines are often essential for the success of project management, and parts of some of the following disciplines (or service departments) might also be included:

Quality Assurance (Control, Statistical etc.)
 Configuration Management
 Logistics (Integrated Logistics Support)
 Contract Administration
 Procurement (Purchasing)
 Personnel Administration
 Facilities (Industrial) Engineering
 Legal
 Computer Programming

Scope Of The Project Management Body Of Knowledge

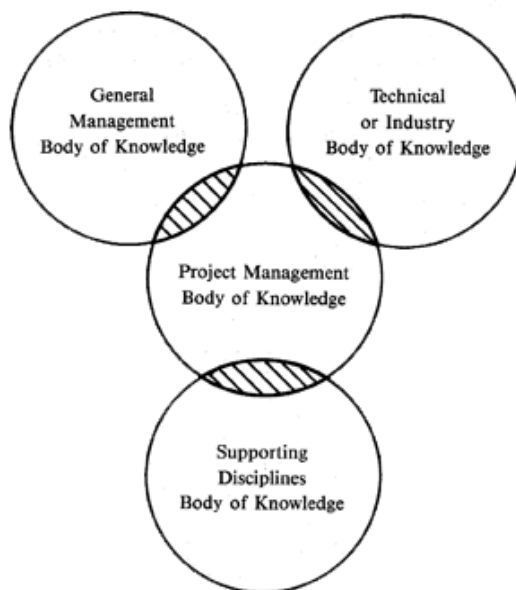


Figure 4

On the other side, the technical body of knowledge is somewhat more difficult to generalize since it is not truly represented by one single circle in the Venn diagram. It really should consist of a number of circles each representing one of the many different industries, technologies, and professional areas in which project management is applied. Each has a large body of knowledge, much of which impacts in some manner on the project manager's job.

The problem is to determine what portions of these technical bodies of knowledge should be included in project management. Indeed, further studies may be necessary to determine whether there are aspects of the project manager's job that are different depending on the particular industry or technology involved.

Project management is widely used in many types of industries or technologies, each of which may consist of many different disciplines. For example:

Aerospace	Government and
Civil Banking	Service
Computer Systems	Information Systems
Construction	Pharmaceuticals
Defense	Resource Industries
Education	Telecommunications
Energy & Utilities	Transportation

Figure 4 suggests that the following ground rules would be appropriate for scoping the project management body of knowledge:

(1) Much of the general management body of knowledge should be recognized as a given or prerequisite for project management and not included in the PMBOK unless aspects of this knowledge are an integral part of the project management process.

(2) The PMBOK should not include major areas of other disciplines, professions or detailed knowledge particular to a specific industry unless this information is also an integral part of the project management process.

(3) The PMBOK should not contain knowledge, technology, techniques or skills that are primarily useful in only one industry or technology. That is, it should not contain such items unless they are broadly useful in almost any application of project management.

(4) The PMBOK should not include major portions of supporting or service disciplines unless they are generally applicable to most projects. Such disciplines stand on their own feet and are principally utilized as tools of project management.

Only those specific applications that reinforce the job of the project management team should become part of the project management body of knowledge.

(5) The PMBOK should emphasize knowledge, skills and techniques which are either unique to project management or are fundamental to carrying

out the project management process.

(6) There is a definite need for the overlaps in the various bodies of knowledge as indicated in Figure 4. Project managers and their PM teams have a great need for an expertise in general management as well as considerable need for knowledge and expertise in the particular project field.

The Need for a Model

Thus, the Overview track recognized that there was a definite need for a framework for the PMBOK to serve the purpose of "gluing it all together". This track felt that the most appropriate way to accomplish this task was to develop a sound structural framework or model, firstly to organize and classify the body of knowledge and secondly to make certain that it is complete. To adequately accomplish these goals and to be useful to the membership of PMI, the model must do the following things:

(1) Clarify the overall scope and extent of the comprehensive project management body of knowledge.

(2) Break up the body of knowledge into logical and understandable categories or divisions.

(3) Utilize and build on the work accomplished by the PMI ESA Project

(4) Indicate the interrelationships between the various categories into which the project management body of knowledge can be subdivided.

(5) Take into account the complexities of project management and the integrating nature of the project manager's job and of his or her supporting team.

(6) Provide a breakdown of the project management body of knowledge into categories which can readily be utilized for storage and retrieval of all elements of project management i.e. functions, processes, activities, tools and techniques.

(7) Be sufficiently simple and understandable to be useful (i.e. saleable) to present and potential project management practitioners.

(8) Be consistent with the course content of project management educational programs (particularly with the PMI sponsored program at Western Carolina University).

Rationale for a Matrix Model

A variety of models were considered after it had

become apparent that a one-dimensional model was not completely satisfactory. The suggestion that a multi-dimensional matrix might better depict the complexities of the project management body of knowledge came from a number of workshop participants including the Pittsburgh Chapter and David Morton. The Overview track also decided that a matrix would ameliorate all of the previously listed limitations of the WBS model.

The development of the rationale began by a consideration of the three basic project management functions or elements of every project, namely schedule, cost, and technical performance (Figure 5). In addition, it was recognized that the integrative project management functions are quite independent of, and cut across, all these basic functions. The applicability of a two-dimensional matrix then became obvious; one dimension consisting of the basic project functions or elements, and the other dimension consisting of the integrative project management functions.

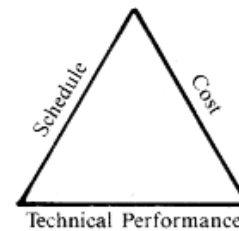


Figure 5

The necessity or desirability of a third (or even fourth) dimension can be debated at length. A very good case can be made for making additional dimensions for the project life cycle, the system environmental level, the system technical environment, or even a breakdown into processes, activities, tools and techniques (Figure 6). For completeness the PMBOK could well be described by a three- or four-dimensional matrix. However, it was felt that more than two dimensions would add

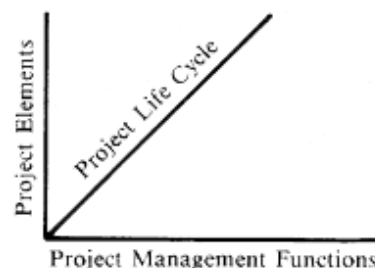


Figure 6

unnecessary complexity to the model and to the resulting descriptions of the project management body of knowledge.

Further it was felt that the significance of these additional dimensions may be minor from a practical point of view, and their existence can be recognized in future descriptions of the detailed blocks of knowledge.

For instance, does the job of the project manager and PM team change significantly during the different stages of a project life cycle? Certainly the project and the project manager's duties will change greatly during the life of a project; however, for the most part the differences are seen as changes in emphasis.

For example, during the startup of a project the project manager will be preoccupied with planning while at the end of a project the emphasis will primarily be on termination. However, all projects, by definition have these characteristics and both are clearly a part of the PMBOK. The basic fundamentals of good project management are common to all projects, and are the heart of the project management body of knowledge.

The Model

It was apparent that the greatest difficulty would be to obtain consensus on the specific breakdown of the two dimensions of the matrix – the project elements and the project functions. Starting with the three basic project elements of cost, schedule, and technical performance, there was considerable disagreement as to whether other elements were needed to complete the picture.

Although it was argued that project scope and environment could fall under technical performance, they were added to the basic project elements to obtain

consensus.

There seemed to be an almost unlimited number of management functions that might be included in the matrix; however, the seven included in Figure 7 (see next page) were selected as the most important. Certainly a number of others could be added.

The matrix model's usefulness is most evident in the flexibility by which the PMBOK can be organized and reviewed. At each intersection in the body of the matrix is a "box" representing a particular block of knowledge defined by the two dimensions of the matrix.

Each "box" or block of knowledge consists of the relevant knowledge, skills, processes, activities, techniques and tools consistent with the particular dimensions. Thus, individual blocks of knowledge can be clearly defined, and interrelationships or overlaps between them can be readily identified.

Conclusions and Recommendations

The Overview workshop track began with the recognition that there was a need for a fresh look at the model for the project management body of knowledge. The limitations of the WBS model led the group rather logically to a consideration of a matrix model since it evidently provides a flexible and useable tool for identifying the PMBOK.

The membership of PMI in their future effort to identify and expand project management as a profession will find the matrix to be a much more flexible and useful framework on which to build. The group, therefore, recommends that the two-dimensional matrix model be adopted to provide a new framework and overview perspective of this rapidly growing unique project management body of knowledge.

		PROJECT ELEMENTS				
		Scope	Quality	Schedule	Cost	Environment
PROJECT MANAGEMENT FUNCTIONS	Mgt. of Planning and Control					
	Mgt. of Proj. Integration					
	Mgt. of Resources					
	Mgt. of Risk					
	Mgt. of Human Resources					
	Contracts and Procurement					
	Mgt. of Info. and Communications					

Figure 7: Project Management Matrix Model

Part 3 AN INTEGRATIVE MODEL

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Abstract

This is a progress report on the portion of the Project Management Body of Knowledge project known as the PMBOK Framework. Although the framework of the PMBOK has been implicit in the development of the definition of the functional components of the PMBOK, its explicit definition has lagged that of its components.

Through the published efforts of Max Wideman and Linn Stuckenbruck we have become aware of the need to define the overall framework of the PMBOK. This report documents development of the Framework to this point, describes available materials, and proposes a course of action for the further development of the PMBOK Framework.

The Need For A PMBOK Framework Model

The need for a Framework model of the Project Management Body of Knowledge is evidenced by the most difficult question we are asked about Project Management, "What is Project Management?" Our inability to give even a consistent answer to this question demonstrates our need.

The Framework model of Project Management should:

- Describe how project management is different from other types of management
- Establish criteria for determining what constitutes a Functional Component
- Identify the present components of Project Management and their dynamic interaction
- Describe the appropriate applications of Project Management and its benefits
- Provide an authoritative lexicon of the technical terms of Project Management

The time is ripe for development of the Project Management Framework Model. When coping with the unknown, we most often start developing new ideas from the base of what we already know. The PMBOK is no exception. We now have a sufficient definition of the more specific components of Project Management so we can begin the work of defining the integration of these. The Framework Model is the tool that helps answer our most difficult question.

Current Structure Of The Framework Model

In recent months, the membership of PMI has been quite productive in making suggestions on the nature and structure of the PMBOK Framework Model. Contributions from Lew Ireland, Phil Nunn and Lloyd Rogers were published in August 1986. Linn Stuckenbruck's report in August 1986 recommended an alternative model.

The purpose of a model of the Project Management Body of Knowledge is to help us organize this knowledge so that we can examine and evaluate the scope of our profession. It also helps colleges and universities to structure programs for training Project Managers and conducting research. These tasks are formal parts of PMI's primary objective that is to advance the state-of-the-art in project management.

To arrive at a more specific Framework Model, the examples already submitted and published were reviewed to identify commonality in their structures. This was a tricky operation because the Framework model should not disturb any of the existing models of the PM Functions. The resulting PM Framework Model, which is intended to integrate the whole of the PMBOK, is shown In Figure 9 at the end of this article.

As an integrated whole, it has some characteristics that are unique to it and not shared with the PM Function models. In familiar terms, "The whole is greater than the sum of its parts". This concept of an integrated whole allows us to examine such topics as Types and Applications of Project Management, the Benefits and Limitations of Project Management, and the External Interfaces of Project Management.

Max's model displayed in Figure 3, 1-5, is an example of a model of one of the External Interfaces of Project Management. It is a workable presentation of the management knowledge environment within which Project Management is imbedded. Although management knowledge is not the only environment for project management that we must consider, it is a particularly difficult one to understand. It is a nebulous abstraction with no direct concrete outcomes.

As the cognition theorist, Art DeLong, has said,

"The whole foundation of mankind is based on how we humans learn by acquiring knowledge". Some specific Project Management environments are shown listed in the Figure on page 3-4.

The Types and Applications of Project Management are the domain of the Framework model. Individually, we do not usually recognize the existence of configurations for projects. This may be due to our limited experience with only one or a few businesses, industries, or governmental activities.

When I start asking questions of people from other lines of work, I start appreciating that there probably are many types of project management. These need to be examined, defined and compared. The Framework is the place to start this effort, although it will filter down into the PM Function models.

When we try to explain the benefits and limitations of Project Management, we are operating at the level of the Framework model. This is where we compare Project Management as an integrated whole to other methods of management. It takes all of the Functional Models combined and then some to be able to make these comparisons.

Under each component in the PM Framework breakdown structure, example items have been listed. These lists are not complete, nor are they necessarily accurate. There probably are some intervening levels of breakdown needed for most of the Framework components. This is work that still needs to be done.

Many of the components of the Framework model are shared with the PM Functional Models. These relationships are only hinted at by the Cross Impact Matrix shown in Figure 8. Where X's do not appear at all, that Framework Component is over whelmingly focused at the Framework level.

Some of the Framework Components of Figure 8 display relationships with only some of the PM Functions. This is the case for the Active Direction component, which is indicated as having a relationship with only Human Resources and Communications & Information. Active direction of a project is a human activity. Its focus is on the human Functions.

This is not necessarily to the exclusion of the other Functions, but the extent of their direct participation is low. For example, Time Management's participation in Active Direction is to provide some of the information communicated, but Active Direction is a human to human activity while schedules are inanimate data.

Two characteristics missing from the Cross Impact Matrix of Figure 8 are the extent of participation by each PM Function, and the dominant direction of the participation. With regard to the direction of

participation, the PM Function models will contribute to the Internal Interfaces of the Framework Model. On the other hand, the Functional Models will get their guidance on Life Cycle from the Framework Model. Clearly, there is more work to be done on these characteristics

For the bored practitioner, I offer this solace. You are right! The examination of abstract models has little practical use unless the model leads us to a usable organization of our knowledge. Just as you suspected, there is no "right" model for the task of organizing our knowledge.

There are also no "wrong" models. There are, in fact, as many models as there are people willing to develop them. However, there is no question that some models facilitate the organization of our knowledge better than others.

The present Framework Model, page 3-4, can be elaborated on, but that should be a controlled academic exercise. Otherwise, we can become so embroiled in the comparison of knowledge models that we lose sight of our purpose.

The Framework Committee's purpose must be to establish a model to organize the Project Management Body of Knowledge so that education programs can continue to be developed and PMI's certification program can continue to grow without losing its coherence.

Future Action

Over the next year, I propose that the PMBOK Framework Functional Committee be thought of as a working group. To reinforce this practical and productive focus, I will probably refer to it as the Framework Working Group.

The Framework Working Group, like all task forces and project teams, needs objectives. My proposed objectives for the Framework Working Group for the next year are therefore to:

(1) Elaborate The Framework Model

This work will put the Function Models of the Project Management Body of Knowledge in perspective with each other, that is, within an integrating framework. This is a target rather than an objective because it must be recognized that this is a pioneering effort. There is little precedent and few guides. The rate of accomplishment is going to be

PROJECT MANAGEMENT FUNCTIONS

		Scope	Quality	Time	Cost	Risk	Human Resources	Procurement	Communication & Information
P M F R A M E W O R K C O M P O N E N T S	Definitions & Glossary	X	X	X	X	X	X	X	X
	Types & Applications								
	Benefits & Limitations								
	Internal Interfaces	X	X	X	X	X	X	X	X
	External Interfaces								
	Life Cycle	X	X	X	X	X	X	X	X
	Planning & Preparation	X	X	X	X	X	X	X	X
	Active Direction						X		X
	Performance Monitoring	X	X	X	X	X		X	
	Analysis & Interpretation	X	X	X	X	X		X	

Note: "X" indicates a strong relationship between the PM Function and the framework component.

A blank indicates a lesser contribution and hence focus at the Framework level.

Figure 8 Cross Matrix Model of the Project Management Framework

quite variable. The importance is placed on development toward the target and making progress.

The PMBOK Framework, as an integration model, will focus on those ideas that tie the components together. It will also attempt to identify the processes by which the components work together in practice. This will be the effort to carry out Harvey Levine's charge to "Tie a ribbon around each of the six packages" And, an effort will be made to avoid reinventing the wheel.

Time spent on evaluating alternative models to the ones already presented will be limited. Most of the work will be placed on elaborating and clarifying the existing models. New and alternative models will be examined only where a gap in the organization of our knowledge prevents work from progressing. In summary, this will be a disciplined design effort rather than a daydreaming session.

I am convinced that this effort to organize the Framework of the PMBOK is needed at this time to stabilize the gains we have already made and provide a firm base for solid development of the PMBOK in the future. I do agree with those who think it is more fun to bite off new ideas than to digest what we already have. However, without this period of digestion, we will lose our direction and sense of purpose as new ideas are presented to us in the future.

This will be a group effort. Several people are being contacted to contribute specifics to this work but anyone willing and able to manipulate abstractions will be welcome.

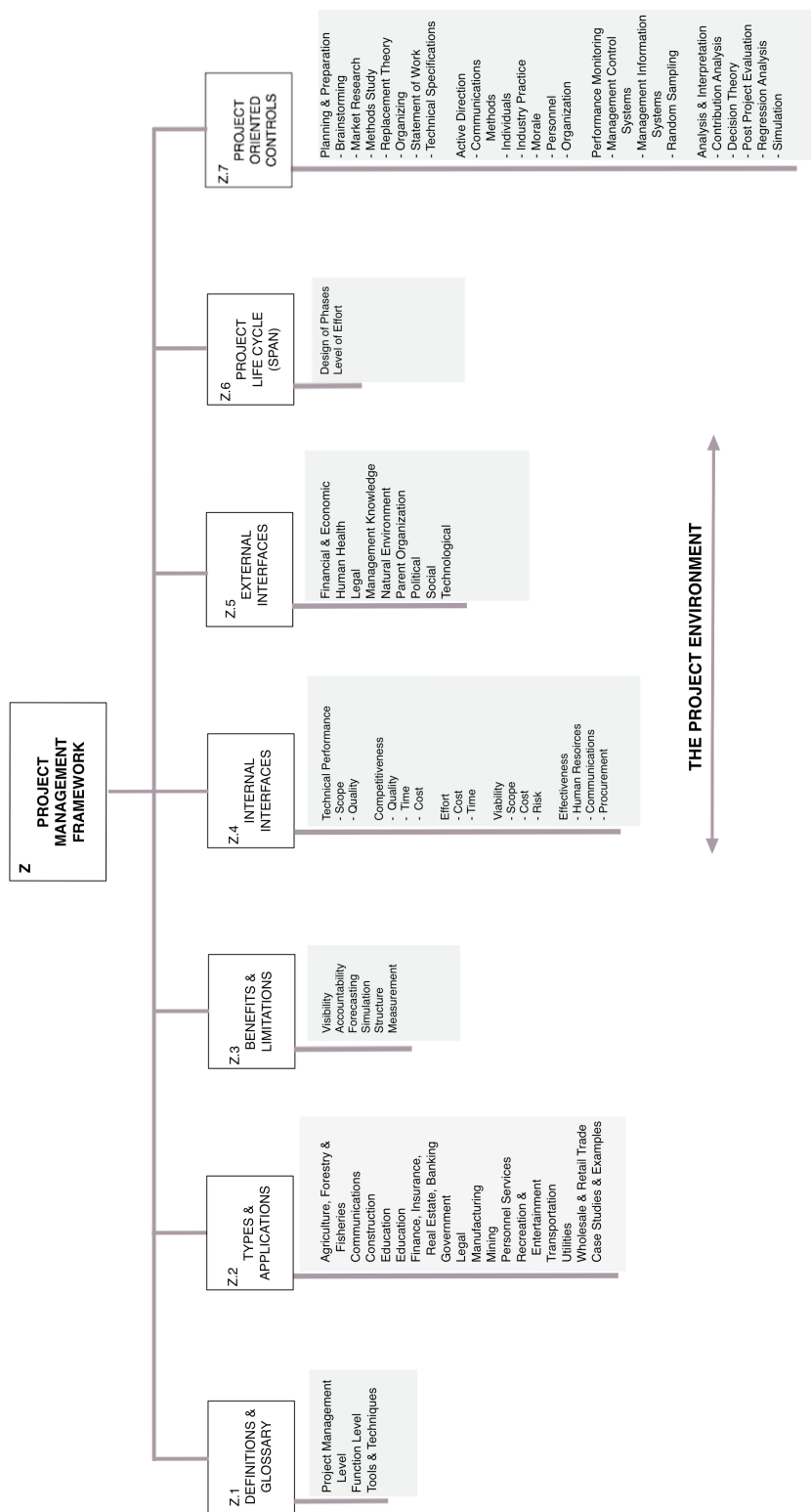
(2) Collect Together The PM Glossary

We shall be seeking help to pull together a complete, concise and understandable glossary of Project Management terminology. We need to combine the several efforts of the many previous contributors, and make a first authoritative publication.

(3) Develop Certification Questions

The Framework Working Group needs to develop a pool of questions about the components and topics unique to the Framework Model. Also questions relating to interfacing among the Function Models need to be developed. The appropriate PMI committee will provide Guidance for the format and content of these questions.

This task will necessarily have to start at least half way through the year because the group working on Framework Model itself will be the best suited to write the questions. But, they must be given time to get the Framework Model refined well enough to provide guidance for question writing.



Part 4 Glossary of General Terms

Framework Functional Definitions

Project Management Institute (PMI): A non-profit organization dedicated to advancing the state-of-the-art in the profession of project management.

Project Management (PM): It is now generally accepted by PMI that project management is an established discipline that can be defined as follows:

"Project Management is the art of directing and coordinating human and material resources throughout the life of a project by using modern management techniques to achieve predetermined objectives of scope, quality, time, cost, and participant satisfaction."

Project Management Body of Knowledge (PMBOK): is defined as all those topics, subject areas and intellectual processes that are involved in the application of sound management principles to the collective execution of any types of effort that qualify as projects.

Project Management Framework: The idea of setting out to achieve certain predetermined objectives in several concurrent areas presupposes the application of discipline and control through sound management practices. This in turn requires delegation of effort to various specialized "functional" management areas in which the separate objectives are to be achieved.

However, each of these functions must contribute to the successful overall achievement of the project's objectives and assist the control effort through systematic processes appropriate to the particular function.

Through its work in examining the body of knowledge that is the discipline of project management, the Institute has now identified nine areas of concentration. This generic Project Management Body of Knowledge consists of a Project Management Framework that in turn encompasses eight major PM functions, namely the management of scope; quality; time; cost; risk; human resources; contract-procurement (including materials and equipment); and communications.

Note that this list includes only those functions that are generally applicable to any type of project, whether it be in construction, defence, aerospace, hi-tech, pharmaceuticals, education and so forth. Not included are the many technical functions that are necessary, but that are specific to each particular

field of project endeavor.

In defining each PM function, it is useful to identify the processes (i.e. specific series of activities) that are involved in the function, and that are necessary to achieve the required function output. These can be defined as follows:

Scope Management: is the function of controlling a project in terms of its goals and objectives through the processes of conceptual development, full definition or scope statement, execution and termination.

Cost Management: is the function required to maintain effective financial control of the project through the processes of evaluating, estimating, budgeting, monitoring, analyzing, forecasting, and reporting the cost information.

Time Management: is the function required to maintain appropriate allocation of time to the overall conduct of the project through the successive stages of its natural life-cycle (i.e. concept, development, execution, and finishing) by means of the processes of time planning, time estimating, time scheduling, and schedule control.

Quality Management: Quality itself is the composite of material attributes (including performance features and characteristics) of the product or service that are required to satisfy the need for which the project is launched. Quality standards through the sub-functions of Quality Assurance and Quality Control.

Quality Assurance (Management): is the development of a broad program that includes the processes of identifying objectives and strategies, of client interfacing, and of organizing and coordinating planned and systematic controls for maintaining established standards. This in turn involves measuring and evaluating performance to these standards, reporting results and taking appropriate action to deal with deviations.

Quality Control (Technical): is the planned process of identifying project established system requirements and exercising influence through the collection of specific (usually highly technical and itself standardized) data. The basis for decision on any necessary corrective action is provided by analyzing the data and reporting it comparatively to system standards.

Human Resources Management: is the function of directing and coordinating human resources throughout the life of the project by applying the art and science of behavioral and administrative knowledge to achieve the predetermined project objectives of scope, cost, time, quality and participant satisfaction.

Communications Management: is the proper organization and control of information transmitted by whatever means to satisfy the needs of the project. It includes the processes of transmitting, filtering, receiving and interpreting or understanding information using appropriate skills according to the application in the project environment. It should also include the storage and retrieval of that information.

It is at once the master and the servant of a project that it provides the means for interaction between the many disciplines, functions and activities. These are both internal and external to the project, and that together result in the successful completion of that project.

Contract-Procurement Management: is the function through which resources (including people, plant, equipment and materials) are acquired for the project (usually through some form of formal contract) in order to produce the end product. It includes the processes of establishing strategy, instituting information systems, identifying sources, selection, conducting proposal or tender invitation and award, and administering the resulting contract.

Risk Management: is the art and science of identifying, analyzing and responding to risk factors throughout the life of a project and in the best interests of its objectives.

Function Chart Structure: Each of these PMBOK management functions is depicted by a Work Breakdown Structure (WBS) Chart broken down as follows:

WBS Descriptor	Description Level
0	Discipline i.e. The complete project management matrix
1	Function i.e. scope, quality, time, etc.
2	Process i.e. The specific series of activities that lead to an output that is the title in the process box, e.g. budgeting, scheduling, organization, quality design, etc. In other words, the "what" in "what is project management".

- | | | |
|---|-------------------|--|
| 3 | Activity | i.e. The series of tasks that lead to the specific process output. In other words the "how do we get there". |
| 4 | Techniques | i.e. The specific arrangement of tasks available to aid or accomplish the activity. |

Other General Definitions

Activity: A task or series of tasks performed over a period of time.

Area of Project Management Application: The environment in which a project takes place, with its own particular nomenclature and accepted practices e.g. facilities, products or systems development projects (to name a few).

Baseline: Management plan and/or scope document fixed at a specific point in time in the project life cycle.

Baseline Concept: Management's project management plan for a project, fixed prior to commencement.

Commitment: An agreement to consign or reserve the necessary resources to fulfill a requirement until expenditure occurs. A commitment is an event.

Concept: An imaginative arrangement of a set of ideas.

Control: The exercise of corrective action as necessary to yield a required outcome consequent upon monitoring performance.

Corporate Business Life Cycle: A life cycle that encompasses phases of policy-planning and identification-of-needs before the typical project life cycle, as well as product-in-service and disposal after the project life cycle.

Cost Effective: Better value for money, or the best performance for the least cost.

Effort: The application of human energy to accomplish an objective.

Environment: The combined internal and external forces, both individual and collective that assist or restrict the attainment of the project objectives. These could be business or project related or may be due to political, economic, technological or regulatory conditions.

Facilities/Product Life Cycle: A lifecycle that encompasses phases of operation and disposal as well as, and following, the project life cycle.

Feedback: Information (data) extracted from a process or situation and used in controlling (directly) or in planning or modifying immediate or future inputs (actions or decisions) into the process or situation.

Forecast: An estimate and prediction of future conditions and events based on information and knowledge available at the time of the forecast.

Function (PM Function): The series of processes by which the project objectives in that particular area of project management, e.g. scope, cost, time, etc., are achieved.

Interface Management: The management of communication, coordination and responsibility across a common boundary between two organizations, phases, or physical entities that are interdependent.

Management: The process of planning, organizing, executing, coordinating, monitoring, forecasting and exercising control.

Matrix (PMBOK matrix): A two-dimensional structure in which the horizontal and vertical intersections form cells or boxes. In each cell may be identified a block of knowledge whose interface with other blocks is determined by its position in the structure.

Matrix Organization: A two-dimensional organizational structure in which the horizontal and vertical intersections represent different staffing positions with responsibility divided between the horizontal and vertical authorities.

Mitigation: The act of revising the project's scope, budget, schedule or quality, preferably without material impact on the project's objectives, in order to reduce uncertainty on the project.

Monitoring: The capture, analysis and reporting of actual performance compared to planned performance.

Plan: An intended future course of action.

Process: The set of activities by means of which an output is achieved.

Project: Any undertaking with a defined starting point and defined objectives by which completion is identified. In practice, most projects depend on finite or limited resources by which the objectives are to be accomplished.

Project Environment: See Environment.

Project Integration: The bringing together of diverse organizations, groups or parts to form a cohesive whole to successfully achieve project objectives.

Project Life Cycle: The four sequential phases in time through which any project passes, namely, Concept; Development; Execution (implementation or operation); and Finishing (termination or close out). Note that these phases may be further broken down into stages depending on the area of project application.

Project Manager: The individual appointed with responsibility for project managing the project.

Project Organization: The orderly structuring of project participants.

Project Phase: The division of a project time frame (or project life cycle) into the largest logical collection of related activities.

Project Risk: The cumulative effect of the chances of certain occurrences that will adversely affect project objectives. It is the degree of exposure to negative events and their probable consequences. Project risk is characterized by three factors: risk event, risk probability, and the amount at stake.

Project Stage: A sub-set of Project Phase

Project Team: The central management group headed by a project manager and responsible for the management and successful outcome of the project.

Public Relations: An activity designed to improve the environment in which an organization operates in order to improve the performance of that organization.

Responsibility: Charged personally with the duties, assignments, and accountability for results associated with a designated position in the organization. Responsibility can be delegated but cannot be shared.

Schedule: A display of project time allocation

Scope: The work content and products of a project or component of a project. Scope is fully described by naming all activities performed, the resources consumed and the end products that result, including their quality standards. A statement of scope should be introduced by a brief background to the project, or component, and the general objective(s).

Status: The condition of the project at a specified point in time.

System: A methodical assembly of actions or things forming a logical and connected scheme or unit.

Technique: Skilled means to an end

Uncertainty: See Project Risk

Work Breakdown Structure: A task-oriented "family tree" of activities that organizes, defines and graphically displays the total work to be accomplished in order to achieve the final objectives of the project.

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SCOPE MANAGEMENT

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Introduction

In setting the foundation for discussing the project management function of Scope Management, one has to first understand that this concept entails managing the entire scope of the project. "The scope of a project can be either the work content or component of a project. It can be fully described by naming all activities performed, the end products that result and the resources *consumed*" [10]. Scope Management, therefore, clearly has to be a concern for any project manager

Although all of the project management functions addressed in Project #121 are being developed individually, as a whole they provide a uniform framework for PMI's "Body of Knowledge". The functions are interrelated and mutually supportive. To achieve the objectives of a project, they must also be employed in an integrated manner. This is especially inherent when discussing Scope Management.

Conceptual Development

Conceptual development entails the identification, definition and documentation of the project's objectives to meet the goal(s) of the project sponsor. Included is the selection of the best summary level approach to achieving these project objectives. Also included in this process is the identification of the need to find a solution.

The end items resulting from conceptual development can include:

- Detailed results from conceptual analysis
 - what precipitated the problem
 - expected results
 - cost estimate at the project summary level
 - benefit/cost analysis (if the solution offers economic benefit)
 - constraints considered
 - alternatives considered
- Conclusions
 - problem and solution at the summary level
 - recommendation whether to proceed or not to proceed to the preliminary phases of the project with the solution
 - project objectives

- Summary Work Breakdown Structure
- Summary Project Master Schedule

This documentation serves as guidance for the development of Scope Statement as well as project initiation.

Scope Statement

The documentation and approval of project requirements/parameters is necessary before proceeding with subsequent phases of a project. This information provides a basis for making future decisions, accomplishing verification measures and evaluating changes to the scope.

Project definition is one of the most important processes of project management. This process assures that project work is structured and subdivided into manageable segments, that responsibility for accomplishment of each segment of work is assigned and that each work segment is adequately defined to facilitate communication and performance of work scope by project participants.

Utilization of the Work Breakdown Structure assures that all work is identified and defined within a common framework. It provides the means to subdivide the project into manageable segments and to describe the scope of work within each segment.

The documentation and approval of the scope baseline before proceeding with subsequent phases of a project should be a common practice. The scope baseline provides a basis for making future decisions, accomplishing verification measures and evaluating potential scope changes.

Work Authorization

The process of authorizing work is one of the keys to the ultimate success of a project. The process entails examining project scope definition, planning documents and subsequent contract documents in light of project objectives and assuring that they are mutually supportive prior to authorizing the commencement of work. Formal authorization of the commencement of work should be accomplished through directives and/or other documents and communicated to responsible performing organiz-

ations. An audit trail of all work authorizations from project initiation to completion of all authorized work should also be maintained.

Documented work authorization provides a means for effective "internal" coordination, communication and obtaining required approvals.

Scope Reporting

The process of Scope Reporting entails the timely determination, recording and accumulation of project progress/status data and transformation of this data into structured information necessary to judge project performance. The processing, integration, summarization and display of this data can be displayed in various formats.

This is necessary so that the data can be structured into information for review by various levels of authority, in order for them to judge whether attainment of project objectives should be continued.

Establishment of required reports, their frequency and report distribution should be accomplished early in the project.

Control Systems

Because of the dynamic nature of a project, the work often may not progress in accordance with the plan. Project control systems assure that all changes to the scope baseline are controlled in a structured manner. This prevents the baseline plan from becoming obsolete.

Changes to authorized work have to be identified, defined, communicated and coordinated before approval. Change approval has to be carried out by predetermined responsible individual(s) having approval authority commensurate with the baseline(s) to be changed. Only then is direction given to those responsible to initiate work on the change.

Project Closeout

This process entails the use of historical records on similar past projects and the archiving of current project records for future use, during the "close-out" phase of a project.

The review and utilization of historic records and lessons learned from completed projects can assist in managing the scope of current projects. This information/data can be used to predict trends, analyze feasibility and to highlight possible problem areas or pitfalls.

During a project's "close-out" phase, a post project analysis should be undertaken involving all project participants, in order to evaluate the project and document the results. This analysis can include:

- Cost, schedule and technical performance versus the original plan
- Evaluation of scope changes and their impact on cost and schedule
- Evaluation of how smooth, effective and timely, changes were carried out and whether they delayed or impacted work progress
- Any special factors regarding quality of work. Evaluation of special circumstances, i.e., natural disasters, weather conditions, unique circumstances, that impacted the project and what was learned from the experience
- Effectiveness of methods/procedures
- Conclusions regarding the completed project and recommendations regarding the completion of future projects.

Summary

The first step in effective Scope Management is the identification, definition and documentation of the project objectives as well as selecting the best approach to achieving these project objectives. The project work is then identified and defined in a common framework – the WBS.

The definition of project scope and associated planning documents are then reviewed for formal work authorization before commencement of work. Following authorization of work, baseline changes are controlled in a structured manner through a control system. Authorization is necessary before work is initiated on the change, thus providing a good audit trail of baseline changes.

As the project progresses, project process/status information is recorded, accumulated and transformed into structured information necessary to judge project performance. The data is analyzed to determine the current status of the project, significant problem areas, developing trends and to forecast future status.

There should be no doubt now, that effective Scope Management has to be a major concern for any Project Manager in order to achieve project objectives.

THIS FUNCTION'S PROCESSES

	Conceptual Development	Scope Statement	Work Authorization	Scope Reporting	Control Systems	Project Closeout
a) General Project Management Processes						
Strategic Planning and Control		1	1		1	
Project Integration		2				
Resource Allocation		2				
b) Basic PM Functions or Elements						
Scope						
Quality		3		3	3	3
Time	3	3		3	3	3
Cost	3	3		3	3	3
c) Integrative PM Functions						
Probability and Risk						
Human Resources		3				
Contract/Procurement			3		2	
Communications	3				2	

Figure A-1:
Function Impact Matrix Chart for
Scope Management

This Function's Impact on other Functions:
Blank = virtually none
1 = possibly or light
2 = likely or average
3 = very likely or heavy

Glossary of Scope Related Terms

Scope Management is the function of controlling a project in terms of its objectives through the phases of concept, development, implementation and termination. This includes the documentation of any changes in scope in the course of the project.

1. Scope Management includes the following potential activities:

1.a Conceptual Development is a process of choosing/documenting the best approach to achieving the project's objectives.

1.b Problem/Need Statement/Goal is to define the problem; document the need to find a solution; and document the overall aims of the sponsor.

1.c Information Gathering: Researching, organizing, recording and comprehending pertinent information/data.

1.c Constraints: Identifying applicable restrictions, including concern for the environment that will affect the project's scope delivery.

1.d Alternative Analysis: Breaking down a complex scope situation for the purpose of generating and evaluating different solutions and approaches.

1.e Project Objectives: Project scope expressed in terms of outputs, required resources and timing.

2. Scope Statement is a documented description of the project as to its output, approach and content, including:

2.a Scope: The work content and products of a project or component of a project. Scope is fully described by naming all activities performed, the resources consumed, and the end products that result, including quality standards.

2.b Scope Criteria: Standards or rules composed of parameters to be considered in defining the project.

2.b.1 Scope Cost: Basic budgetary constraints.

2.b.2 Scope Schedule: Basic time constraints.

2.b.3 Scope Performance/Quality: Basic objectives of the project. This defines the characteristics of the project's end product as required by the sponsor.

2.b.4 Scope Interfaces: Points of interaction between the project or its components and its/their respective environments.

2.c Management Plan: A document that describes the overall guide lines within which a project is organized, administered and managed to assure the timely accomplishment of project objectives. It includes:

2.c.1 Organization Structure: Identification of participants and their hierarchical relationships.

2.c.2 Job Descriptions: Documentation of a project participant's job title, supervisor, job summary, responsibilities, authority and any additional job factors.

2.c.3 Policies/Procedures: General guidelines/formalized methodologies on how a project will be managed.

2.c.4 Accountability/Responsibility Matrix: Structure that relates the Project Organization Structure to the Work Breakdown Structure; assures that each element of the project scope of work is assigned to a responsible individual.

2.d Work Breakdown Structure: A task or product oriented "family tree" of activities that organizes, defines and graphically displays the total work to be accomplished in order to achieve the final objectives of the project. Each descending level represents an increasingly detailed definition of the project objectives. It is a system for subdividing a project into manageable work packages, components or elements to provide a common framework for Scope/Cost/Schedule communications, allocation of responsibility monitoring and management.

2.e Scope Baseline: A summary description of the project's or components' original content and end product including basic budgetary and time constraint data.

2.f Scope Baseline Approval: Approval of the Scope Baseline by the appropriate authority (project sponsors and senior project management staff).

3. Work Authorization is a process of sanctioning all project work, including:

3.a Work Packages/Control Point: WBS elements of the project isolated for assignment to "work centers" for accomplishment. Production control is established at this element level.

3.b Contracts: Binding agreements to acquire goods and/or services in support of a project that include:

3.b.1 Study: The methodical examination and/or

analysis of a question or problem.

3.b.2 Design: The creation of a final approach for executing the project's work

3.b.3 Equipment Procurement: The acquisition of equipment/material to be incorporated into the project.

4. Scope Reporting: is a process of periodically documenting the status of basic project parameters during the course of a project.

4.a Cost Status: Project's financial position.

4.b Schedule Status: As affecting time constraint status.

4.c Technical Performance Status: As affecting quality

4.d Integrated Project Progress Reports: Documentation that measures "budget" vs. actual (cost/ schedule) by utilizing BCWP, BCWS, ACWP.

4.d.1 S Curves: Graphical display of the accumulated costs and labour hours or quantities, plotted against time for both budgeted and actual amounts

4.d.2 Earned Value: A method of reporting project status in terms of both cost and time. It is the budgeted value of work performed regardless of the actual cost incurred

4.e Variance Reports: Documentation of project performance about a planned or measured performance parameter.

4.f Trend Reports: Indicators of variations of project control parameters against planned objectives.

4.g Exception Reports: Documentation that focuses its attention on variations of key control parameters that are critical rather than on those that are progressing as planned.

5. Control System: is a mechanism that reacts to the current project status in order to ensure accomplishment of project objectives, and includes:

5.a Configuration (Baseline) Control: A system of procedures that monitors emerging project scope against the scope baseline. Requires documentation and management approval on any change to the baseline.

5.b Design Control: A system for monitoring project scope, schedule and cost during the project's design stage.

5.b.1 Work Plan: The "Designer's" schedule plan, budget and monitoring system utilized during the design stage.

5.b.2 Trend Monitoring: A system for tracking the estimated cost/schedule/resources of the project vs. those planned.

5.c Document Control: A system for controlling and executing project documentation in a uniform and orderly fashion.

5.d Acquisition Control: A system for acquiring project equipment, material and services in a uniform and orderly fashion.

5.e Specification Control: A system for assuring that project specifications are prepared in a uniform fashion and only changed with proper authorization.

6. Project Closeout is a process that provides for acceptance of the project by the project sponsor, completion of various project records, final revision and issue of documentation to reflect the "as-built" condition and the retention of essential project documentation.

6.a Historical Records: Project documentation that can be used to predict trends, analyze feasibility and high light problem areas/pitfalls on similar future projects.

6.b Post Project Analysis and Report: A formal analysis and documentation of the project's results including cost, schedule and technical performance versus the original plan.

6.c Financial Closeout: Accounting analysis of how funds were spent on the project. Signifies a point in time when no further charges should be made "against" the project.

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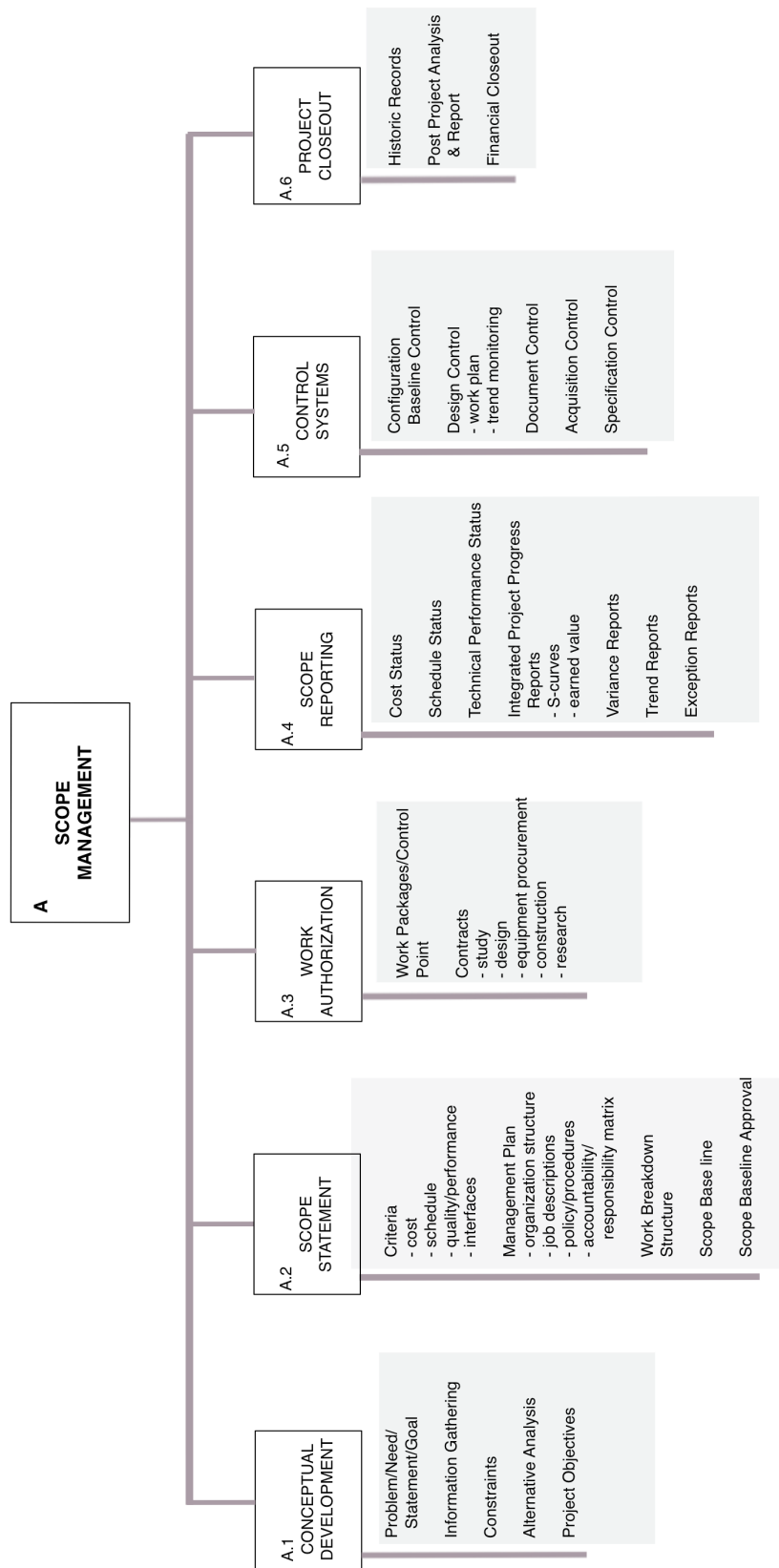
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QUALITY MANAGEMENT

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Introduction

Quality Management (QM) is a key element of Project Management. It is a simple concept. It involves carrying out a project through its four phases (concept, development, execution, and finish) with zero deviations from the project specifications.

The environment necessary to support this effort must focus on quality policies, plans, procedures, programs and specifications. This article identifies the key components that should be used to manage quality throughout the life of a project.

Key Issue

The Project Management Body of Knowledge (PMBOK) must be generic enough to allow for general industry comprehension. Therefore, the nomenclature and language must be recognizable to clients of diverse backgrounds. There are many organizations such as ASQC, ASME or IEEE that specify quality characteristics in technical terms.

We, as a task force, have identified general quality characteristics that are understood by those disciplines involved in project management. The American National Standards Institute pioneered this approach for interdisciplinary communication (ANSI A3-1978 and ANSI Z1 1S - 1979).

Background

The original Quality Management Task Force accomplished the difficult task of developing an initial QM framework. As with the concept of quality itself, the QM framework is not a finished product, but a progress we step toward the asymptotic line of perfect quality.

This report is the first revision of the work Pat Patrick's committee initiated in 1986. The 1987 Task Force used the comments and suggestions that PMI members submitted to Max Wideman, in refining the initial report. Our purpose is not to create a cookbook of precise recipes for achieving project quality. Instead, we have concluded that QM should be a reference tool – to be molded or adapted as a project team needs, to ensure that the project specifications or requirements are met. As a ref-

erence tool, it contains three main components: Overall Quality Philosophy, Quality Assurance, and Quality Control. This concept of quality management is directly related to the PMBOK model that follows.

PMBOK Function Integration

The PMBOK structure is comprised of four core functions: scope, quality, time, and cost. These functions serve as the walls supporting the PMBOK. The three QM components – Quality Assurance, Quality Control and overall Quality Philosophy - provide the length, width and depth of the QM wall. (Figure B-1 illustrates this model.)

Quality Management Functional Chart

The Quality Management Function is the process of ensuring that all aspects of a project and its results fully meet the needs and expectations of the project's clients, participants and shareholders – both internal (relating to the project's system of development), and external (relating to the project's performance or service).

The primary components of the quality management function are:

A) Overall Quality Philosophy: - The involvement of all project participants in ensuring that project goals, requirements and performance standards are in compliance with the expectations of both the client and the project team

B) Quality Assurance: - The managerial processes that determine the organization, design, objectives and resources, and that provide the project team, client and shareholders with performance standards and feedback on the project's performance.

C) Quality Control: - The technical processes that examine, analyze and report the project's progress and conformance with performance requirements. (see Figs B-6&7 for the total QM Function Chart.)

We feel that the QM Function Chart can be used to educate potential project managers because it identifies quality characteristics that managers need to focus on throughout the life of a project. In order to fully understand these characteristics, a unified perspective on the process of QM is presented in the

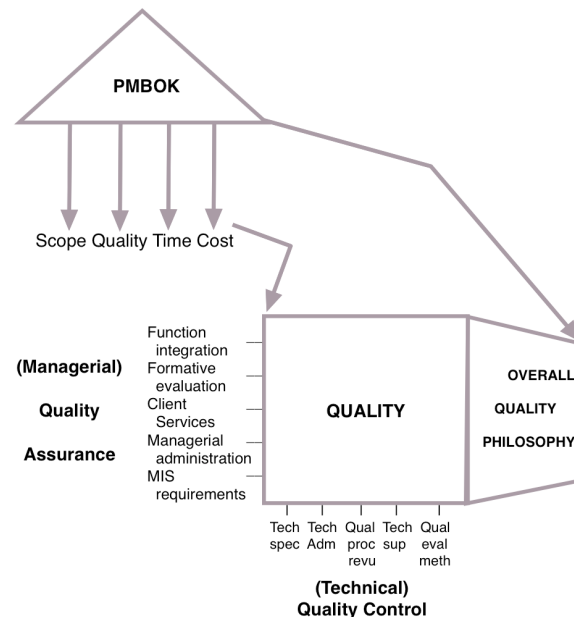


Figure B1: The House of Quality

following section.

Quality Management – The Process

The management of quality in industry has changed during the last decade. In the past, quality management centered on the inspection of a product after it was built, with little involvement from the builders. The emphasis was on "catching" defects after the fact. For example, a decade ago the manufacturing industry averaged a production reject rate of 20 to 30 thousand rejects per million.

The emphasis today has changed to the conscious planning of the policies and procedures designed to determine and control project specifications with the individuals involved in on-line production. With this shift in emphasis, the same manufacturing industry now averages only 20 to 50 rejects per million.

We have come to realize that the definition of quality is simply "conformance to requirements/specifications". Thus, quality should not be confused with excellence, luxury, prestige, "gold-plating" or other terms that describe results in qualifying degrees.

There can be waste involved in producing a product or service that exceeds requirements just as surely as in producing a product that falls short of requirements. This definition of quality is the essential concept on which quality management operates.

The ultimate responsibility for quality rests with the line organization. Therefore, QM depends on a team

comprised of quality resource people and line personnel responsible for the actual production. This team approach requires an Overall Quality Philosophy to carry out the two main quality responsibilities: Assurance and Control. Some essential steps in the process of quality management are as follows:

Ownership of Quality Responsibility:- The individual employee performing a given task has the ultimate responsibility for the conformance of results to the requirements/specifications. When the individual is provided with the essential tools, skills, knowledge and opportunities, he/she is encouraged to develop a sense of personal pride and commitment in the product's internal and external quality. This concept is called "ownership".

Self-Inspection:- The individual performing a given task also performs measurements to ensure that conformance is continually achieved. This provides immediate feedback that permits adjustment of the process in the production of "zero defects".

Zero Defects:- The objective of quality management, that has been proven to be an attainable objective through the use of statistical process control, is to eliminate deviations from specifications. [1]

Statistical Process Control:- Statistical Process Control is the application of formal statistical sampling and control procedures that permit very accurate monitoring of the process by which a task is performed,

THIS FUNCTIONS PROCESSES

	Overall Quality Philosophy	Quality Assurance (Managerial)	Quality Control (Technical)			
a) General Project Management Processes						
Strategic Planning and Control	3	3	3			
Project Integration	3	3	1			
Resource Allocation	2	2	2			
b) Basic PM Functions or Elements						
Scope	3	3	3			
Quality						
Time	3	2	2			
Cost	3	2	2			
c) Integrative PM Functions						
Probability and Risk	2	2	3			
Human Resources	3	2	1			
Contract/Procurement	3	3	3			
Communications	3	2	1			

Figure B-2:
Function Impact Matrix Chart for
Quality Management

This Function's Impact on other Functions:
Blank = virtually none
1 = possibly or light
2 = likely or average
3 = very likely or heavy

thereby ensuring that the product will be in conformance with specifications. The objective of Statistical Process Control is to determine whether a repetitive activity or series of activities is predictable, and then to enhance the ability to manage that activity in a stable environment.

Statistical Decision Making:- is the utilization of formal statistical concepts and techniques to decide on alternative choices, particularly during the execution and finishing phases of the project.

Practical examples of these techniques include sampling theory, central tendency (mean or average), variability (standard deviation), process control charts, Pareto analysis (ABC analysis), multivariate analysis, design of experiments, hypothesis testing, fishbone diagrams, cause/effect analysis, failure mode/effect analysis, etc.

Statistical Sampling:- The collection of data from less than 100% of the elements in a population, from which inferences can be made and actions taken, is called Statistical Sampling. It has been shown that in most instances, the inferences from statistical sampling can be as accurate as comparable inferences from 100%

inspection. Sampling is done in a planned, systematic way, or it can be done so that each sample is chosen independent of any other sample (random selection)

Cost of Quality:- The term applies to the costs required to achieve quality management, i.e., costs necessary for ensuring conformance to specifications. It also refers to the costs incurred as a result of non-conformance, which are generally subdivided into internal (those costs incurred before the product leaves the producing organization) and external (those costs incurred after the product leaves the producing organization).

Cost of Quality (Management's Responsibility):- At least 85% of the costs of quality are the direct responsibility of management (W Edwards Deming, et al.) Management must provide the employees with the necessary Overall Quality Philosophy, Quality Assurance and Quality Control systems to maximize product quality while minimizing or eliminating product defects [10]

Quality Assurance/Conformance to Requirements:- Administrative processes and procedures are necessary to ensure, and often prove, that the scope

statement conforms to the requirements of the client's target market. Also included are all of the relevant legal, regulatory and standards requirements appropriate for the product or service, including the processes by which it is to be produced

Quality Control/Conformance to Specifications:-
The technical processes are procedures necessary to ensure conformity each step of the way. That is, from the product design through product use, maintenance, and disposition, they are performed in conformance with the scope requirements and quality plans to ensure that quality is achieved throughout.

Glossary of Terms

1. Client Quality Services: The process of creating a two-way feedback system to define expectations, opportunities and anticipated needs.

2. Design of Experiment: The planning of an experiment to minimize the cost of data obtained and maximize the validity range of the results. Requirements for a good experiment include clear treatment comparisons, controlled fixed and experimental variables and maximum freedom from systematic error.

The experiments should adhere to the scientific principles of statistical design and analysis. Each experiment should include three parts: the experimental statement, the design and the analysis. Examples of experimental designs include single/multifactor, block, factorial, Latin square and nested arrangements.

2.b Quality Evaluation Methods: The technical process of gathering measured variables or counted data for decision making in the Quality Process Review. Normally these evaluation methods should operate in a holistic context involving proven statistical analyses, referred to previously as statistical process control. A few example methods are defined as follows:

2.b.1 Graphs and charts: A visual comparison of variables that yield data in numerical facts. Examples include trend graphs, histograms, control charts, frequency distributions and scatter diagrams.

2.b.2 Pareto diagrams: A graph popular, particularly in non-technical projects, to prioritize the few change areas (often 20% of the total) that cause most quality deviations (often 80% of the total).

2.b.3 Exception reporting: The process of documenting those situations where there are significant deviations from the quality specifications of a project. The assumption is made that the project will be developed within established boundaries of quality. When the process falls outside of those boundaries, a report is made on why this deviation occurred.

3. Formative Quality Evaluation: - The process of reviewing the project data at key junctures during

the project's life cycle for a comparative analysis against the pre-established quality specifications. This evaluation process is ongoing during the life of the project to ensure that timely changes can be made as needed to protect the success of the project.

4. Function Quality Integration: The process of actively ensuring that quality plans and programs are integrated, mutually consistent, necessary and sufficient to permit the project team to achieve the defined product quality.

5. Managerial Quality Administration: The managerial process of defining and monitoring policies, responsibilities and systems necessary to retain quality standards throughout the project.

6. MIS Quality Requirements: The process of organizing a project's objectives, strategies and resources for the data systems.

7. Overall Quality Philosophy: The universal belief and performance throughout a company, based on established quality policies and procedures. Those policies and procedures become the basis for collecting facts about a project in an orderly way for study (statistics).

W. Edwards Deming has said, "Everyone in the company must learn the rudiments of statistical control of quality, not just to solve a problem, but as a plan of knowledge by which to find problems and the causes thereof. It will not suffice to have some brilliant successes here and there". [10]

8. Quality Assurance (Managerial): The development of a comprehensive program that includes the processes of identifying objectives and strategies, of client interfacing and of organizing and coordinating planned and systematic controls for maintaining established standards. This in turn involves measuring and evaluating performance to these standards, reporting results and taking appropriate action to deal with deviations.

9. Quality Control (Technical): The planned process of identifying established technical

specifications for the project and exercising influence through the collection of specific (usually highly technical and standardized) data. The basis for a decision on any necessary corrective action is provided by analyzing the data and comparing them to system specifications/requirements.

9. Quality Management Function: Quality itself is the composite of material attributes (including performance features and characteristics) of the product, process or service that are required to satisfy the need for which the project is launched. Quality policies, plans, procedures, specifications and requirements are attained through the sub-functions of Quality Assurance (Managerial) and Quality Control (Technical).

10. Quality Process Review: The technical process of using data to decide how the actual project results compare with the quality specifications/requirements. If deviations occur, this analysis may call for changes in the project design, development, use, etc., depending on the decisions of the client, shareholders and the project team.

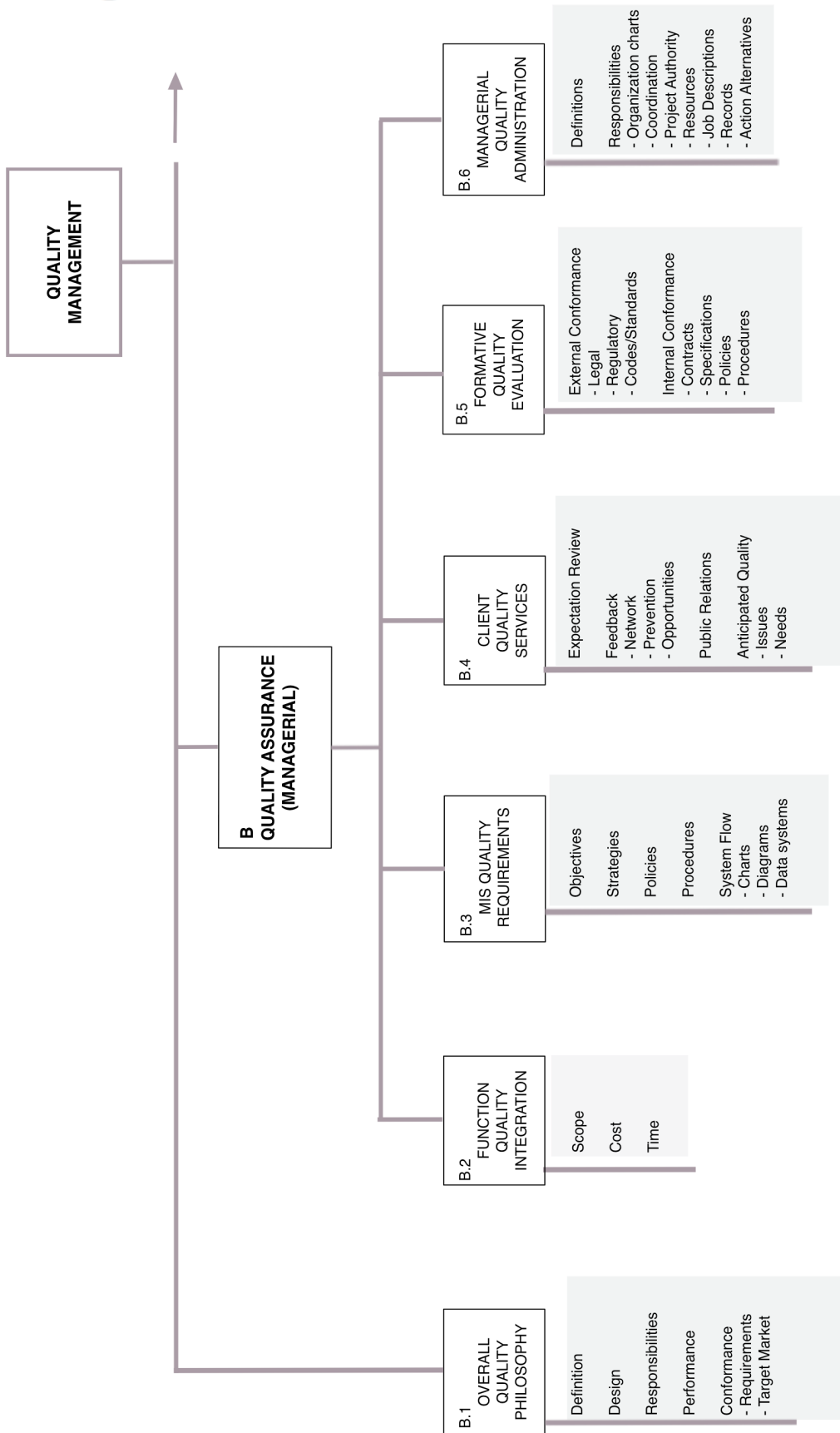
11. Summative Quality Evaluation: The process of determining what lessons have been learned after the project is completed. The objective is to document which behaviors helped determine, maintain or increase quality standards (these might be used in future projects), and which ones did not.

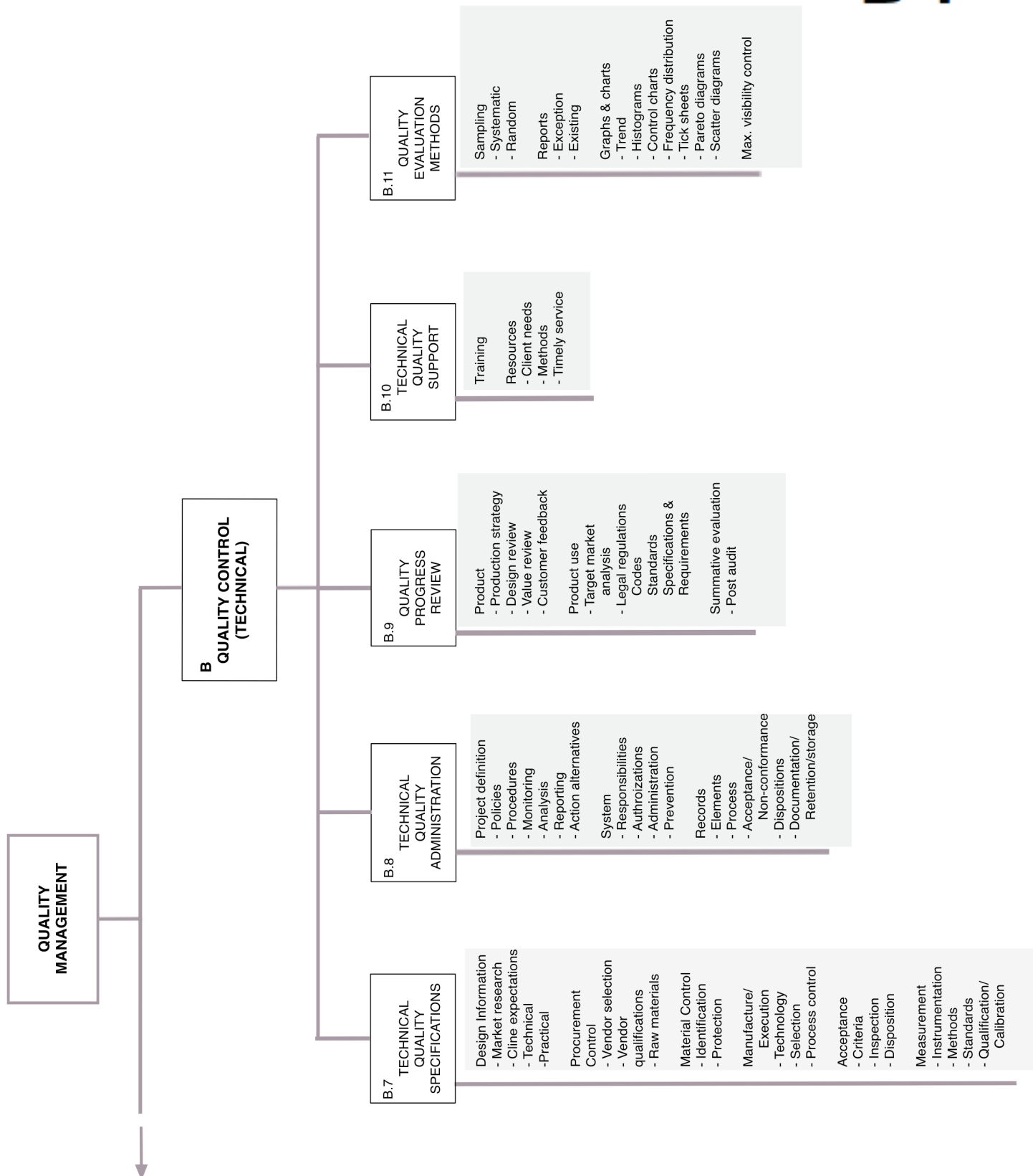
12. Technical Quality Specifications: The process of establishing the specific product requirements, including execution criteria and technologies, project design, measurement specifications, and material procurement and control, that satisfy the expectations of the client, shareholders and project team.

13. Technical Quality Support: The process of providing technical training and expertise from one or more product support group(s) to a project in a timely manner. Effects of these groups could generate considerations for future client needs or warrantee services.

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TIME MANAGEMENT

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Introduction

As approved by the PMI Board, Project #121, PMI Knowledge Base was launched to re-examine the PMI "Body of Knowledge" as originally established as a result of a comprehensive effort under PMI's Ethics, Standards and Accreditation (ESA) project. The Pittsburgh Chapter accepted the task to objectively review the Time Management Function (TMF). This report summarizes the findings and recommendations of that effort

Findings

A task group was established by the Pittsburgh Chapter to accomplish the objectives of Project #121, PMI Knowledge Base Standards. The task group followed the recommended approach as presented in the project outline (dated 3/23/85).

This group quickly discovered why the original (August '83) TMF subtask team agonized at length over the approach to defining the TMF content. There was not a problem in identifying new processes and techniques, but rather many hours were spent trying to classify them. The biggest breakthrough the group made was the realization that the "Processes" identify the *what* (*what is project management*) and the "Activities" identify the possible ways of *how* to accomplish the *what*. Once this concept was realized, a clearer picture emerged as to the logical breakdown of the TMF content.

A second problem emerged when discussions focused on the question of how broad a scope should the "Activities" cover. That is, should they cover scope that may be already developed in other "Processes" or even in other "Functions". The second breakthrough was the recognition that a particular "Activity" may interface with other "Activities" both within the TMF and other Functions" i.e., what information input is required from other "Activities".

Initially, the group developed a Functional Chart with the same four "Processes" as the ones included in the Project #121 Outline but with different "Activities". This was done as an attempt to integrate the Project #121 "Activities"; the August 1983 PMQ Special Report "Activities"; and the "Activities" developed by the group. Due to many factors (including summer vacations, job commitments, etc.),

it was found not to be practical to independently develop a new chart if the August 30th date were to be met, therefore the entire Functional Chart included in the Project#121 outline was adopted with minor modifications. This updated chart is shown on pages C-11, C-12, C-13 and C-14. The subsequent "Process" Breakdown is shown in subset boxes C.1, C.2, C.3 and C.4.

Recommendations

The original (August '83) TMF subtask group did an absolutely outstanding job. This became more evident as their path was retraced to try to maintain an objective viewpoint. Arguments could be made for and against the content of the charts, but the structure of the charts, which was developed during the original project and refined during this project, is basic and sound, and should be maintained.

The content of each "Process" in the TMF needs to be polished and refined. With the breakthrough made during this project, the next project team needs to focus only on one "Process". The next project manager should standardize the logical breakdown structure of the chart and assign a task group to work only on planning, estimating, scheduling or control.

As this group and the original group found, this task will turn out to be a far larger-than-expected assignment. Consequently, a good deal of discussion will be expended as to how and where the various "Activities" and "Techniques" should be assigned. Most importantly, this next project could commence soon, so as not to lose the momentum and basic understanding of the approach developed during this project effort.

Overall Statement

Prior to delving into an overall statement describing the Time Management Function (TMF), it is necessary to understand the approach taken by the TMF task group. It was not the intent of the group to develop a cookbook approach to understanding the TMF, but rather to provide a listing of possible ingredients that can be used in an effort to manage the time function in a project. This is meant to be a Tool and, like any tool, to be of any use one must know the intended application if the desired results

are to be achieved. It is hoped that information contained within this document and the others included with it can be used for the education of potential project managers and to help establish a broader data base for the subject of project management as it relates to TMF.

Time is an integral part of life. However, many people and organizations do not actively manage it. Time, like life itself, can speed by, never being used in an organized effort to achieve some goal, or time can be managed to efficiently complete specific objectives. The better time is managed the more efficient a project will be, assuming all others processes remain the same. Lack of time management can and probably will result in failure of a project.

The management of time is crucial to the successful completion of a project. Not only is the short-term realization of success or failure of the project at stake but also the personal reputation of the project manager and the project team members. In some large projects that run for several years at costs in excess of a billion dollars, the financing charges can approach \$1 million per day. Even in many smaller projects, especially in a competitive market, it is essential to complete projects on time or lose the edge in the market place.

The function of Time Management has been divided into four main processes:

1. Planning
2. Estimating
3. Scheduling
4. Control

Like the functions of project management these processes are ever changing. However, the four processes are in line with the thinking of the Project Management Institute and are a good starting point in describing the Time Management Function.

Each of the above four processes must contain something of its predecessor, but need not necessarily contain any component of its successor.

1. Planning

Planning consists of identification of the intention of the project management group with respect to the methods and procedures they intend to follow towards the management of the project's time function. In other words, it includes depicting what the project management group intends to do, how it will be done and what will be used to do it.

2 Estimating

Estimating, as it relates to the TMF, is the determination of the duration of an activity. Despite all the sophistication, however, it is something we can only attempt with a limited degree of accuracy due to the uncertainties associated with imperfect humans and their working conditions. Although it is a difficult task to estimate work durations with assured accuracy, it is not totally impossible to quantify. The estimator has available to him many modern techniques and historic or past performance data.

3 Scheduling

Scheduling is, in essence, the recognition of realistic time and resource restraints that will, in some way, influence the execution of the plan. To paraphrase this, it could be said that a plan represents how one intends to execute a project without regard to when the project will be executed. Whereas the schedule applies the recognition of time and resource restraints to the plan.

4 Control

Control contains, as its components, the measurement of what actually happened against what was expected to happen; what the results, or effect, will be; and if negative, the implementation of steps to prevent undesirable impacts and, if positive, the implementation of steps to ensure its continuation.

Control, therefore, must contain the recognition of what has been happening, and some overt action to ensure that the objectives of the project are met in the future.

THIS FUNCTIONS PROCESSES

	Time Planning	Time Estimating	Time Scheduling	Schedule Control		
a) General Project Management Processes						
Strategic Planning and Control	3	1	2	3		
Project Integration	2	1	2	2		
Resource Allocation	1	3	3	2		
b) Basic PM Functions or Elements						
Scope	2	3	2	2		
Quality	2	3	-	2		
Time						
Cost	2	3	2	3		
c) Integrative PM Functions						
Probability and RISK	1	3	1	1		
Human Resources	2	3	3	1		
Contract/Procurement	2	2	2	2		
Communications	2	-	1	3		

**Figure C-1: Function Impact Matrix Chart
for
Time Management**

This Function's Impact on other Functions:

Blank = virtually none
1 = possibly or light
2 = likely or average
3 = very likely or heavy

Glossary of Terms

Activity Description: Any combination of characters that easily identifies an activity to any recipient of the schedule.

Activity Duration: The best estimate of the time (hours, days, weeks, months, etc.) necessary for the accomplishment of the work involved in an activity, considering the nature of the work and the resources needed for it.

Actual Finish Date:

The calendar date work actually finished on an activity. It must be prior to or equal to the data date. The remaining duration of this activity is zero.

Actual Start Date: The calendar date work actually began on an activity. It must be prior to or equal to the data date.

Analysis: The study and examination of some-thing complex and separation into its more simple components. Analysis typically includes discovering not only what are the parts of the thing being studied,

but also how they fit together and why they are arranged in this particular way. A study of project variances for cause, impact, corrective actions, and results.

Approve: To accept as satisfactory. Approval implies that the thing approved has the endorsement of the approving agency; however, the approval may still require confirmation by somebody else. In management use, the important distinction is between APPROVE and AUTHORIZE. Persons who approve something are willing to accept it as satisfactory for their purposes, but this decision may not be final. Approval may be by several persons. The person who authorizes has final organization authority. This authorization is final approval.

Archive Tape: A computer tape that contains historical project information.

As-Built Schedule: The final project schedule that depicts actual completion (finish) dates, actual durations, and start dates.

Assurance: To examine with the intent to verify. Authorize: To give final approval. A person who can authorize something is vested with authority to give final endorsement that requires no further approval

Backward Pass: Calculation of late finish times (dates) for all non-completed network activities. Determined by working backwards through each activity.

Bar Chart: A graphic presentation of work activities shown by a time-scaled bar line (sometimes referred to as a Gantt chart)

Breakdown: Identification of the smallest activities or tasks in a job according to a defined procedure.

Budget: A planned allocation of resources

Calendar: The calendar used in developing a project plan. This calendar identifies project work days, and can be altered so weekends, holidays, weather days, etc., are not included.

Calendar Range: The span of the calendar from the calendar start date through the last calendar unit performed. The calendar start date is unit number one.

Calendar Start Date: The first calendar unit of the working calendar.

Calendar Unit: The smallest unit of the calendar produced. This unit is generally in hours, days, or weeks; can also be grouped in shifts.

Change: An increase or decrease in any of the project characteristics.

Commissioning: Activities performed for the purpose of substantiating the capability of the project to function as designed.

Commitment: An agreement to consign, or reserve the necessary RESOURCES to fulfill an agreement, until EXPENDITURE occurs. A commitment is an EVENT.

Completed Activity: An activity with an actual finish date and no remaining duration.

Constraint: Any factor that affects when an activity can be scheduled. (See RESTRAINT)

Contingency Plan: A plan that identifies key assumptions beyond the Project Manager's control, and their probability of occurrence. The plan identifies alternative strategies for achieving project success.

Contract Dates: The dates specified in the contract that impact the Project Plan.

Crashing: Action to decrease the duration of an activity or project by increasing the expenditure of resources.

Criteria: A statement that provides objectives,

guidelines, procedures, and standards that are to be used to execute the development, design, and/or implementation portions of a project.

Critical Activity: Any activity on a critical path.

Critical Path: The series of interdependent activities of a project, connected end-to-end, that determines the shortest total length of the project. The critical path of a project may change from time to time as activities are completed ahead of or behind schedule.

Critical Path Method (CPM): A scheduling technique using precedence diagrams for graphic display of the work plan. The method used to determine the length of a project and to identify the activities that are critical to the completion of the project.

Critical Path Network (CPM): A plan for the execution of a project that consists of activities and their logical relationships to one another.

Current Finish Date: The current estimate of the calendar date when an activity will be completed.

Current Start Date: The current estimate of the calendar date when an activity will begin.

Data Collection: The gathering and recording of facts, changes and forecasts for reporting and future planning.

Data Date (DD): The calendar date that separates actual (historical) data from scheduled data.

Data Refinements: Rework or redefinition of logic or data that may have previously been developed in the planning sub-function as required to properly input milestones, restraints, priorities and resources.

Date of Acceptance: The date on which the client agrees to the final acceptance of the project. Commitments against the capital authorization cease at the DATE OF ACCEPTANCE. This is an EVENT.

Detail Schedule: A schedule used to communicate the day-to-day activities to working levels on the project.

Discussion: Dialogue explaining implications and impacts on objectives. The elaboration and description of facts, findings and alternatives.

Display: A pictorial, verbal, written, tabulated or graphical means of transmitting findings, results and conclusions.

Distribution: The dissemination of information for the purpose of communication, approval or decision making.

Documentation: The collection of reports, user information and references for distribution and retrieval, displays, back-up information and record pertaining to the project.

Dummy Activity: An activity, always of zero duration, used to show a logical dependency when an activity cannot start before another is complete, but which does not lie on the same path through the network.

Early Finish Date (EF): The earliest time an activity maybe completed equal to the early start of the activity plus its remaining-duration.

Early Start Date (ES): The earliest time any activity may begin as logically constrained by the network for a given data date.

Earned Value: A method of reporting project status in terms of both cost and time. It is the budgeted value of work performed regardless of the actual cost incurred.

Endorsement: Written approval. Endorsement signifies personal understanding and acceptance of the thing endorsed, and recommends further endorsement by higher levels of authority if necessary. Endorsement of COMMITMENT by a person vested with appropriate authority signifies authorization. See APPROVE, AUTHORIZE.

Event: An event is an identifiable single point in time on a project.

Expenditure: The conversion of RESOURCES. An expenditure is an EVENT. Conversion of resources may take several forms:

Exchange - conversion of title or owner- ship (e.g. dollars for materials).

Consumption - conversion of a liquid resource to a less recoverable state (i.e., expenditure of time, human resources, dollars to produce something of value; or the incorporation of inventoried materials into FIXED ASSETS).

Fast Track: The starting or implementation of a project by overlapping activities, commonly entailing the overlapping of design and construction (manufacturing) activities.

Feasibility: The assessment of capability of being completed; the possibility, probability and suitability of accomplishment.

Floating Task: A task that can be performed earlier or later in the schedule without affecting the project duration.

Forecast: An estimate and prediction of future conditions and events based on information and knowledge available at the time of the forecast.

Forecasting: The work performed to estimate and predict future conditions and events. Forecasting is an ACTIVITY of the management function of planning. Forecasting is often confused with budgeting, that is a

definitive allocation of resources rather than a prediction or estimate.

Forward Pass: Network calculations that determine the earliest start/earliest finish time (date) of each activity. These calculations are from data date through the logical flow of each activity.

Free Float (EF): The amount of time (in work units) an activity may be delayed without affecting the early start of the activity immediately following.

Gantt Charts: See Bar Charts

General Sequencing: An overview of the order of performing activities.

Graph: The display or drawing that shows the relationship between activities. Pictorial representation of relative variables.

Guideline: A document that RECOMMENDS methods to be used to accomplish an objective.

Hammock: An aggregate or summary activity. All related activities are tied as one summary activity and reported at the summary level.

Hanger: A break in a network path.

Impact Interpretation: Clarification of the significance of a variance with respect to overall objectives.

Imposed Date (External): A predetermined calendar date set without regard to logical considerations of the network.

Implementation, Completion of: Completion of implementation means that the project team has:

1. Provided completed project activities in accordance with the project requirements.
2. Completed project close out.

In-Progress Activity: An activity that has been started but is not completed on a given date.

In-Service Date: The in-service date is that point in time when the project is placed in a state of readiness or availability when it can be used for its specifically assigned function.

Input Limits: Imposition of limitations to the resources through which the plan will be executed.

Input Milestones: Imposed target dates or target events that are to be accomplished and that control the plan with respect to time.

Input Restraints: Imposed external restraints, such as dates reflecting input from others and target dates reflecting output required by others, and such items as float allocation and constraints.

Input Priorities: Imposed priorities or sequence desired with respect to the scheduling of activities within previously imposed constraints.

Interface Activity: An activity connecting a node in

one subnet with node in another subnet, representing logical interdependence. The activity identifies points of interaction or commonality between the project activities and outside influences.

Interfaces Program: A computer program that relates status system line items to their parent activities in the Project Plan.

Interpretation: Reduction of information to appropriate and understandable terms and explanations.

Key Event Schedule: A schedule comprised of key events or milestones. These events are generally critical accomplishments planned at time intervals throughout the project and used as a basis to monitor overall project performance. The format may be either network or bar chart and may contain minimal detail at a highly summarized level. This is often referred to as a milestone schedule.

Lag: The logical relationship between the start and/or finish of one activity and the start and/or finish of another activity

Lag Relationship: The four basic types of lag relationships between the start and/or finish of a Work Item and the start and/or finish of another Work Item are:

1. Finish to Start
2. Start to Finish
3. Finish to Finish
4. Start to Start

Late Finish (LF): The latest time an activity may be completed without delaying the project finish date

Late Start (LS): The latest time an activity may begin without delaying the project finish date of the network. This date is calculated as the late finish minus the duration of the activity.

Legal Tape: A computer tape that contains the contract base project plan as the first entry, and the (resource level) Target Project Plan as the second entry. Also, all approved major changes to logic, time or resources will be added, as a separate entry, to the Legal Tape. No other entries will be made to this tape.

Level Finish/Schedule (SF): The date when the activity is scheduled to be completed using the RESOURCE ALLOCATION PROCESS.

Level Float: The difference between the level finish and the late finish date.

Level of Detail: A policy of expression of content of plans, schedules and reports in accordance with the scale of the breakdown of information.

Level Start/Schedule (SS): The date the activity is scheduled to begin using the RESOURCE ALLOCATION PROCESS. This date is equal to or later in time than early start.

Line Item: The smallest unit of product whose status is tracked in a status system.

Lists: The tabulations of information organized in meaningful fashion.

Logic: The interdependency of the activities in the network.

Management Time: Man-hours related to the Project Management Team.

Method: The manner or way in which work is done. When formalized into a prescribed manner of performing specified work, a method becomes a PROCEDURE.

Milestone: A significant event in the project. (Key Item or Key Event.)

Milestones for Control: Interim objectives, points of arrival in terms of time for purposes of progress management.

Near-Critical Activity: An activity that has low total float.

Near-Term Activities: Activities that are planned to begin, be in process, or be completed during a relatively short period of time; such as 30, 60, or 90 days.

Network Diagram: A schematic display of the sequential and logical relationship of the activities that comprise the project. Two popular drawing conventions or notations for scheduling are "arrow" and "precedence" diagramming.

Non-Work Unit: A calendar unit during which work may not be performed on an activity, such as weekends and holidays.

Objective: A predetermined result, the end towards which effort is directed.

Operation: The operation of a new facility is described by a variety of terms, each depicting an EVENT in its early operating life. These are defined below, in chronological order:

Initial Operation - the project milestone date on which material is first introduced into the system for the purpose of producing products.

Normal Operation - the project milestone date on which the facility has demonstrated the capability of sustained operations at design conditions and the facility is accepted by the client.

Original Duration: The first estimate of work time needed to execute an activity. The most common units of time are hours, days and weeks.

Path: The continuous, linear series of connected activities through a network.

Performance: The calculation of achievement used to measure and manage project quality.

Pert: Program Evaluation and Review Technique. An event and probability based network analysis system generally used in the research and development field where, at the planning stage, activities and their durations between events are difficult to define. Typically used on large programs where the projects involve numerous organizations at widely different locations.

Precedence Diagram Method (PDM) using Arrows: A graphical symbol in PDM networks used to represent the Lag describing the relationship between Work Activities. For example:

Finish to Finish Relationship: This relationship restricts the finish of the Work Activity until some specified duration following the finish of another Work Activity

Finish To Start Relationship: The relationship where the Work activity may start just as soon as another Work Activity is finished.

Start To Finish Relationship: The relationship restricts the finish of the Work Activity until some duration following the start of another Work Activity.

Start To Start Relationship: This relationship restricts the start of the Work Activity until some specified duration following the start of the preceding Work Activity.

Percent Complete: A ratio comparison of the completion status to the current projection of total work.

Planned Activity: An activity that has not started or finished prior to the data date.

Plan Development: Stage of planning during which the plan is initially created.

Planner Time: Man hours related to the planning function.

Plug Date: A date externally assigned to an activity that establishes the earliest or latest date in which the activity is allowed to start or finish.

Policy: Directives issued by management for guidance and direction where uniformity of action is essential. Directives pertain to the approach, techniques, authorities and responsibilities for carrying out the management function.

Precedence Diagram Method (PDM) using nodes: A method of constructing a logic network to represent the activities and connecting them by lines that show dependencies.

Predecessor Activity: Any activity that exists on a common path with the activity in question and occurs before the activity in question.

Prescribe: To direct specified action. To prescribe

implies that action must be carried out in a specified fashion.

Priorities: The imposed sequences desired with respect to the scheduling of activities within previously imposed constraints.

Procedure: A prescribed method of performing specified work.

Progress: Development to a more advanced stage. Progress relates to a progression of development and therefore shows relationships between current conditions and past conditions.

Progress Analysis: The evaluation of calculated progress against the approved schedule and the determination of its impact.

Progress Trend: An indication on whether the progress of an activity or of a project is increasing, decreasing, or remaining the same (steady) over a period of time.

Project Brief: See Project Plan.

Project Change: An approved change to project work content caused by a scope of work change or a special circumstance on the project (weather, strikes, etc.).

Project Duration: The elapsed duration from project start date through project finish date.

Project Finish Date/Schedule: The latest schedule calendar finish date of all activities on the project derived from network or resource allocations process calculations.

Project Objectives: Project scope expressed in terms of time, resources and outputs.

Project Plan: A management summary document that gives the essentials of a project in terms of its objectives, justification, and how the objectives are to be achieved. It should describe how all the major activities under each project management function are to be accomplished, including that of overall project control. The Project Plan will evolve through successive stages of the Project Life Cycle. Prior to project implementation, for example, it may be referred to as a Project Brief. (See also Baseline and Baseline Concept.)

Project Planning: The identification of the project objectives and the ordered activity necessary to complete the project.

Project Segments: Project subdivisions expressed as manageable components.

Project Start Date/Schedule: The earliest calendar start date among all activities in the network.

Proposal Project Plan: Usually the first plan issued on a project and accompanies the proposal. It contains key analysis, procurement, and implementation

milestones; historical data; and any client-supplied information. Usually presented in bar chart form or summary level network, this schedule is used for inquiry and contract negotiations.

Real Time: The application of external time constraints that might affect the calendar time position of execution of each activity in the schedule.

Recommend: To offer or suggest for use. Recommendation describes the presentation of plans, ideas, or things to others for adoption. To recommend is to offer something with the option of refusal.

Remaining available resources: The difference between the resource available pool and the level schedule resource requirements. Computed from the resource allocation process.

Remaining Duration: The estimated work units needed to complete an activity as of the data date.

Remaining Float (RF): The difference between the early finish and the late finish date.

Reporting: A planning activity involved with the development and issuance of (internal) time management analysis reports and (external) progress reports.

Resource: Any factors, except time, required or consumed to accomplish an activity. Any substantive requirement of an activity that can be quantified and defined, e.g., manpower, equipment, material, etc.).

Resource Allocation Process: The scheduling of activities in a network with the knowledge of certain resource constraints and requirements. This process adjusts activity level start and finish dates to conform to resource availability and use.

Resource Availability Date: The calendar date when a resource pool becomes available for a given resource.

Resource Availability Pool: The amount of resource availability for any given allocation period.

Resource Code: The code used to identify a given resource type.

Resource Description: The actual name or identification associated with a resource code.

Resource-Limited Planning: The planning of activities so that predetermined resource availability pools are not exceeded. Activities are started as soon as resources are available (subject to logical constraints), as required by the activity.

Resource Plots: A display of the amount of resources required as a function of time on a graph. Individual, summary, incremental, and cumulative resource curve levels can be shown.

Responsibility: Charged personally with performing the physical and mental effort (work) necessary to fulfill the requirements of a position. Responsibility

can be delegated but cannot be shared.

Restraint: An externally imposed factor affecting when an activity can be scheduled. The external factor may be manpower, cost, equipment, or other such RESOURCE.

Review: To examine critically to determine suitability or accuracy.

Schedule: A display of project time allocation.

Schedule Pictorial Display: A display in the form of a video, still picture or slide that represents scheduling information.

Scheduling: The recognition of realistic time and resource restraints which will, in some way, influence the execution of the PLAN.

Scope Change: A deviation from the originally agreed-to project scope.

Secondary Float (SF): The difference between the CPM calculated early finish and the resulting imposed finish date.

Specification: An information vehicle that provides a precise description of a specific physical item, procedure, or result for the purpose of purchase and/or implementation of the item or service.

Stabilization: The period of time between start CONTINUOUS OPERATION and NORMAL OPERATION. This period encompasses those activities necessary to establish reliable operation at design conditions of capacity, product quality, and efficiency

Standard: A basis for the uniformity of measuring performance. Also, a document that prescribes a specific consensus solution to a repetitive design, operating, or maintenance problem.

Standard Network Diagram: A predefined string of activities used to shorten the time needed to develop a CPM network.

Standard Procedure: Prescribes that a certain kind of work be done in the same way wherever it is performed.

Standard Proposal Schedule: A pre-established network on file.

Start-up: That period after DATE OF INITIAL OPERATION, during which the unit is brought up to acceptable production capacity and quality. Start-up is the activity that commences on the Date of Initial Operation. Start-up is an ACTIVITY that is often confused (used interchangeably) with Date of Initial Operation.

Status: The condition of a project at a specified point in time.

Status System: System for tracking status at lowest level of detail.

Statusing: Indicating most current project status.

Strategic Plan: The target plan prioritized by critical total float from the current schedule.

Subnet: The subdivision of a network into fragments usually representing some form of subproject.

Successor Activity: Any activity that exists on a common path with the activity in question and occurs after the activity in question.

Summary Schedule: A single page, usually time-scaled, project schedule. Typically included in Management level progress reports. Also known as MILESTONE SCHEDULE.

Take-off: A term used for identifying and recording from drawings the material and quantities for estimating the time and cost required for the completion of an activity.

Target Date: The date an activity is desired to be started or completed; accepted as the date generated by the initial CPM schedule operation and resource allocation process.

Target Plan: The target plan prioritized by critical total float from the current schedule.

Target Reporting: A method of reporting the current schedule against some established base line schedule and the computation of variances between them.

Task Types: Characterization of tasks by resource requirement responsibility, discipline, jurisdiction, function, etc.

Tied Activity: An activity that must start within a specified time or immediately after its predecessor's completion.

Time Delay Claim: A request for an extension to the CONTRACT DATES.

Time-limited Scheduling: The scheduling of activities so predetermined resource availability pools are not exceeded unless the further delay will cause the project finish to be delayed. Activities can be delayed only until their late start date. However, activities will begin when the late start date is reached, even if resource limits are exceeded. Networks with negative total float time should not be processed by time-limited scheduling.

Time Periods: Comparing calculated time versus specified time in relation to constraints and time span objectives.

Total Float (TF): The amount of time (in work units) that an activity may be delayed from its early start with out delaying the project finish date. Total float is equal to the late finish minus the early finish or the late start minus the early start of the activity.

Trending: The REVIEW of proposed changes in

resources allocation and the FORECASTING of their impact on BUDGET. To be effective, Trending should be regularly performed and the impacts of budget plotted graphically. Used in this manner, trending supports the decision to AUTHORIZE the change.

Update: To revise the schedule to reflect the most current information of the project.

Variance: Any difference between the projected duration for an activity and the actual duration of the activity. Also the difference between projected start and finish dates and actual or revised start and finish dates. Any actual or potential deviation from an intended or budgeted figure or plan. A variance can be a difference between intended and actual time.

Verification: The confirmation of data, application of judgment, and comparison with other sources and previous monitor results.

Work Unit: A calendar time unit when work may be performed on an activity

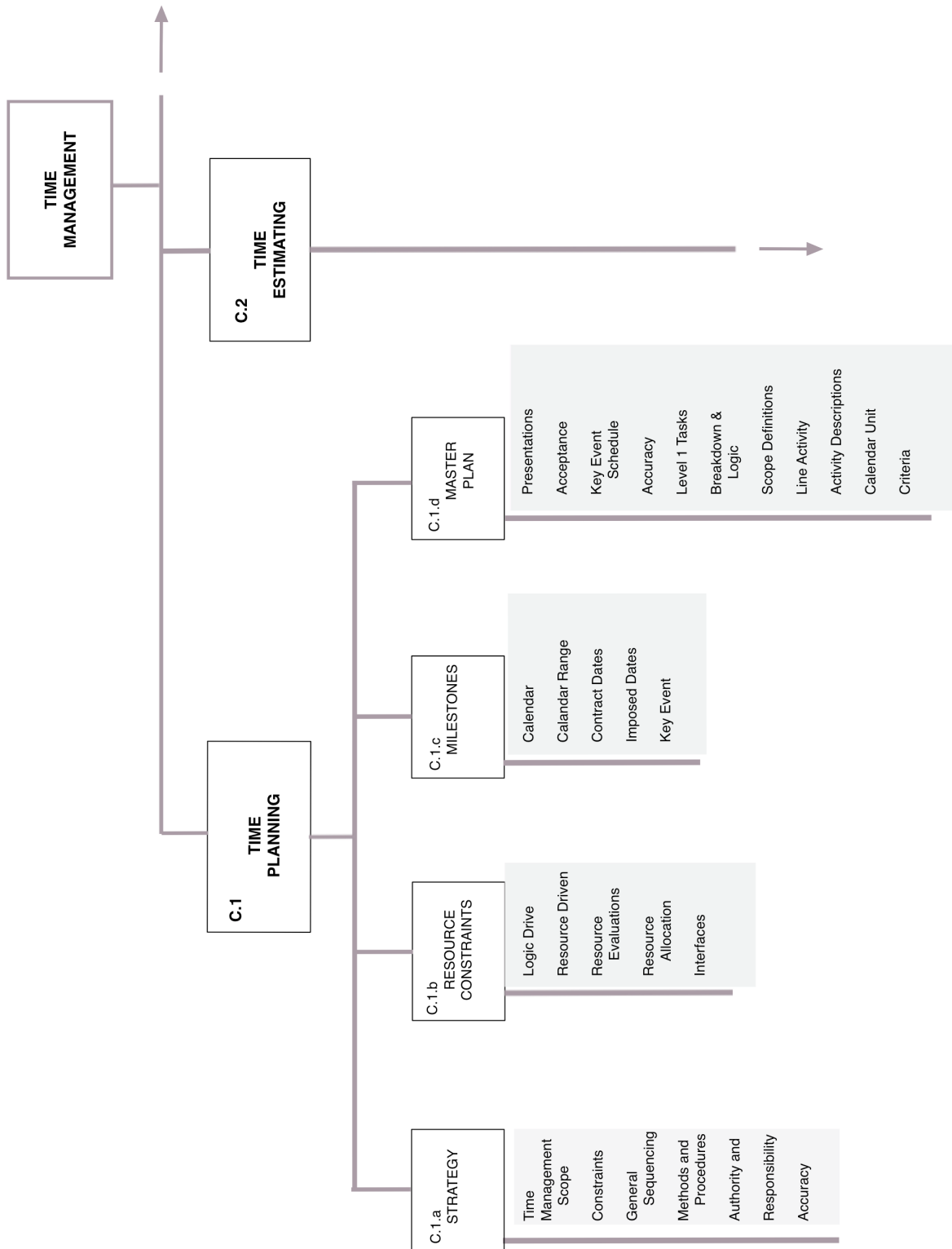
Working Calendar: The total calendar dates that cover all project activities, from start to finish.

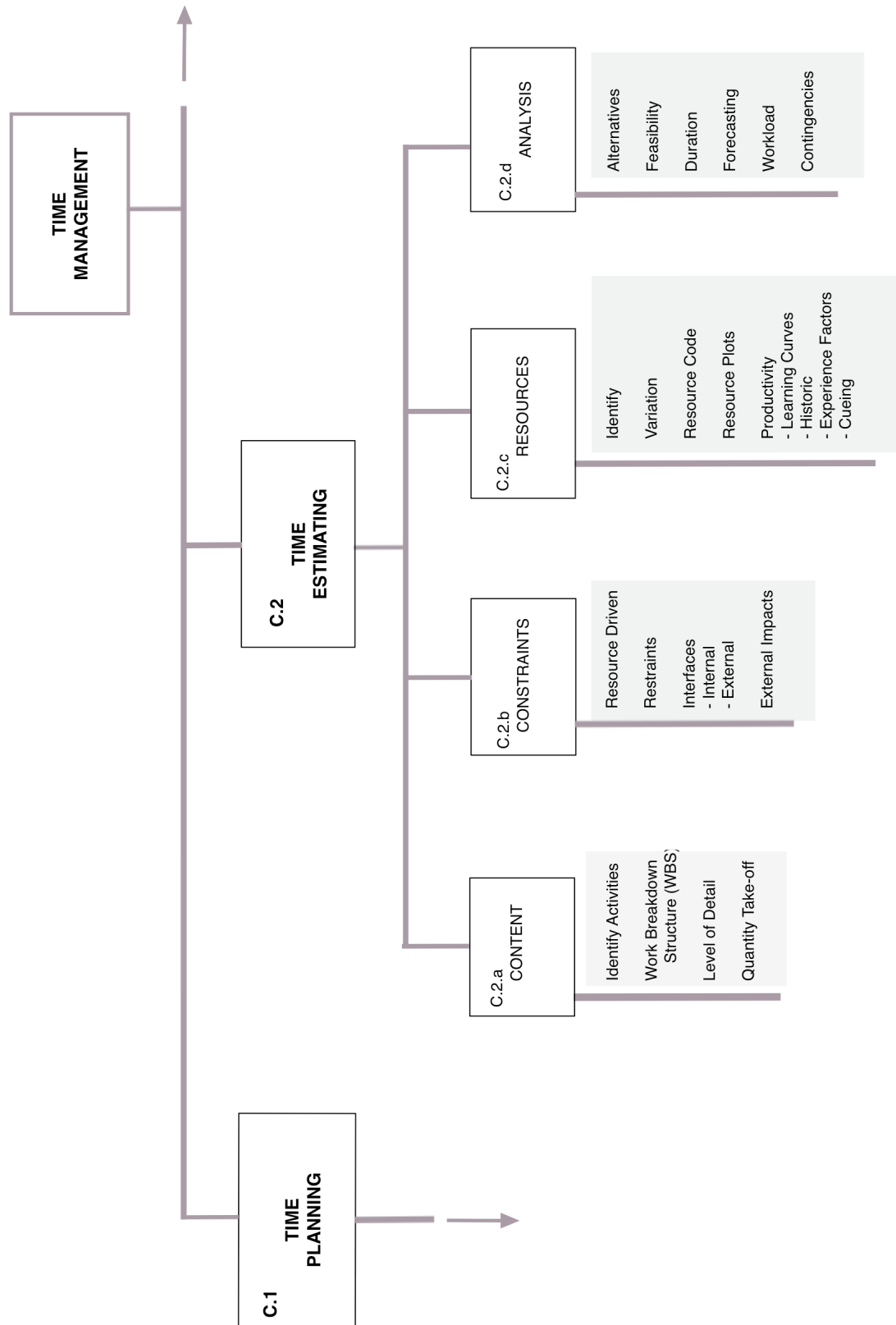
Workload Review: A review of the planned work demand on resources over time spans versus acceptable limits and their availability.

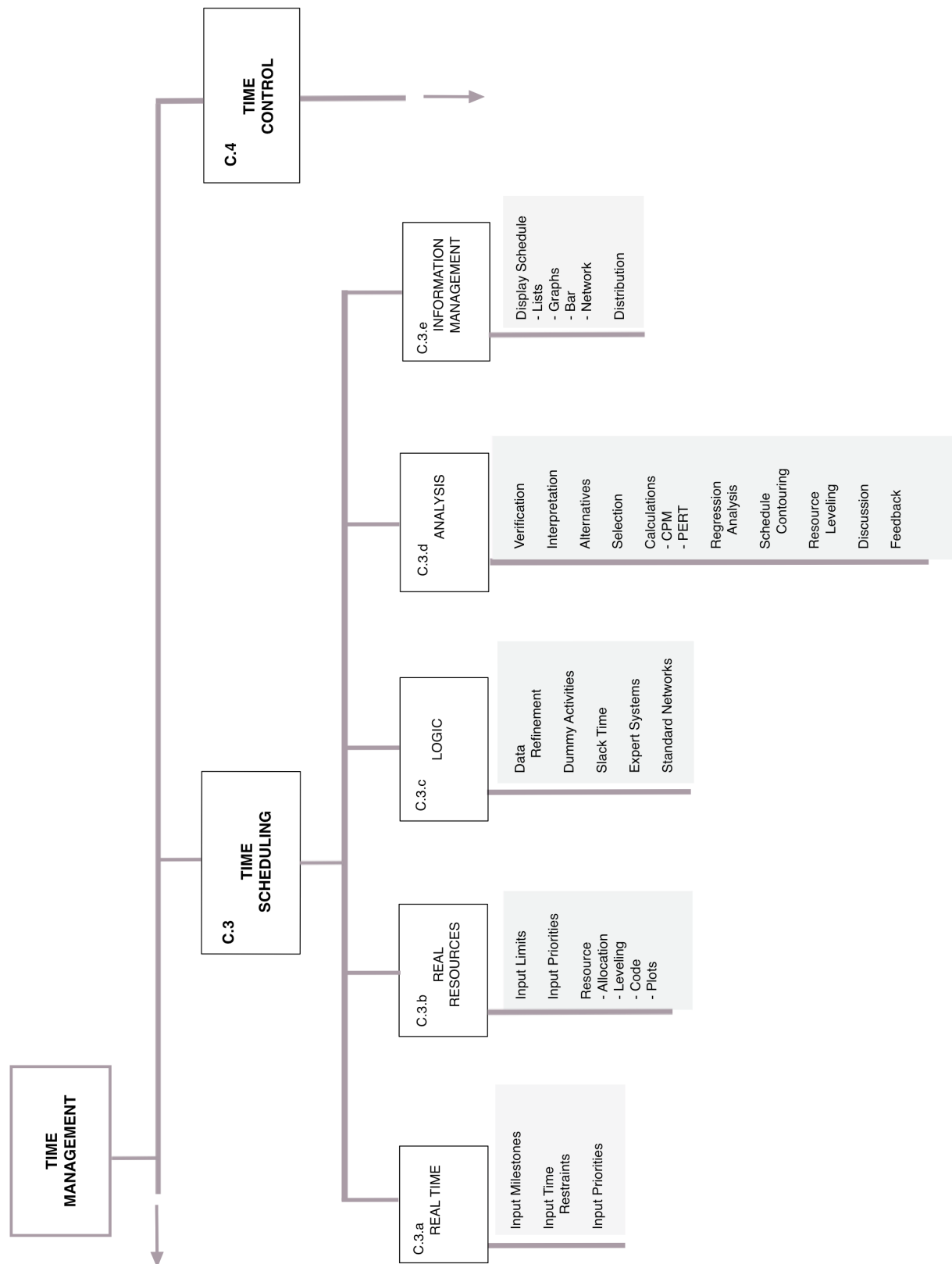
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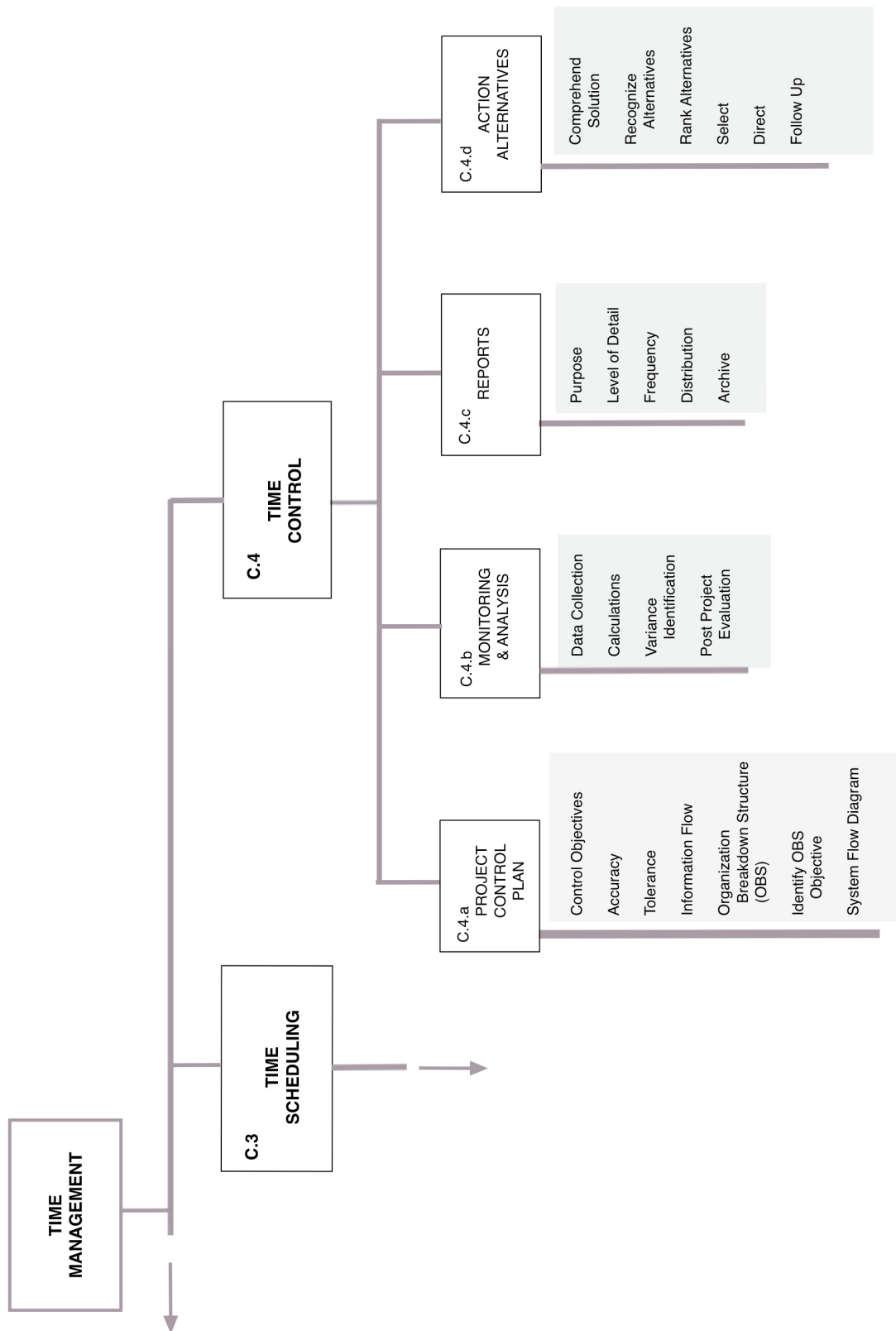
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COST MANAGEMENT

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Background

Cost Management is one of the primary functions of Project Managers. When integrated with scope, quality and time management, these four functions form the core of Project Management. The cost management function maintains its important focus at every stage throughout the life cycle of a project. In listing the reasons for the success of a project, the management of cost is the most important as all project aspects affect this function. What counts for the owner is the "bottom line."

The initial Cost Management Task Group was chaired by Mr. D.W. Haeney, Stelco Inc., (a member of the PMI Southern Ontario Chapter) in 1983. Mr. P.G. Georgas, Stelco Inc., (also a member of the PMI Southern Ontario Chapter) is now chairing the Cost Management function of Project 121, Body of Knowledge assisted by G.V. Vallance, Stelco Inc. The preliminary report of the Cost Management Function Committee was completed for presentation at the PMI October 1985 Denver Workshop.

The workshop reviewed and critiqued this preliminary report and instituted several modifications. The time phase of the chronological progression of processes and activities throughout the project life cycle was eliminated from the function chart. The result was that some processes were combined.

However, the resulting two dimensional modified workshop chart still did not meet the requirements of being fully integrated with other Project management functions. A matrix system was suggested and this final report incorporates the matrix approach and the interface with other Project Management functions.

Introduction

This report is the final submission of the 1985 Cost Management Function Committee. The report includes all of the ideas and work from the initial report (August 1985), the modifications recommended at the workshop, the matrix chart, technical references and Mr. Wideman's suggestions.

It is understood that the matrix and function charts, technical reference and glossary of terms will be used to establish a data library for education pur-

poses (accreditation and certification) for all PMI members and students. There still remains further and continued discussion and with subsequent revisions before the Cost Management function of the PMI Body of Knowledge can be considered reasonably complete. This report is only a beginning and future groups will enlarge and refine the existing information.

Cost Management Function

The Cost Management function includes the processes that are required to maintain financial control of projects (i.e., economic evaluation that initiates the project, estimating, organizing, controlling, analyzing, reporting, forecasting and taking the necessary corrective action). For the Function Impact Matrix chart, see Figure D-1 and for the Function WBS chart, see the end of this section. The glossary of terms is also attached to this report.

The initial Function chart was developed using the guidelines of March, 1985 for presentation at the Denver workshop. The resulting WBS Function chart incorporated the workshop data and subsequent suggestions by Mr. Wideman. One major conclusion of the workshop was the addition of the matrix format to the Body of Knowledge. The Function Impact Matrix chart (Figure D-1) shows the complexities of interfacing with other project management functions. Both charts encompass the total project cost management concepts from initiation to completion during the total project life cycle.

Cost Function Chart

The process levels used in the Cost Function chart (Figure D-1) are as follows:

1. Cost Estimating & Forecasting
2. Cost Budgeting
3. Cost Control
4. Cost Applications

Each of the process levels (WBS-2) were expanded into activity levels (WBS-3). An additional level (WBS-4) lists the techniques that are associated with some of the activities.

Cost Estimating and Forecasting

Cost estimating is the process of assembling and predicting costs of a project over its life cycle. It encompasses economic evaluation, project investment cost and cost forecasting.

The economic evaluation is the initial planning phase to determine whether a project is economically and technically feasible and whether sufficient funding can be obtained to implement the project. It involves the assessment of "order of magnitude" estimates, project profitability, financing and acceptance.

The project investment cost is the prediction of future cost even though all the parameters are not fully defined. It is during this process that order of magnitude, budget and definitive estimates are produced.

Cost forecasting is the process of developing the future trends along with the assessment of probabilities, uncertainties and inflation that could occur during the project. Statistical techniques assist in the development of a project cost confidence level consistent with the degree of risk desired.

These processes assist in predicting the future financial outcome for a successful project.

Cost Budgeting

The cost budgeting process is one of establishing budgets, standards and a monitoring system by which the investment cost of the project can be measured and managed. This process is the planning phase once project approval is obtained. It includes all the accounting functions required to establish procedures and systems to monitor the project.

Cost Controls

Although the control functions appear in all of the Project Management function charts, the activities associated with each are not universal and hence the term Cost Control is used to differentiate from the other functions. The process of cost control is the gathering, accumulating, analyzing, monitoring,

reporting and managing the costs on an ongoing basis.

Cost Applications

This is the process level associated with special applications of cost techniques that are not included in the other cost processes. It also includes associated topics that affect cost management such as computer applications, value analysis, etc.

Cost Function Impact Matrix Chart

The Function Impact Matrix chart (Figure D-1) illustrates the interaction and integration of the processes of the Cost Management function with the other project management functions. The traditional core project management functions (Scope, Quality, Time and Cost) are dynamically linked with the older "softer" components of integrative project management functions (Probability and Risk, Human Resources, Contract/Procurement, and Communications). The general project management processes (Strategic Planning and Control, Project Integration, and Resource Allocation) are also shown. The resulting matrix chart provides a mosaic of the interfaces and demonstrates the complexities of the Cost Management Function.

Summary

The four processes and their associated activities as shown on the WBS Function chart on page D-7 cover all aspects of the total Cost Management function. The WBS Function chart, the Function Impact Matrix chart (Figure D-1), glossary of terms and technical references attached provide a subject outline for an educational program. A truly successful project depends on the successful interaction and integration of all the Project Management functions. The Function charts will provide the educational background required for the accreditation and certification programs in Project Management.

Glossary of Terms

Cost Management is a function that includes the processes that are required to maintain effective financial control of projects (evaluating, estimating, budgeting, monitoring, analyzing, forecasting and reporting the cost information).

Cost is the cash value of project activity.

1. Cost Estimating and Forecasting is the process of assembling and predicting the costs of a project. It

encompasses the economic evaluation, project investments cost and predicting of future trends and costs.

1.a Economic Evaluation is the process of establishing the value of a project in relation to other corporate standards/benchmarks, project profitability, financing, interest rates and acceptance.

THIS FUNCTIONS PROCESSES

	Cost Estimating Forecasting	Cost Budgeting	Cost Controls	Cost Applications		
a) General Project Management Processes						
Strategic Planning and Control	3	1	1	2		
Project Integration	1		3			
Resource Allocation	1		2	2		
b) Basic PM Functions or Elements						
Scope	2	3	1	1		
Quality	2	3	3	1		
Time	2	3	3	1		
Cost						
c) Integrative PM Functions						
Probability and Risk	2		2	1		
Human Resources	2		3	1		
Contract/Procurement	2	3	2	1		
Communications	1	2	3	1		

Figure D-1
Function Impact Matrix Chart for
Cost Management

This Function's Impact on other Functions:

Blank = virtually none
1 = possibly or light
2 = likely or average
3 = very likely or heavy

1.a.1 Feasibility Studies are the methods and techniques used to examine technical and cost data to determine the economic potential and the practicality of project applications. It involves the use of techniques such as the time value of money so that projects may be evaluated and compared on an equivalent basis. Interest rates, present worth factors, capitalization costs, operating costs, depreciation, etc., are all considered

1.b Profitability is a measure of the total income of a project compared to the total monies expended at any period of time. The techniques that are utilized are Payout Time, Return on Original Investment (ROI), Net Present Value (NPV), Discounted Cash Flow (DCF), Sensitivity and Risk Analysis.

1.c Financing involves the techniques and methods related to providing the sources of monies and methods to raise funds (stock, mortgages, bonds, innovative financing agreements, leases, etc.) required for the project including interest charges

1.d Prospectus is the assembly of the evaluation profitability studies and all the pertinent technical data

in an overall report for presentation and acceptance by the owner and funders of a project.

1.d.1 Project Budget is the amount and distribution of money allocated to a project.

1.d.2 Budget (unqualified) usually refers to an estimate of funds planned to cover a **fiscal period**. (Instead see Project Budget. Also: a planned allocation of resources.)

1.e Project Investment Cost is the activity of establishing and assembling all the cost elements (capital and operating) of a project as defined by an agreed scope of work. The estimate attempts to predict the final financial outcome of a future investment program even though all the parameters of the project are not yet fully defined

1.e.1 Order of Magnitude (-25, +75 percent). This is an approximate estimate made without detailed data, that is usually produced from cost capacity curves, scale up or down factors that are appropriately escalated, and approximate cost capacity ratios. This type of estimate is used during the formative stages of an expenditure program for initial evaluation of the

project. Other terms commonly used to identify an Order of Magnitude estimate are preliminary, conceptual, factored, quickie, feasibility and SWAG

1.e.2 Parametric Cost Estimating is an estimating methodology using statistical relationships between historical costs and other project variables such as system physical or performance characteristics, contractor output measures, or manpower loading, etc. Also referred to as "top down" estimating.

1.e.3 Budget Estimate (-10, +25 per cent). A budget estimate is prepared from flow sheets, layouts and equipment details. This is often required for the owner's budget system. These estimates are established on quantitative information and are a mixture of firm and unit prices for labour, material and equipment. These estimates are used to establish the funds required and for obtaining approval for the project. Other terms used to identify a Budget estimate include Appropriation, Control, Design, etc.

1.e.4 Definitive Estimate (-5, +10 per cent). A definitive estimate is prepared from well-defined data, specifications, drawings, etc. This category covers all estimate ranges from a minimum to maximum definitive type. These estimates are used for bid proposals, bid evaluations, contract changes, extra work, legal claims, permit and government approvals. Other terms used for a Definitive Estimate include check, lump sum, tender, post contract changes, etc.

1.e.5 Project Close Out and Start Up Costs are the estimated extra costs (both capital and operating) that are incurred during the period from the completion of project implementation to the beginning of normal revenue earnings on operations.

1.f Contingency Allowances. Specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur. If an allowance for escalation is included in the contingency it should be as a separate item, determined to fit expected escalation conditions of the project.

1.g Inflation/Escalation Allowances is a factor in cost evaluation and cost comparison that must be predicted as an allowance to account for the price changes with time that can occur and over which the Project Manager has no control (such items as cost of living index, interest rates, other cost indices, etc.)

1.h. Forecasting is the work performed to estimate and predict future conditions and events. Forecasting is an activity within the management function of planning.

Forecasting is often confused with budgeting, which is a definitive allocation of resources rather than a prediction or estimate.

1.i. Trend Analyses are mathematical methods for establishing trends based on past project history and allowing for adjustment, refinement or revision to predict future cost. Regression analysis techniques can be used for predicting cost/schedule trends using data from historical projects.

1.j. Statistics are the mathematical methods used to determine the best range of probable values for a project. Also used to assess the degree of accuracy or allowance for unpredictable future events such as accidents, technological innovations, strikes, etc., that can occur during the project life. The techniques that can be used are risk analysis with Monte Carlo simulation, confidence levels, range analysis, etc.

2. Cost Budgeting is the process of establishing budgets, standards and a monitoring system by which the investment costs of the project can be measured and managed, that is, the establishment of the control estimate. It is vital to be aware of the problems "before the fact" so that timely corrective action can be taken.

2.a. Work Breakdown Structure (WBS). A task-oriented "family tree" of activities that organizes, defines and graphically displays the total work to be accomplished in order to achieve the final objectives of a project. Each descending level represents an increasingly detailed definition of the project objective. It is a system for subdividing a project into manageable work packages, components or elements to provide a common framework for Scope/Quality/Cost/Schedule communications, allocation of responsibility, monitoring and management.

2.b. Code of Accounts. Once the project has been divided into the WBS work packages, a code or numbering system is assigned to the cost data for cost monitoring, control, reports, tax class separations and forecasting purposes.

2.c. Budget Costs are the translation of the estimate into man-hour rates, quantity units of production, etc. so that these budget costs can be compared to actual costs and variances developed to highlight performance and alert those responsible to implement corrective action if necessary.

2.d Cash Flow Analysis is the activity of establishing cash flow (dollars in and out of the project) by month and the accumulated total cash flow for the project for the measurement of actual versus the budget costs. This is necessary to allow for funding of the project at the lowest carrying charges and is a method

of measuring project progress.

2.e. Managerial Reserves are the reserve accounts to allocate and maintain funds for contingency purposes. These accounts will normally accrue from the contingency and other allowances in the project budget estimate.

2.f Cost Performance Measurement Baseline is the task of formulating the budget costs measurable goals particularly time and quantities for the purpose of comparisons, analyzing and forecasting the future costs.

2.g Project Cost Systems is the establishment of a project cost accounting system, ledgers, asset records, liabilities, write offs, taxes, depreciation expense, raw materials, pre-paid expenses, salaries, etc.

2.g.1. Project Accounting is the process of identifying, measuring, recording and communicating actual project cost data.

2.h. Funding is the financial arrangements necessary for progress payments of work completed, provision of working capital, appropriation procedures, etc.

3. Cost Controls are the processes of gathering, accumulating, analyzing, reporting and managing the costs on an on-going basis and includes all of the following activities.

3.a. Project Procedures are the methods, practices and policies (both written and verbal communications) that will be used during the project life.

3.b. Project Cost Changes are the changes to a project and the initiating of the preparation of detail estimates to determine the impact on project scope, cost and schedule. These changes must then be communicated clearly (both written and verbally) to all participants that approval/rejection of the project changes has been obtained (especially those that change the original project intent).

3.c. Monitoring Actual versus Budget is one of the main responsibilities of cost management for continually measuring and monitoring the actual cost versus the budget in order to identify problems, establish the variance, analyze the reasons for variance and take the necessary corrective action. Changes in the Forecast Final Cost are constantly monitored, managed and controlled.

3.d Variance Analysis is the analysis of the following:

3.d.1 Schedule Variance = $BCWP - BCWS$

3.d.2 Cost Variance = $BCWP - ACWP$

3.d.3 % over/under = $\frac{ACWP - BCWP}{BCWP} \times 100$

3.d.4 Unit Variance Analysis

- Labour Rate
- Labour Hours/Unit of Work Accomplished
- Material Rate
- Material Usage

3.e Integrated Cost/Schedule Reporting is the development of reports that measure budget versus actual, S curves, BCWS, BCWP, ACWP.

3.e.1. BCWS is the Budget Cost of Work Scheduled

3.e.2. BCWP is the Budget Cost of Work Performed

3.e.3. ACWP is the Actual Cost of Work Performed

3.e.4. S Curves are the graphical display of the accumulated costs and labour hours against time for both budgeted and actual amounts.

3.f. Progress Analysis is the development of performance indices such as:

3.f.1. Cost Performance Index = $CPI = \frac{BCWP}{ACWP}$

3.f.2. Schedule Performance Index = $SPI = \frac{BCWP}{BCWS}$

3.f.3. Productivity is the measurement of labour efficiency when compared to an established base. It is also used to measure equipment effectiveness, drawing productivity, etc.

3.g. Corrective Action is the development of changes in plan and approach to improve the performance of the project.

4. Cost Applications are the processes of applying cost data to other techniques that have not been described in the other processes.

4.a. Post Project Evaluation is the activity of appraising the costs and technical performance of a completed project and the development of new applications in project management methods to overcome problems that occurred during the project life for the benefit future projects.

4.b. Life Cycle Costing is the concept of including all costs within the total life of a product from concept, implementation, start up to dismantling. It is used for making decisions between alternatives and is a term used principally by the government to express the total cost of an article or system. It is also used in the private sector by the real estate industry.

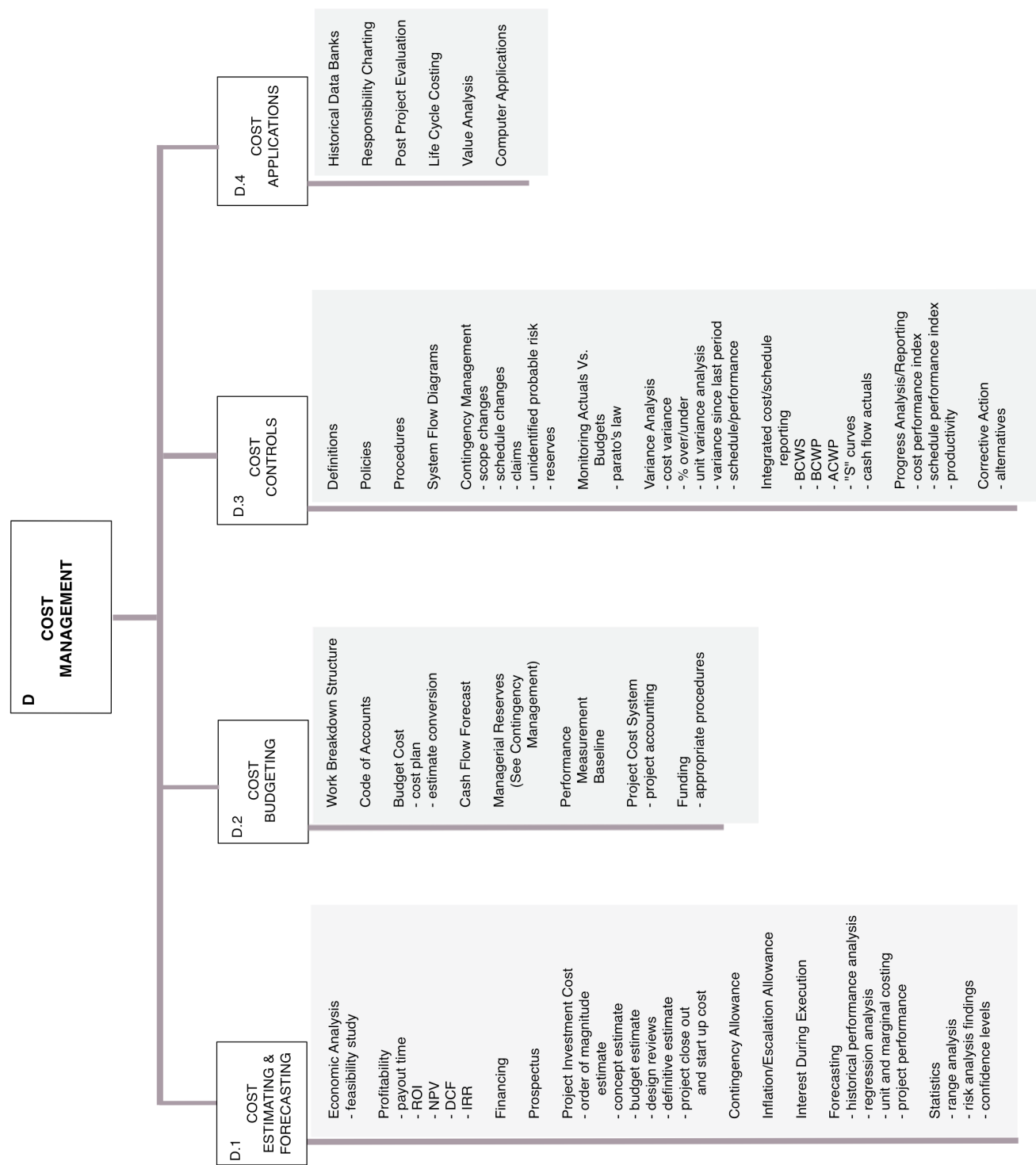
4.c. Value Analysis is an activity devoted to optimizing cost/performance. It is the systematic use of techniques which identify the required functions of an item, establish values for those functions and provide the functions at the lowest overall cost without loss of performance (i.e., optimum overall cost).

4.d. Computer Cost Applications are the computer assisted techniques to handle analysis and store the volume of data accumulated during the project life that are essential to the cost management function. The areas associated with cost management are:

- Cost Estimating Data Base
- Computerized Estimating
- Management Reports
- Economic Analysis
- Analysis of Risk and Contingency
- Progress Measurements
- Productivity Analysis and Control
- Risk Management
- Commitment Accounting
- Integrated Project Management Information Systems

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RISK MANAGEMENT

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Introduction

The whole point of undertaking a project is to achieve or establish something new, to venture, to take chances, to risk. Thus, risk has always been an intrinsic part of project work.[3] However, in today's markets, with heavy competition, advanced technology and tough economic conditions, risk taking has assumed significantly greater proportions.

Generally, when we speak of taking a risk we tend to think only of those things that are highly chancy or hazardous. Yet many risks are so commonplace in everyday life that we scarcely give them a thought. Instead, we react to them subconsciously, and take precautions that experience has taught us are only prudent.

In crossing the road, for example, we take the precaution of looking both ways, and only cross when the road is clear. If we are in a hurry, we might "take a chance " (increase the risk) by crossing when we see a sufficient gap in the traffic. If the traffic is heavy, and the risk appears to be extreme, then we might walk further to a designated crossing area at an intersection, traffic lights or to an overpass, if available.

Rarely do we systematically assess all the risks involved in reaching our destination. Even less do we consider the consequences if our chances fail to come off, except perhaps once a serious accident has actually occurred. Otherwise, we might decide never to go anywhere at all!

On the other hand, when our children are small, we admonish them not to go near the road (risk identification and avoidance). When they have to cross the road to get to school, we examine the dangers and either teach them how to cross safely or direct them to the school crossing guard (risk assessment and planning of shift of responsibility). When they get home at the end of the day, we ask them "how they got on" - perhaps we can do something more to help them for tomorrow (information feedback and corrective action). We also make a mental note for when our youngest reaches the same age (building the data base).

Risk Management

Project managers will recognize the classic systems methodology of input, process, output and feedback loop outlined above which is so vital to the effective control of a project. Yet risk is somehow different. It has to do with uncertainty, probability or unpredictability, and contingency planning.

Indeed, the term risk management itself tends to be misleading because management implies control of events.[2] On the contrary, risk management must be seen as preparation for possible events in advance, rather than responding as they happen. With time in hand, it is possible to identify alternative action plans and select that which is most consistent with project objectives. Consider the following improbable but quite possible situation. You find yourself being shot at . You have three choices

1. You can move to avoid the bullet;
2. You can deflect the bullet; or
3. You can repair the damage done by the bullet

At no time are you in control of the bullet. What you have to manage is your response to the event (risk), not the event itself.

Therefore, risk management is seen as the formal process whereby risk factors are systematically identified, assessed and provided for. In other words, such provisions constitute response planning and may include such defensive actions as mitigation by risk avoidance, deflection by insurance or contractual arrangement and contingent planning such as the provision and prudent management of budgeted contingency allowances to cover uncertainties.

Not only are the uncertainties in most projects numerous, but they are also interrelated. This affects project results in complex ways. It tends to lead to underestimation of risk and makes it difficult for management to be confident in identifying and prioritizing the areas on which risk management should be focused. A systematic approach is therefore necessary in order to sort through the myriad of uncertainties, to pinpoint the truly critical ones, and to identify cost-effective ways of reducing those uncertainties.

In practice, depending on the size and nature of the project, effective risk management may require some detailed quantitative analysis of the impact of the various uncertainties. This is required in order to judge the reliability of the estimates, the effectiveness of possible alternative strategies and to plan the best overall responses. Risk management is inextricably tied into cost, schedule and quality and is, therefore, a key component of the project management process

Definition of Project Risk and Risk Management

In the context of project management, project risk may be defined as the chance of certain occurrences adversely affecting project objectives. [1] [6] It is the degree of exposure to negative events, and their probable consequences. Project risk is therefore characterized by the following risk factors. [2]

1. The *risk event* or identification i.e., precisely what might happen to the detriment of the project;
2. The *risk probability* i.e., how likely the event is to occur; and
3. The *amount at stake*, i.e., the extent of loss that could result.

Risk management may therefore be defined as follows:

Risk management, in the project context, is the art and science of identifying, analyzing and responding to risk factors throughout the life of a project and in the best interests of its objectives.

Following the typical hierarchy of the Project Management Institute's Body of Knowledge Management Functions (See Figure 1). The Figures on pages E-7 & E-8 show a risk management breakdown structure. That is to say, the function itself is at level 1, followed by processes, activities, and finally techniques at level 4 [7] As illustrated earlier, and as shown in Figure 1, the risk management processes are risk identification, impact analysis, response planning, the response system, and the application of the resulting data.

Risk Identification

On most projects, responsibility for project risk is so pervasive that it is rarely given sufficient central attention. It should be noted, therefore, that not all risk events are independent. Indeed, the total amount at stake may be highly dependent upon a series of interacting events. Unhappily, the old saying, "It never rains but it pours!" is not an uncommon experience. Moreover, a series of risk events can, and frequently does,

cross traditional functional responsibility boundaries with disastrous consequences.

Risk can be divided into two basic types. The first of these, *business risk*, involves the inherent chances for a profit or loss associated with any business endeavor. Business entities employ staffs of specially trained managers, accountants, engineers, technicians, and laborers in order to reduce the chance of a loss and increase the chance of profit.

The second type of risk is usually called Pure, or *Insurable Risk*. Insurable risk differs from business risk in that it involves only a chance for loss and no chance for profit. For example, insurable risks can be further divided into four general categories. These include the chance for direct property loss, the chance for indirect property loss, the chance for liability loss, and the chance for personnel-related loss.

Obviously, direct property loss involves the destruction of property such as by fire, flood or by windstorm. Indirect loss is somewhat more subtle and involves, for example, the extra expenses associated with renting a temporary replacement of a crucial piece of equipment following its damage or destruction, or the business interruption if operations cannot be continued because a replacement is not immediately available.

Liability loss, of course, involves the chance of a member of the public filing a lawsuit for bodily injury, personal injury, or property damage against the contractor.

Finally, personal losses generally involve injuries to employees such as contemplated by Workman's Compensation Laws.

On any given project, the spectrum of risk events will obviously vary, as will both their degree of probability and the amount at stake. The Figure on page E-7 sets out to classify roughly the types of project risk according to cause rather than effect. [3] [6]. It will be seen that this form of classification also serves to rank the various risk groups according to ability to manage effective responses (from low ability to high ability). The degree of ability to manage the response is, of course, independent of probability and amount at stake.

Ultimate responsibility for the identification of risks and their subsequent treatment must rest with the owner or the client. That person must be motivated to assume this responsibility by the threat posed to the successful completion of the project objectives. That is, those objectives that will likely be expressed in terms of cost, time and functional performance.

THIS FUNCTIONS PROCESSES

	Risk Identification	Impact Analysis	Response Planning	Response System	Data Applications	
a) General Project Management Processes						
Strategic Planning and Control	3		3		1	
Project Integration						
Resource Allocation	2					
b) Basic PM Functions or Elements						
Scope	1	2	1	1	1	
Quality	1	1	1	1	1	
Time	2	3	3	3	1	
Cost	3	2	3	2	1	
c) Integrative PM Functions						
Risk Management						
Human Resources	2		2	2		
Contract/Procurement	3		2	2		
Communications	3		3	2		

**Figure E-1:
Function Impact Matrix Chart for
Risk Management**

This Function's Impact on other Functions:

Blank = virtually none
1 = possibly or light
2 = likely or average
3 = very likely or heavy

Response System

Risk response should be considered in terms of avoidance, reduction, transfer or retention. Thus, in dealing with risk, it may be ignored (by default), recognized but no action taken (as a matter of policy), or reduced, transferred or shared (as part of response planning). These approaches may also be combined. The first step, then, is to set some policies, procedures, goals and responsibilities for risk management on the project in question. This will set the scope and framework for the management function, whether it is simply recognition of a task to be undertaken by the project manager, or the responsibility of a specialist or team under his/her direction.

Bear in mind that risk events will affect the project's cost, schedule, or quality of the work to an extent that depends on the event and how it is handled. The overall project risk will also vary considerably throughout the life of the project. It will increase as tasks with risk events of high probability are

undertaken and will generally tend to decrease as the bulk of the work is completed.

The project risk may also change substantially as a result of changes in the scope of the project or changes in the method of working. Consequently, continuous review of the situation with appropriate adjustment of response planning is recommended.

Impact Analysis

In broad terms, a risk impact analysis requires the project to be broken down into management tasks closely allied to the project's work breakdown structure. The extent and depth of this analysis should be determined by the risk management policies and goals noted above. In practice, particular emphasis may be given at this point to those events that may be perceived as having "high risk" (i.e., high probability) and hence require detailed analysis.

Care, however, should be taken not to overlook the possibility of a significant impact as a result of some

combination of apparently minor events. For example, a series of relatively insignificant schedule delays could result in completely missing a "window of opportunity" such as reaching a market before a competitor, construction in the summer season rather than in winter, or completing a project before an anticipated adverse regulatory change.

At the other end of the scale, a very "low risk" may, as a matter of policy, be considered "out-of-scope" even though the event could have a major impact. For example, a risk event might be such that it has the potential to undermine other activities of the sponsoring organization. In this case, appropriate response planning should be undertaken as part of the organization's business planning rather than at the project level.

Various diagramming techniques such as influence diagrams [4] and probability trees are available for gaining an appreciation of risk event interdependencies.[4] Through such techniques a screening process can be applied to assess the merits of further detailed consideration of specific risks and the manner in which combined effects of risk events can be modeled. These techniques are generally within the purview of specialists in risk analysis in the various technical project fields.

During the analysis, especially on large projects, it is often necessary to develop a further breakdown in which each activity is numbered and documented for reference. As with the project work breakdown structure, this breakdown serves to focus discussion, to aid in identification of all risks and to provide a basis for formalizing dependency links within the project. Using this breakdown, the risks within each activity are identified by mentally stepping through all aspects of the activity to produce a comprehensive list of uncertainties.

The next step in the process is to quantify the various risks identified. This must be done in terms of severity of impact, probability, and sensitivity to changes in related project variables. In complex situations, perhaps the most satisfactory approach is to model the variables by discrete distributions with specified intervals. This allows maximum flexibility in representing distribution shapes as well as offering mathematical simplicity. It also paves the way for solving complex combinations of dependent and independent variables by repetitive computerized calculations.

Where risk combination is analyzed by modeling, three levels of models are typically required. These are:

1. For detailed analysis of the joint impact of a small number of risks within an activity;
2. For examining the joint effects of all risks within an activity; and
3. For examining the broad overall impact of risks from several or all activities.

This can be conceptualized as the successive summarization of a large probability tree. The resulting output shows overall distributions as they impact cost, schedule and quality. These distributions can be displayed graphically so as to show the relative importance of each contributing risk, as well as their cumulative effect.

A significant commitment of time and resources may be required for an in-depth impact analysis. Therefore, this analysis may only be appropriate at the level of detail where the stakes are high and where there is substantial uncertainty. [4]

Data Applications

The actual database used to quantify the risk events and probabilities must be obtained from objective sources such as recorded experience on past projects. Data collected on the current project, as it proceeds, will be even more valuable for updating the assessment of overall project risk. All such data should be archived to form part of the *post project assessment* and the organization's eventual *historic database*.

However, for many of the risks, especially at the initial impact analysis stage, the data are necessarily subjective in nature and must be obtained through careful questioning of experts or persons with the relevant knowledge. For example, an expert could be asked to estimate the optimistic, most probable and pessimistic values for a particular variable, together with percentage chances of better than optimistic or worse than pessimistic outcomes. The amount at stake for each and the sensitivity of this amount to changes in related variables must also be assessed.

The description of risk distributions and combinations, and the quantification and sensitivity assessments, can all be demanding technical tasks.

Response Planning

As a result of the methodology outlined above, a picture of project risk will emerge. This will include where, when and to what extent exposure may be anticipated. For a complete picture the internal intrinsic worth of the project should also be established as well as the external "status quo" of the risks to the sponsoring organization associated with not carrying out the

project at all.

With this picture in mind it is then possible to formulate suitable risk management strategies, whether by way of mitigation, deflection or systematic contingency planning. Mitigation may simply involve the proper recognition of certain risks by appropriate modification of the project's scope, budget, schedule, quality specification or all four.

Adequate contingency allowance and good control, even on a tight budget, will reduce the chance of overrun. A logically developed schedule with attention to resource requirements and conflicts will reduce the probability of schedule overrun. But, in the enthusiastic initiation of a project, how often has one heard the battle cry: "Our objective is to build the best there is!"? Not surprisingly, such unrealistic definitions of quality result in very high-risk projects indeed!

Deflection involves the transfer of risk by such means as contracting it to another party, whether by insurance or by including it in the implementation contract. In the latter case, caution is advised since experience shows that this strategy will only be cost effective if the contractor has proper and effective

control over the risk or risks concerned [5]. Contingency planning includes the management of a contingency budget [6], the development of schedule alternatives or workarounds and complete emergency responses to deal with specific major areas of risk.

The effects of all such strategies can, if required, be analyzed by making appropriate changes to the risk model. In this way decisions can be optimized and the project can proceed with increased confidence.

Conclusion

As noted in the Introduction, the whole point of undertaking a project is to achieve something new, to venture, to take a risk. While much of the detail described in the foregoing outline of risk management is applicable to large complex projects, the principles involved are just as applicable to any size project in any field of endeavor.

Since there is no point in taking any risk that is not necessary, risk management should be a recognized project management responsibility on all projects - even on a small one.

Glossary of Terms

The suggested definitions for the terms in this glossary are all presented in the context of project management in general and in risk management in particular.

1. Risk Management: The art and science of identifying, analyzing and responding to risk factors throughout the life of a project and in the best interest of its objectives.

1.a Project Risk: The cumulative effect of the chances of uncertain occurrences that will adversely affect project objectives. It is the degree of exposure to negative events and their probable consequences. Project risk is characterized by three factors: *risk event*, *risk probability* and *the amount at stake*:

1.a.1 Risk Event: The precise description of what might happen to the detriment of the project.

1.a.2 Risk Probability: The degree to which the risk event is likely to occur.

1.a.3 Amount at Stake: The extent of adverse consequences that could occur to the project.

2. Risk Factor: Any one of risk event, risk probability or amount at stake, as defined above.

3. Risk Identification: The process of systematically identifying all possible risk events that may impact on a project. They may be conveniently

classified according to their cause or source and ranked roughly according to ability to manage effective responses. A suggested classification is shown on pages E-7 & E-8. Not all risk events will impact all projects, but the cumulative effect of several risk events occurring in conjunction with each other may well be more severe than the examination of the individual risk events would suggest. Remember the slogan: "It never rains but it pours!"

3.a Impact Analysis: The mathematical examination of the nature of individual risks on the project, as well as potential structures of interdependent risks. It includes the quantification of their respective impact severity, probability, and sensitivity to changes in related project variables, including the project life cycle. To be complete, the analysis should also include an examination of the external "status quo" prior to project implementation as well as the project's internal intrinsic worth as a reference baseline. A determination should also be made as to whether all risks identified are within the scope of the project's response planning process.

3.b Response Planning: The process of formulating suitable risk management strategies for the

project, including the allocation of responsibility to the project's various functional areas. It may involve mitigation, deflection and contingency planning. It should also make some allowance, however tentative, for the completely unforeseen occurrence.

3.c Mitigation: The act of revising the project's scope, budget, schedule or quality, preferably without material impact on the project's objectives, in order to reduce uncertainty on the project.

3.d Deflection: The act of transferring all or part of a risk to another party, usually by some form of contract.

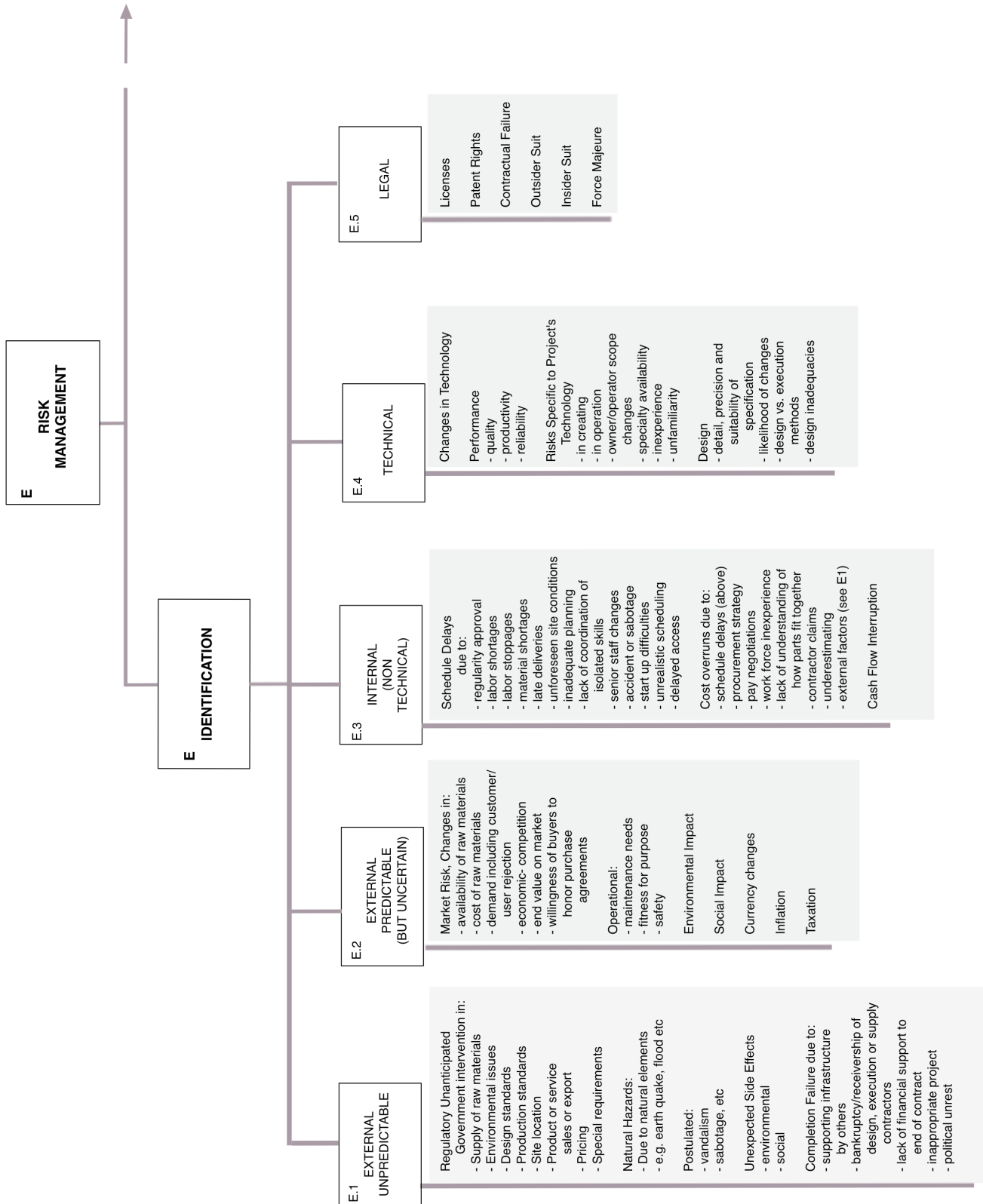
3.e Contingency Planning: The establishment of management plans to be invoked in the event of specified risk events. Examples include the provision and prudent management of a contingency allowance in the budget, the preparation of alternative schedule activity sequences or "workarounds" and emergency responses to reduce the impact, and the evaluation of liabilities in the event of the complete project shutdown.

4. Response System: The on-going process put in place during the life of the project to monitor, review and update project risk and make the necessary adjustments. Examination of the various risks will show that some risks are greater in some stages of the project life cycle than in others.

4.a Data Application: The development of a database of risk factors both for the current project and as a matter of historic record.

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HUMAN RESOURCES MANAGEMENT

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Introduction

The fall meeting of the PMI Board of Directors, was held in conjunction with the 1986 PMI Seminar/Symposium in Montreal, Canada. Proposed changes to the Project Management Body of Knowledge (PMBOK) published in the 1986 Special Summer Issue of the Project Management Journal were discussed. Particular concern was expressed over the fact that the Human Resources Management Function of the PMBOK was incomplete relative to the other functions of the PMBOK.

Dr. Adams and Dr. Stuckenbruck were requested to form a committee that would include representation from industry, to build on the work published by the previous committee and to make it consistent with the remainder of the PMBOK. This approach is consistent with the philosophy of developing the PMBOK as an evolutionary document. That is with each successive committee building on the work of those who went before until the body of knowledge accurately reflects the project management profession.

In approaching this task, the subject of human resources was viewed specifically from the perspective of the project manager, and not from the perspective of the human resources specialist. In our view, while the entire field of human resources management might apply to project management to one degree or another, certain aspects of human resources management are much more useful to the project manager than others.

We chose to select those areas believed to be most relevant to the project manager and emphasize them throughout this function of the PMBOK. In this respect, we believe that our philosophy towards human resources management is somewhat different than that expressed by the previous committee chairman. It should be noted that the definitions provided below are intended to reflect the view of the project manager. These definitions should be compatible with, but do not necessarily duplicate, the definitions that might be found through out the human resources management literature.

Our view of project management defines the project manager as filling a position that crosses many organizational boundaries. The project manager is responsible for developing his/her project team and building it into a cohesive group to complete the project. This must be done, however, within the constraints imposed by the parent organization and other organization(s) outside the project team (clients, the larger organization, government agencies, etc.)

Essentially, these "external" organizations impose administrative requirements on the project team, and the team, as it is developed, must function within the boundaries established by these requirements. The work breakdown structure for the human resources management function recognizes this situation by identifying administrative and behavioral tasks for the project manager to deal with.

A combination of administrative and behavioral knowledge and skills thus appears necessary for managing the human resources contributing to project completion. Much of the administrative activity of the project manager is directed by organizations and agencies outside of the project itself, and the constraints imposed on the project can largely be identified in this area of the work breakdown structure.

The behavioral aspects of the work breakdown structure deal with the project team members, their interaction as a team, and their contacts with individuals outside the project itself. We believe this orientation best reflects the major aspects of human resources management that must be understood and employed by the project manager.

In expanding the material previously published, every effort was made to use as much of the previous work as could reasonably fit within our perspective of project management. This approach is consistent with the philosophy of building on, rather than re-inventing, the work that has previously been accomplished.

To this end, (1) the basic definition of Project Human Resource Management remains the same.

"The art and science of directing and coordinat-

ing Human Resources throughout the life of a project by using administrative and behavioral knowledge to achieve predetermined project objectives of scope, quality, cost, time, and participant satisfaction."

This definition is sufficiently broad to focus within the project, as indicated by the previous committee; and yet reflect the requirements imposed by outside organizations and agencies. (2) The Functional Impact Matrix (see Figure F-1) was revised to reflect the degree of relationship we believe exists among the various components of the PMBOK and the major components of the Human Resource Management Function. On the scale of one to three, "one" represents a relationship that may be weak, infrequent, or project dependent, while "three" represents the most significant relationship. (3)

The work breakdown structure for Project Human Resource Management was revised as necessary to reflect the separation of topics under the major subheadings (see pages F-7 & 8). This was consistent with both our philosophy of project management and our understanding of human resource management.

Glossary of Terms

Human Resources Management, as viewed by the project manager, is the "Art and science of directing and coordinating human resources throughout the life of a project by using administrative and behavioral knowledge to achieve predetermined project objectives of scope, quality, time, cost, and participant satisfaction."

Administrative aspects of project human resources management involves the process of providing formal guidance and control to the project team as summarized in the following descriptions.

1. Employee Relations consists of those formal activities and procedures used by an organization to administer and develop its work force.

1.a. Recruitment, Selection, and Job Placement involves attracting a pool of potential employees, determining which of those employees is best suited for work on the project, and matching that employee to the most appropriate task based on his or her skills and abilities.

1.b. Personnel Training provides for the development of specific job skills and techniques required by the individual to become more productive.

1.c. Labor Relations includes those formal activities developed by an organization to negotiate

The process of motivating a team, for example, is different from the process of motivating an individual, so the subheadings should appropriately reflect different aspects of human resource management theory. Finally, (4) we have provided the needed glossary of terms and a project management-oriented reference list for the Human Resource Management Function.

We would like to congratulate the workshop track members from the 1985 PMI Pre-Symposium Body of Knowledge Workshop on their hard work, their concentration, and their contribution to the development of project management as a profession.

We must all realize that the PMBOK is a dynamic representation of the project management field at any point in time, and that the PMBOK must continue to evolve as our understanding of project management evolves. To this end, we have built on the work of those who came before us, and we look forward to others studying, modifying, and expanding our work as the profession develops, grows, and matures.

and bargain with its work force, whether or not that work force is unionized.

1.d. Career Path Planning is the process of integrating the individual's career planning and development into the organization's personnel plans with the objective of satisfying both the organization's requirements and the individual's career goals.

1.e. Manpower Planning is the process of projecting the organization's manpower needs over time, in terms of both numbers and skills, and obtaining the human resources required to match the organization's needs.

1.f. Organization Development is the use of behavioral science technology, research, and theory, to change an organization's culture to meet predetermined objectives involving participation, joint decision making, and team building.

1.g. Records Management involves the procedures established by the organization to manage all documentation required for the effective development and application of its work force.

1.h Compensation and Evaluation involves the measurement of an individual's performance and the financial payment provided to employees as a reward

THIS FUNCTION'S PROCESSES

Administrative

Behavioral

Employee Relations	Compensation & Evaluation	Gov't Regs and Reqmts	Individuals Outside Proj	Team Members	Project Team
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a) General Project Management Functions

Strategic Planning and Control	1	2	2	1	3	3
Project Integration	2	1			3	3
Resource Allocation	2	2	1	3	3	3

b) Basic PM Functions or Elements

Scope	1		3		2	3
Quality	3	2	2	2	3	3
Time	2	1	3	2	3	3
Cost	2	1	3	2	3	3

c) Integrative PM Function

Probability and Risk	2	1	3	1	1	2
Human Resources						
Contract/Procurement			3		1	1
Communications	3	3	3	3	3	3

Figure F-1:
Function Impact Matrix Chart for
Human Resources Management

This Function's Impact on other Functions:

Blank = virtually none
1 = possibly or light
2 = likely or average
3 = very likely or heavy

for their performance and as a motivator for future performance.

2.a. Job Descriptions are written outlines of the skills, responsibilities, knowledge, authority, environment, and interrelationships involved in an individual's job.

2.b. Performance Evaluation involves the formal system by which managers evaluate and rate the quality of subordinates' performance over a given period of time.

2.c. Salary Administration is the formal system by which the organization manages its financial commitments to its employees. It includes man hour accounting and the development of a logical structure for compensation.

2.d. Benefits Administration is the formal system by which the organization manages its non-financial commitments to its employees. Includes such benefits as vacation, leave time, and retirement.

3. Government Regulations and Requirements consists of those laws, regulations, rules, policies, and administrative requirements imposed upon organizations by government agencies.

3.a. Discrimination refers to the requirements imposed on the organization and the procedures implemented by the organization to assure fairness in hiring and promotion practices.

3.b. Equal Opportunity refers to the procedures implemented by the organization to assure that it meets the requirements of the Equal Employment Opportunity sections of the Civil Rights Act. It includes affirmative action and other programs as well as the documentation procedures necessary to demonstrate compliance.

3.c. Arbitration refers to the formalized system for dealing with grievances and administering corrective justice as part of collective bargaining agreements.

Behavioral aspects of project human resources management involves the project manager's relationships with people, and the management of their reactions and behavior whether or not they are members of the project team.

4. Individuals Outside the Project refers to all those individuals who impact the project work but who are not considered members of the project team.

4.a. Top Management, from the project manager's perspective includes the individual to who he or she reports on project matters and other managers senior to that individual.

4.b. Line/Functional Managers are those responsible for activities in one of the primary functions of the organization, such as production or marketing, with whom the project manager must relate in achieving the project's goals.

4.c. Service and Support Personnel are those individuals working in functions such as personnel, accounting, maintenance, and legislative relations that are needed to keep the "primary functions" operating effectively.

4.d. Staff Personnel are those individuals working in departments that are not directly involved in the organization's mainstream activity, but rather perform advising, counseling, and assisting duties for the line/functional departments.

4.e.1. The Public (External) includes all those that are not directly involved in the project but who have an interest in its outcome. This could include, for example, environmental protection groups, equal employment opportunity groups, and others with a real or imagined interest in the project or the way it is managed.

4.e.2. The Public (Internal) Are all personnel working directly or indirectly on the project

4.f. Customer/Client Personnel are those individuals working for the organization that will assume responsibility for the product produced by the project when the project is completed.

4.g. Regulatory Personnel are those individuals working for government regulatory agencies whose task it is to assure compliance with their particular agency's requirements.

4.h. The Environmentally Concerned are those individuals who align themselves with the views of various groups concerned with issues of protecting the environment.

4.i. The Legally Concerned are those individuals who are concerned with assuring that the project complies with all aspects of the law.

5. Team Members are individuals reporting either

part-time or full-time to the project manager who are responsible for some aspect of the project's activities

5.a. Communicating with Individuals involves all activities by which the project manager transfers information or ideas to individuals working on the project.

5.b. Motivating is the process of inducing an individual to work toward achieving the organization's objectives while also working to achieve personal objectives.

5.c. Counseling is the process of advising or assisting an individual concerning career plans, work requirements, or the quality of work performed.

5.d. Negotiating is the process of bargaining with individuals concerning the transfer of resources, the generation of information, and the accomplishment of activities.

5.e. Delegating is the process by which authority is distributed from the project manager to an individual working on the project.

5.f. Problem Resolution involves the interaction between the project manager and an individual team member with the goal of finding a solution to a technical or personal problem that affects project accomplishment.

5.g. Personal Rewards involves providing an individual with psychological or monetary benefits in return for his or her performance.

5.h. Personal Recognition involves the public acknowledgement of an individual's performance on the project.

6. The Project Team is that group of people, considered as a group, that shares responsibility for the accomplishment of the project's goals and who report either part-time or full-time to the project.

6.a. Leadership is the process by which the project manager influences the project team to behave in a manner that will facilitate project goal achievement.

6.b. Team Building is the process of influencing a group of diverse individuals, each with their own goals, needs, and perspectives, to work together effectively for the good of the project such that their team effort will accomplish more than the sum of their individual efforts could otherwise achieve.

6.c. Team Motivation is the process by which the project manager influences his project team to initiate effort on the project tasks, expend increasing amounts of effort on those tasks, and to persist in expending effort on these tasks over the period of time necessary for project goal accomplishment.

6.d Team Decision Making is the process by which

the project manager and his team determine feasible alternatives in face of a technical, psychological, or political problem, and make a conscious selection of a course of action from among these available alternatives.

6.e. Team Reward System is the process by which the project team receives recognition for its accomplishments.

6.f. Conflict Management is the process by which the project manager uses appropriate managerial techniques to deal with the inevitable disagreements, both technical and personal in nature that develop among those working toward project accomplishment.

6.g. Organizational Politics is the informal process by which personal friendships, loyalties, and enmities are used in an attempt to gain an advantage in influencing project decisions.

6.h. Communicating with Groups is the means by which the project manager conducts meetings, presentations, negotiations, and other activities necessary to convey the project's needs and concerns to the project team and other groups.

References

Note: The following references are divided into three groups: primary, secondary, and tertiary.

- The primary group consists of those published by PMI. These are available through the PMI Executive Director's office.
- The secondary group is specifically project management oriented references published by other agencies, and may be more difficult to obtain.
- The third group of references is more general Human Resources Management that may be useful in developing a more complete understanding of the Human Resources field. They too may be more difficult to obtain.

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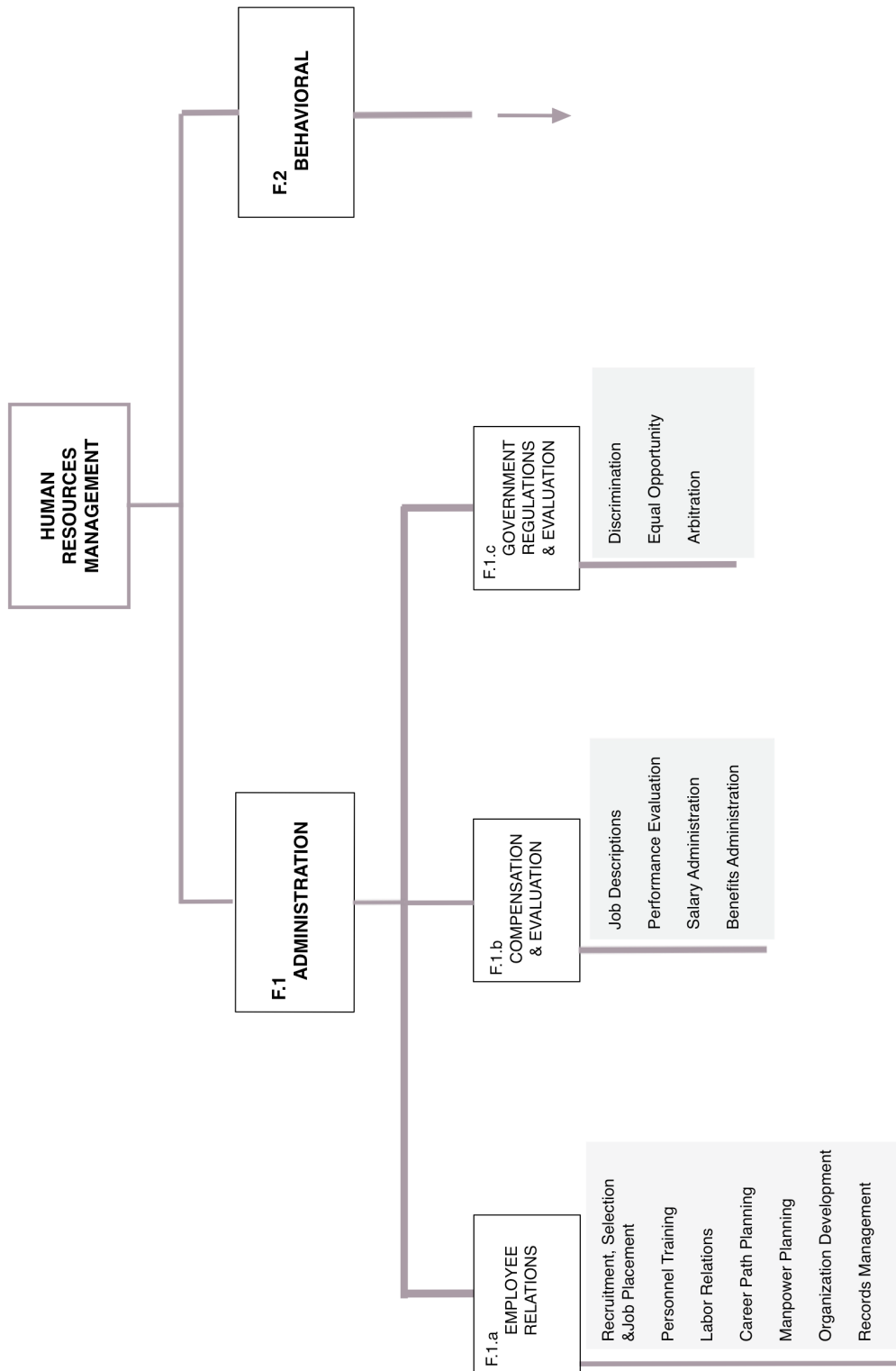
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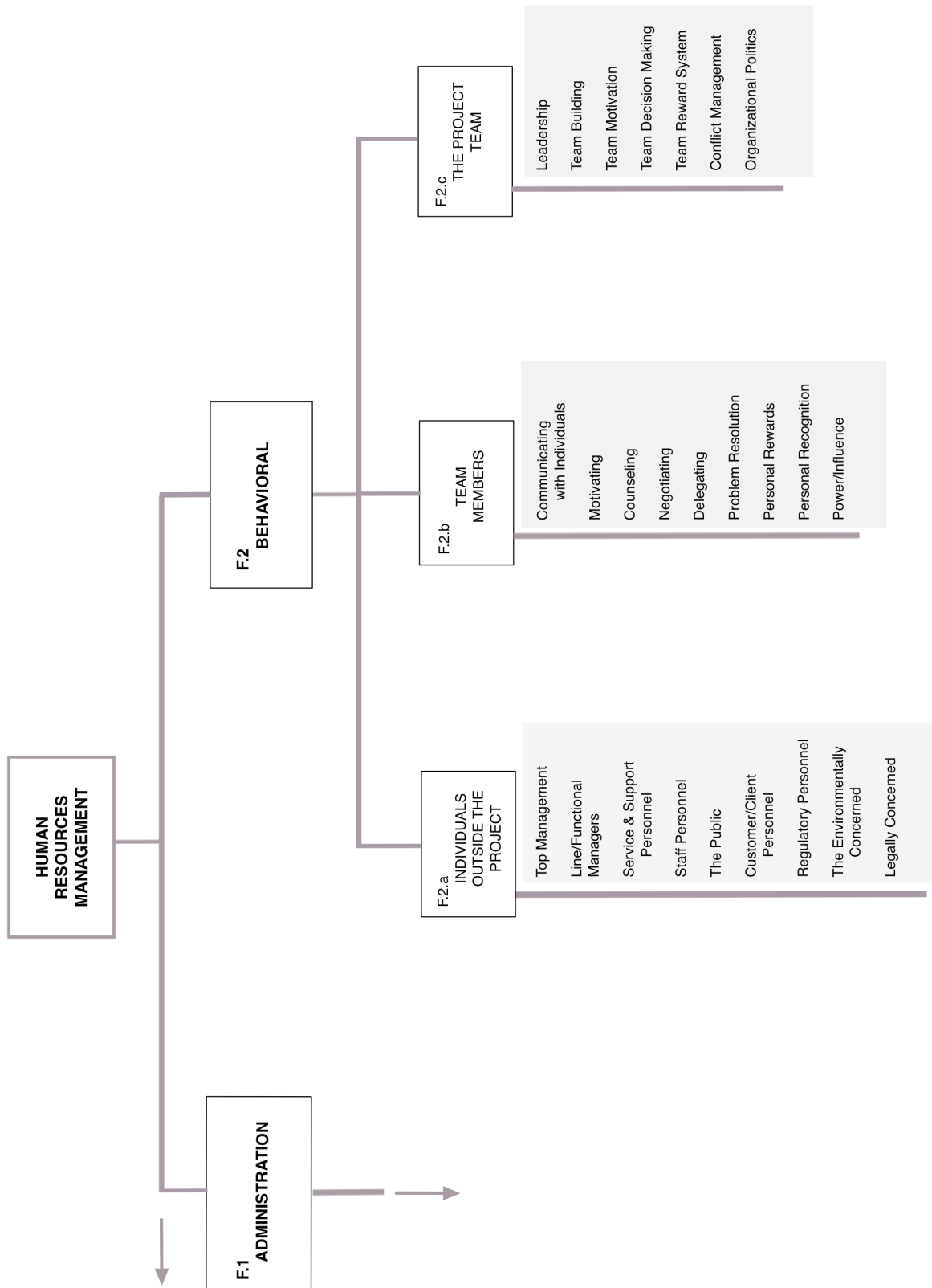
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CONTRACT/PROCUREMENT MANAGEMENT

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Introduction

Project Managers, in the pursuit of successful project management and to provide a timely, cost effective, quality service to their clients, may acquire personnel, goods and services during project execution. By the same token, personnel and services may be acquired by others, both within and outside the organization, especially to provide service in their specialty areas.

In both cases, the objective is achieved by a contract, written or oral, that is a legally binding device. This document defines the relationship, duration, nature and extent of service, statement of work, consideration and terms and conditions. The process by which personnel/goods/services are acquired is called *procurement*.

Acquisition of personnel is carried out through the employment process in coordination with Human Resources Management.

During recent years, due to a general scarcity of resources, long project lead times and increasing complexities of the legal system under which projects operate, a contract document is required to legally bind the parties, and defined procurement procedures are implemented to ensure fairness in the acquisition process.

Consequently, it has become very important for project managers to have a clear understanding of the theory, practices and processes of the entire discipline of contract/procurement management. This is so that their personnel/goods/service acquisition activities do not become isolated incidents, but rather an integrated whole upon which to build a successful project management practice.

Contract/Procurement strategy should first be determined during the project development phase at a time dependent on a number of factors. These factors include corporate needs, environment, degree of scope definition, time and cost considerations, and

the availability and location of suitable resources.

Procurement of personnel for a project is an inevitability subject to corporate policy that is an integral part of the Administrative process under Human Resources Management. It has its own particular glossary of terms.

After the resolution of the strategy, the backbone of Contract/Procurement Management, is the Acquisition process whose activity sequence is as follows:

- source selection/prequalification
- contract types identification
- procurement/tender documents
- invitation to bid
- bid responses
- bid evaluations
- contract risk assessment
- procurement/contract negotiations
- award
- bid protest, if any

It should be recognized that the procedures are greatly dependent upon the area of project management application and the corporate environment. For example: R&D projects probably mostly involve the use of internal resources necessitating the procurement of personal commitments within a matrix environment. Whereas for construction, most of the work is secured by contract established at arm's length.

Again, government procurement requirements are far more rigid than those of the private sector due to political implications and regulatory considerations.

Further, international procurement has to recognize the varying environmental, social, political, legal and financial implications of performing work in another country.

The successful implementation of the acquisition process provides the favorable climate necessary for effective contract administration and subsequent post contract evaluation.

Glossary of Terms

Note. For purposes of this article, it must be recognized that different procurement practitioners use a

variety of terms that are considered synonymous (e.g. supplier/vendor/contractor; or quotation/tender/bid)

1. Procurement Objective: To define the method to follow and the service to be contracted or resource to be procured for the performance of work.

1.a Scope of Work: A narrative description of the work to be accomplished or resource to be supplied.

1.a.1 Specifications: Written, pictorial or graphic information that describes, defines or, specifies the services or items to be procured.

1.a.2 Relationship with CWBS (Contract Work Breakdown Structure): The relationship with each other, with the overall work and their interface with any other project activities, of the goods/services to be procured.

1.b Strategy: A framework guiding those choices that determine the nature and direction to obtain the objective.

1.b.1 Corporate Procurement Strategy: Direction set by the corporation of which the project is a part, and the relationship of specific procurement actions to these corporate directions.

1.b.2 Project Procurement Strategy: The relationship of specific procurement actions to the operating environment of the project.

1.c Procurement Environment: The combined internal and external forces, both individual and interacting with one another that assist or restrict the attainment of the objective. These could be business or project related, or may be due to political, economic, technological or regulatory conditions.

1.c.1 Micro Procurement Environment: Consideration of firm, project or client imposed policies and procedures applicable in the procurement actions.

1.c.2 Macro Procurement Environment: Consideration, interrelationship and action of outside changes such as legal, social, economic, political or technological that may directly or indirectly influence specific procurement actions.

1.d Alternatives: Review of the means available and the impact of tradeoffs to attain the objectives.

1.d.1 Feasible Procurement Alternatives: Reviews of available alternate procurement actions that could attain the same objectives.

1.d.2 Screening: Techniques used for reviewing, analyzing, ranking and selecting the best alternative for the proposed action.

1.e Procurement Risk Analysis: Analysis of the consequences and probabilities that certain undesirable events will occur and their impact on attaining the contract/procurement objectives.

1.e.1 Procurement Risk Characterization: Identifying the potential external or internal risks associated with procurement actions using estimates

of probability of occurrence.

1.e.2 Risk Assessment: Review, examination and judgment whether or not the identified risks are acceptable in the proposed actions.

2. Information Systems: A structured, interacting, complex of persons, machines, and procedures designed to produce information that is collected from both internal and external sources for use as a basis for decision-making in specific contract/procurement actions.

2.a Procurement Information Sources: Identification and listing of various available sources, internal as well as external, to provide relevant information on specific procurements.

2.a.1 Internal Procurement Sources: Intra-firm sources and records including historical data on similar procurements, cost and performance, data on various suppliers and other data that could assist in proposed procurements.

2.a.2 External Procurement Sources: Extra-firm sources including industry contacts, market data, competitive intelligence and regulatory information that could aid procurement decision-making.

2.b Procurement Data Gaps: Identification of data gaps in available information in reference to a particular procurement.

2.c Supplementary Information: Identification and collection of additional information from supplementary sources and, its review and analysis.

3. Procurement Identification: The identification of the different categories of procurement of which one or more may be required during project execution.

3.a Project Personnel: Those members of a project team employed directly by the organization responsible for a project.

3.b Project Goods: Equipment and/or materials needed to implement a project.

3.c Project Services: Expertise and/or labour needed to implement a project not available directly from a project manager's organization.

4. Acquisition Process: The process of acquiring personnel goods/services for new or existing work within the general definitions of contracts requiring an offer and acceptance, consideration, lawful subject matter and competent parties.

4.a Acquisition Methods: The various ways by which goods/services are acquired from suppliers.

4.a.1 Procurement Advertising: Method of procurement where a contract results from solicitation of competitive bids through the media.

THIS FUNCTION'S PROCESSES

	Objective	Information Systems	Procurement	Acquisition Process	Contract Administration	Post Contract Evaluations
a) General Project Management Processes						
Strategic Planning and Control	3	1	1		1	
Project Integration	3	3		3	3	
Resource Allocation	2	2	2	2	2	1
b) Basic PM Functions or Elements						
Scope	3	3	3	3	3	3
Quality	2	2	2	3	3	3
Time	3	2	2	3	3	3
Cost	3	2	2	3	3	3
c) Integrative PM Functions						
Probability and Risk	3	2	2	2	3	1
Human Resources	2		3			2
Contract/Procurement						
Communications	1	2		3	3	2

Figure G-1
Function Impact Matrix Chart for
Contract/Procurement Management

This Function's Impact on other Functions:

Blank = virtually none
 1 = possibly or light
 2 = likely or average
 3 = very likely or heavy

4.a.2 Procurement Invitation: Method of procurement where a contract results from a selected invitation of competitive bids.

4.a.3 Contract Negotiation: Method of procurement where a contract results from a bid that may be changed through bargaining.

4.a.4 Purchase: Out-right acquisition of items, mostly off-the-shelf or catalog, manufactured outside the purchaser's premises.

4.b Procurement Sources Selection: The process of selecting organizations and/or individuals whose resources, credibility and performance are expected to meet the contract/procurement objectives.

4.b.1 Resource Identification: Identification of potential sources that could provide the specified material or services. These sources could be identified either from the internal firm/project list of vendors or by advertising the need for procurement.

4.b.2 Bid List: List of suppliers invited to submit bids for goods/services as specified.

4.b.3 Procurement Sole Source: Only one source that could fulfill the requirements of the procurement.

4.b.4 Procurement Pre-Qualifications: The ex-

perience, past performance, capabilities, resources and current work loads of the potential sources.

4.b.5 Procurement Data Review: A review of qualification data to determine its sufficiency.

4.b.6 Procurement Data Verification: A review of qualification data to determine its accuracy.

4.b.7 Procurement Supplier Valuation: An assessment of the supplier's qualification in order to identify those from whom proposals/bids are to be requested or those who are to be invited to enter negotiations for the award of a contract.

4.b.8 Procurement Pre-Selection Meetings: Meetings held to clarify, supplement and/or verify qualifications data and specifications.

4.b.9 Supplier's Ranking: Qualitative and/or quantitative determinations of prospective suppliers' qualifications relative to the provision of the proposed goods/services.

4.c Contract Types: The various forms of contracts by which the goods/services can be acquired.

4.c.1 Cost Plus Percentage of Cost (CPPC) Provides for a reimbursement of allowable cost of services performed plus an agreed upon percentage

of the estimated cost as profit.

4.c.2 Cost Plus Fixed Fee (CPFF): Provides reimbursement of allowable cost plus a fixed fee that is paid proportionately as the contract progresses.

4.c.3 Cost Plus Incentive Fee (CPIF): Provides the supplier for cost of delivered performance plus a predetermined fee as a bonus for superior performance.

4.c.4 Fixed Price Plus Incentive Fee (FPPIF): Provides the supplier with a fixed price for delivered performance plus a predetermined fee for superior performance.

4.c.5 Firm Fixed Price (FFP): A lump sum contract where the supplier agrees to furnish goods or services at a fixed price.

4.c.6 Unit Price(UP): A fixed price contract where the supplier agrees to furnish goods/services at unit rates and the final price is dependent on the quantities needed to carry out the work.

4.d Procurement/Tender Documents: The documents issued to prospective suppliers when inviting bids/quotations for supply of goods/services.

4.d.1 General Conditions: General definition of the legal relationships and responsibilities of the parties to the contract and how the contract is to be administered. They are usually standard for a corporation and/or project.

4.d.2 Supplementary Conditions: Modifications, deletions and additions to standard General Conditions developed for particular goods/services.

4.d.3 General Requirements: Non-technical specifications defining scope of work, payments, procedures, implementation constraints, etc., pertaining to the contract.

4.d.4 Technical Specifications: Documentation that describes, defines or specifies the goods/services to be supplied.

4.e Invitation to Bid: The invitation issued to prospective suppliers to submit a bid/quotation/proposal for supply of goods/services.

4.e.1 Request for Proposal: - A formal invitation containing a scope of work that seeks a formal response (proposal) describing both methodology and compensation to form the basis of a contract.

4.e.2 Request for Quotation (RFQ): - A formal invitation to submit a price for goods and/or services as specified.

4.e.3 Intention for Bid (IFB): Communications, written or oral by the prospective organizations and/or individuals indicating their willingness to perform the specified work. This could be a letter, statement of qualifications or response to a request for proposal quotation.

4.f Bid Response: Communications, positive or negative from prospective suppliers in response to the Invitation for Bid.

4.f.1 Verbal Bid: Undocumented quotation by telephone or by other verbal means of communication.

4.f.2 Formal Bid: Bid/quotation/letter/proposal submitted by the prospective suppliers in response to the Request for Proposal or Request for Quotation.

4.g Bid Evaluations: Review and analysis of responses to determine supplier's ability to perform the work as requested. This activity may include an evaluation of suppliers financial resources, ability to comply with technical criteria and delivery schedules, satisfactory record of performance and eligibility for award.

4.g.1 Bid Technical Considerations: Suppliers technical competency, understanding of the technical requirements and capability to produce technically acceptable goods or services. Generally this evaluation ranks highest among all other evaluations.

4.g.2 Bid Cost Considerations: These include a consideration of supplier's approach and reasonableness of cost, cost realism, forecasted economic factors affecting cost and cost risks used in the cost proposal.

4.g.3 Bid Time Considerations: Evaluation of supplier's offer with regard to dates identified for completion of phases of the work and/or total work.

4.g.4 Other Bid Considerations: These include an evaluation of personnel and financial resources, facilities, performance record, responsiveness to contract terms and conditions and a general willingness to perform the work.

4.g.5 Contract Pre-award Meetings: Meetings with prospective suppliers before final award determination to aid ranking and/or finalize terms of agreement between the parties.

4.g.6 Contract Award Ranking: Qualitative and/or quantitative determinations of prospective supplier's bid/tender/proposal/quotation relative to each other measured against a common base.

4.h Contract Risk: The potential and consideration of risk in procurement actions. Generally the forces of supply and demand determine who should have the maximum risk of contract performance but the objective is to place on the supplier the maximum performance risk while maintaining an incentive for efficient performance. In a fixed price contract, the supplier accepts a higher risk than in a cost type contract in which the supplier's risk is lowest.

4.i Procurement/Contract Negotiations: Process of communication, discussions, and agreement between the parties for supply of goods/services in support of the procurement objectives.

4.i.1 Best and Final Contract Offer: Final offer by the supplier to perform the work after incorporating negotiated and agreed changes in the procurement documents.

4.j Contract Award: The final outcome of acquisition process in which generally the contract is awarded to one prospective supplier through acceptance of a final offer confirmed by either the issuance of a purchase order or the signing of a legally binding contract formalizing the terms under which goods/services are to be supplied.

4.k Bid Protests: The process by which an unsuccessful supplier may seek remedy for unjust awards.

5. Contract Administration: Monitoring and control of performance reviewing progress, making payments, recommending modifications and approving contractor's actions to ensure compliance with contractual terms during contract execution.

5.a Funding: The status of internal or external monies available for performing the work.

5.a.1 Payment Authorization: The process of allocated fund transfer to an account from which the supplier can be paid for delivered goods/services as per contractual terms.

5.a.2 Limitation of Funds: The value of funds available for expenses beyond which no work could be authorized for performance during the specified period.

5.b Notice to Proceed: Formal notification to the supplier requesting the start of work.

5.b.1 Work Authorization/Release: In case where work is to be performed in segments due to technical or funding limitations, work authorization/release authorizes specified work to be performed during a specified period.

5.c Contract Performance Control: Control of work during contract execution.

5.c.1 Inspection: Examination or measurement of work to verify whether an item or activity conforms to a specific requirement.

5.c.2 Work Acceptance: Work is considered accepted when it is conducted, documented and verified as per acceptance criteria provided in the technical specifications and contract document.

5.c.3 Quality Assurance: Planned and systematic actions necessary to provide adequate confidence that the performed service or supplied goods will serve satisfactorily for its intended and specified

purpose. (Note: See also Framework Glossary for expanded definition.)

5.c.4 Non-conformance: A deficiency in characteristics, documentation or procedure that renders the quality of material/service unacceptable or indeterminate.

5.c.5 Corrective Action: Measures taken to rectify conditions adverse to specified quality, and where necessary, to preclude repetition.

5.c.6 Stop Work Order: Request for interim stoppage of work due to non-conformance, funding, or technical considerations.

5.c.7 Supplier Expediting: Actions taken to ensure that the goods/services are supplied in accordance with the schedule documented in the contract.

5.d Contract Financial Control: Exercise of control over contract costs.

5.d.1 Progress Payments: Interim payment for delivered work in accordance with contract terms generally tied to meeting specified performance milestones.

5.d.2 Audits: A planned and documented activity performed by qualified personnel to determine by investigation, examination, or evaluation of objective evidence the adequacy and compliance with established procedures or the applicable documents and the effectiveness of implementation.

5.d.3 Duty and Tax Administration: Action taken to legally minimize duties and taxes applicable to the goods/services supplied.

5.d.4 Back Charge: The cost of corrective action taken by the purchaser chargeable to the supplier under the terms of the contract.

5.e Contract Order Modifications: Changes in a contract during its execution to incorporate new requirements or to handle contingencies that develop after contract placement. Changes may include price adjustments or changes in scope.

5.e.1 Supplementary Agreement: Contract modification that is accomplished by the mutual action of the parties to the contract.

5.e.2 Change Order/Purchase Order Amendment: Written order directing the contractor to make changes according to the provisions of the contract documents.

5.f Contract Dispute: Disagreement between the parties. This may occur during contract execution or at completion and may include misinterpretation of technical requirements and any terms and conditions or due to changes not anticipated at the time of contract award.

5.f.1 Supplier Default: Failure on the part of supplier to meet technical or delivery requirements of the contract.

5.f.2 Dispute -Disagreements not settled by mutual consent which could be decided by litigation or arbitration.

5.g Contract Closeout: Contract Closeout activities that assure that the contractor has fulfilled all contractual obligations and has released all claims and liens in connection with work performed.

5.g.1 Substantial Completion: When the work is ready for, or is being used for, the purpose intended and is so certified and only minor remains to complete the contract. This enables release of any holdback monies.

5.g.2 Final Completion: When the entire work has been performed to the requirements of the contract and, except for those items arising from the provisions of warranty, is so certified.

5.g.3 Inventory Closeout: Settlement and credit of inventory if purchased from project funds.

5.g.4 Contractor Claims Release: Certificate to release and hold harmless from future claims by the contractor.

5.g.5 Final Payment: Final settlement paid at contract completion of the contractually obligated amount including any retention moneys.

5.g.6 Records Retention: The necessity to retain records for reference for a specified period after contract closeout in case they are needed.

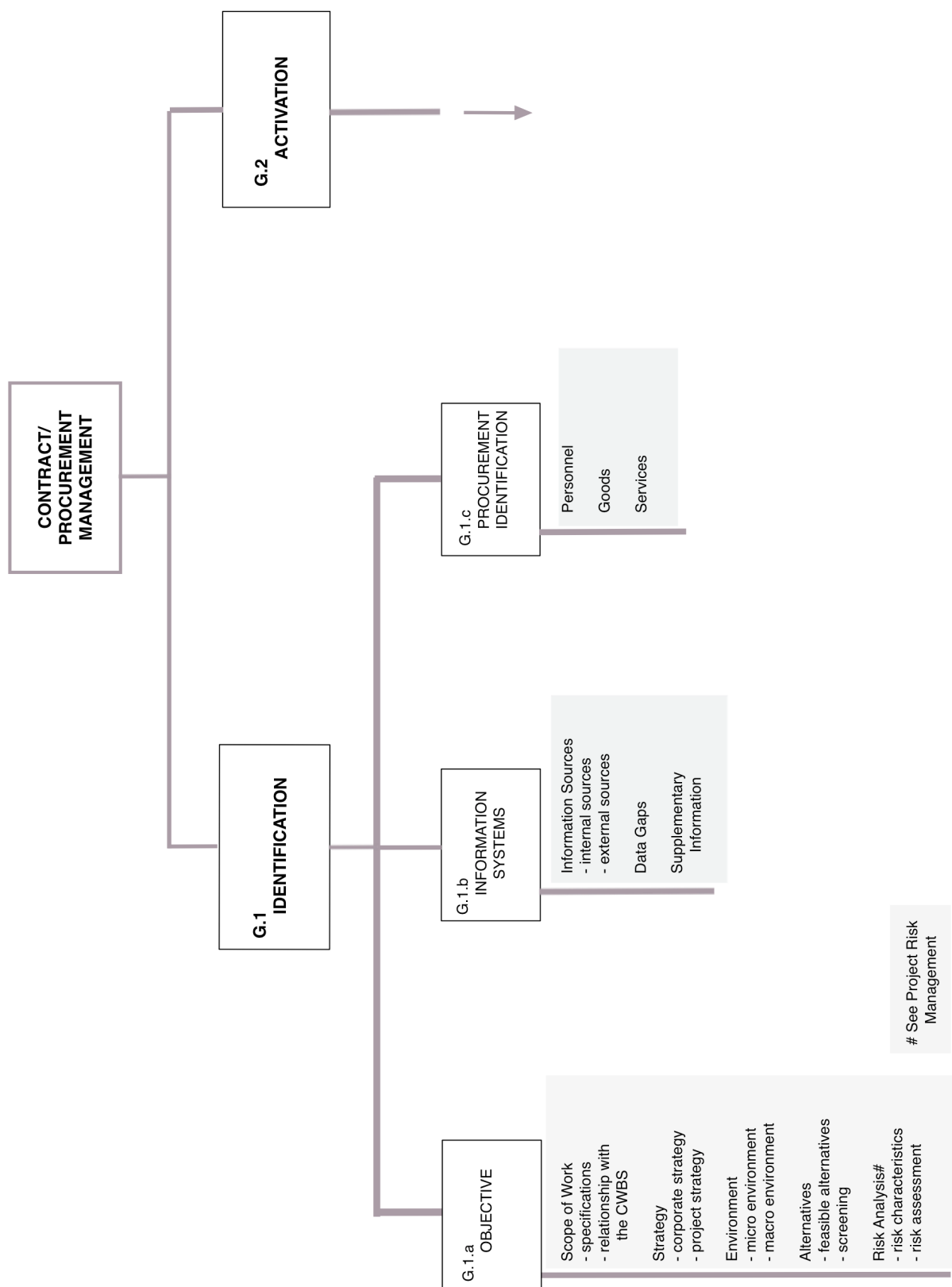
6. Post Contract Evaluations: Objective review and analysis of the performance of both parties, the realistic technical problems encountered, and the corrective actions taken.

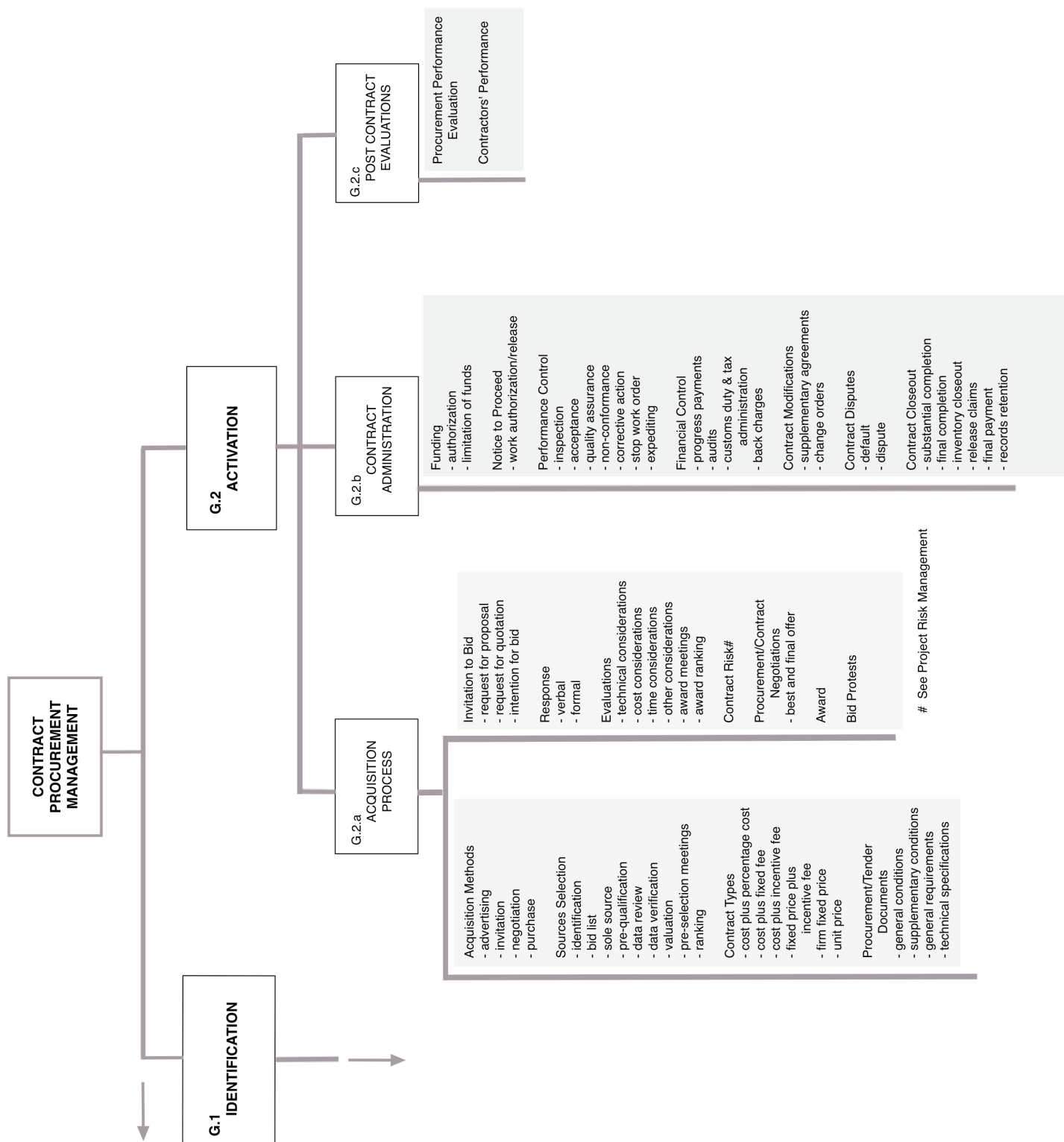
6.a Procurement Performance Evaluation: A comprehensive review of the original specification, statement of work, scope and contract modifications, for the purpose of avoiding pitfalls in future procurements.

6.b Contractor's Performance Evaluation: A comprehensive review of contractor's technical and cost performance and work delivery schedules.

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COMMUNICATIONS MANAGEMENT

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Introduction

Communications, like Human Resources, provides a basic vehicle for management, especially project management. As originally put forward by Henri Fayol (c. 1916) and amplified by subsequent thinkers of the process school, management is a process that consists of:

Planning,	including forecasting
Organizing,	including staffing
Commanding,	including motivating and maintaining activity
Directing,	including coordinating
Controlling,	including monitoring

Each of these activities relies heavily on both the Communications and Human Resources functions. Therefore, an understanding of both of these project management functions is essential to successful project management. Typical communications models are shown in Figures H-1 and H-2.

Communication is also a complex activity. It has many interconnected levels and facets and it becomes more abstract and complex as civilization advances.

The process of communication involves four major components: the communicator, the message, the medium, and the recipient.

- The **communicator** is the originator of the message. The way s/he conveys the message will demonstrate how confident s/he is of his/her command of the subject; how convinced s/he is of the validity and significance of the message; how urgently s/he wishes to inform, or persuade, or even control the audience. This will be reflected not only in the actual phrasing, but also in the non-verbal communication part.
- The **message** we want to convey may consist of thoughts, feelings, or ideas. Regardless of its content, the message must be reduced to "code" that must be understood by both the sender and the receiver.
- The **medium**, the vehicle or method, used to convey the message, will also color the message and ultimately influence its effect. A memo written in tiring prose will not create

the same re-action as a tersely worded oral message presented at a hastily called meeting.

- The recipient is the player who "makes or breaks" the communication process. Until s/he accepts the message and makes its meaning "common" between himself and the sender, no communication occurs

Communication is much like a game, and those who know its rules – those who have a command of good skills, play it better than those who don't.

The project manager must be a communicator to:

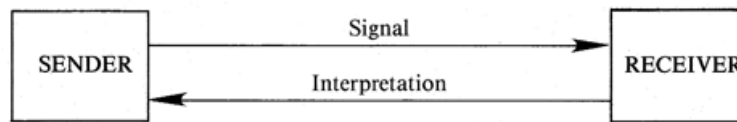
- upper management,
- the project team, and
- members outside the project, i.e. to those who have an interest in the project's results.

This is a vital role in project management because the project manager will have information coming in from many different sources, and in many different forms. Project managers who fail to decipher and pass on the appropriate information on time and to the right people can themselves become the bottleneck in the project.

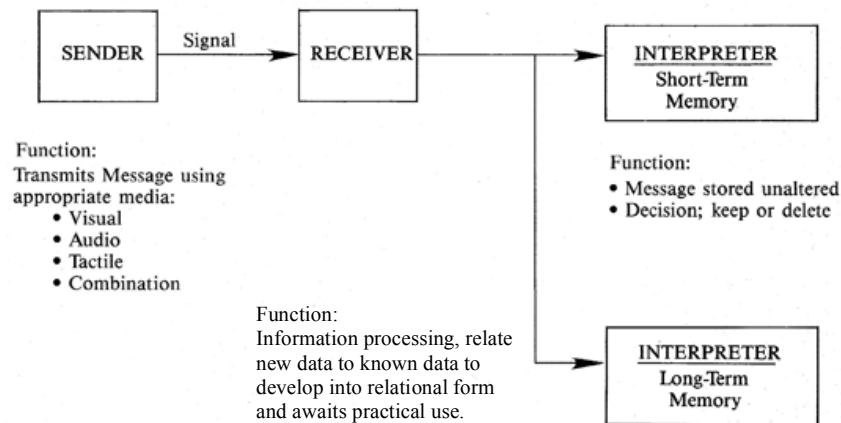
The communication process is not always easy because the project manager may find barriers exist to communication, such as lack of clear communication channels and problems with technical language that must be used. The project manager has the responsibility of knowing what kind of messages to send, knowing to whom the message must be sent, as well as translating the messages into a language that all can understand.

Innovative project managers are constantly building consensus or confidence in decisions at critical junctures in a project by practicing active communication skills. Communication is certainly the essence of civilization. Without communication we could neither recognize nor share common interests, which means we could not easily cooperate in achieving mutual goals.

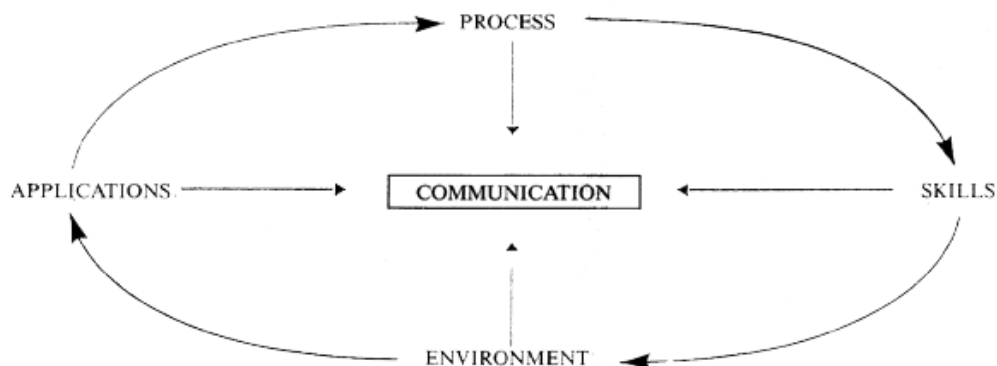
The quality of one's communication skills is probably the most important of all traits. If we are successful in communications skills, we can overcome what often seems like overwhelming roadblocks.



**Figure H-1: Simple
Interactive one on one**



**Figure H-2: Complex
Processed by multiple internal/external audience with much less interaction**



**Figure H-3
The Communication Cycle**

THIS FUNCTION'S PROCESSES

	Process	Skills	Environment	Application		
a) General Project Management Processes						
Strategic Planning and Control	3	3	3	3		
Project Integration	3	3	3	3		
Resource Allocation	2	2	2	2		
b) Basic PM Functions or Elements						
Scope	3	3	3	3		
Quality	3	3	3	3		
Time	3	3	3	3		
Cost	3	3	3	3		
c) Integrative PM Functions						
Probability and Risk	2	1	3	2		
Human Resources	3	3	3	3		
Contract/Procurement	1	3	1	2		
Communications						

Figure H-4
Function Impact Matrix Chart for
Communications Management

This Function's Impact on other Functions:

Blank = virtually none
 1 = possibly or light
 2 = likely or average
 3 = very likely or heavy

The success of a project manager is directly proportional to their communications skills at three levels:

- Project Team (Subordinates)
- Support and Competing Project Teams (Peers)
- Corporate Managers and Clients

The project manager must see that information in the appropriate amounts is getting to those that "need to know", and to those who think they need to know. So important is this principle that the project manager must see that communication is redundant. That is to say, secondary and tertiary information paths are working so that if data wasn't received in one channel (i.e., written), then alternate channels (i.e., oral briefing) are also used to ensure the task is accomplished.

Communication is never easy; even between people who have an enormous background of shared values and experiences. Therefore, it behooves the communicator to use every device and technique at their command to enable the recipient to accept and understand the message.

The first consideration of the communicator should be to avoid creating barriers that will impede transmission of the message. Project managers can increase their skills by paying attention to the interaction of verbal and non-verbal communication, and by making an effort to keep verbal communication as factual and objective as possible.

The job of the project manager is a demanding one. Project managers must be able to work with, and obtain, the desired results in a professional manner from supervisors, subordinates colleagues, and clients. To a large degree, management's success in reaching desired goals depends on good communication skills. Since project managers spend most of their time communicating, it is important they carefully hone their communications skills throughout their careers.

These skills are essential not only to the project manager's success but also to the overall success of the project. After all, an excellent idea has no intrinsic value if it does not get communicated.

Glossary of Terms

1. Active Listening: Standard techniques of active listening are to pay close attention to what is said, to ask the other party to spell out carefully and clearly what they mean, and to request that ideas be repeated if there is any ambiguity or uncertainty.

2. Application: An act of putting to use (new techniques); an act of applying techniques. Example: The use of project management techniques applicable to a particular industry/product sector.

3. Common Sense: Sound and prudent but often unsophisticated judgment.

4. Communication Management: Conducting or supervising the exchange of information.

5. Conflict Resolution: To seek a solution to a problem; five methods in particular have been proven through research to occur in a project:

5.a Confrontation: Where two parties work together toward a solution of the problem.

5.b Compromise: Both sides agree such that each wins or loses a few points.

5.c Smoothing: Differences between two groups are played down and the strong points of agreement are given the most attention.

5.d Forcing: The project manager uses his/her power to direct the solution. Essentially, this is a type of win-lose agreement where one side gets its way and the other does not.

5.e Withdrawal: One or both sides withdraw from the conflict

6. Culture: The integrated pattern of human knowledge, belief, and behavior that depends upon man's capacity for learning and transmitting knowledge to succeeding generations.

7. Environment: The circumstances, objects, or conditions by which one is surrounded.

8. Ethics: A set of moral principles or values; the principal of conduct governing an individual or a group

9. Extrasensory: Residing beyond or outside the ordinary senses (instances of perception).

10. Information Flow – Distribution List: A list of individuals that would receive information on a given subject or project.

11. Intelligence: The ability to learn or understand or to deal with new or trying situations.

12. Interaction: Mutual action or reciprocal action or influence.

13. Interpret: Present in understandable terms

14. Involuntary: Contrary to or without choice;

not subject to control of the will (reflex).

15. Language: A systematic means of communicating ideas or feelings by the use of conventionalized signs, sounds, or gestures

16. Management Styles:

16.a Authoritarian: Lets individuals know what is expected of them, gives specific guidance as to what should be done, makes his part of the group understood, schedules work to be done, and asks group members to follow standard rules and regulations.

16.b Combative: A project manager that is marked by an eagerness to fight, or be disagreeable over any given situation.

16.c Conciliatory: A project manager that is friendly and agreeable; one that attempts to assemble and unite all project parties involved to provide a compatible working team.

16.d Disruptive: A project manager that tends to break apart the unity of a group; one that tends to be an agitator and causes disorder on a project

16.e Ethical: A project manager that is honest, sincere, able to motivate and to press for the best and fairest solution; one that generally goes "by the books".

16.f Facilitating: The project manager is available to answer questions and give guidance when needed; he does not interfere with day to day tasks, but rather maintains that status quo

16.g Intimidating: A project manager that frequently reprimands employees for the sake of an image as a "tough guy" at the risk of lowering department or team morale.

16.h Judicial: A project manager that exercises the use of sound judgment or is characterized by applying sound judgment to most areas of the project.

16.i Promotional: Encourages subordinates to realize their full potential, cultivates a team spirit and lets subordinates know that good work will be rewarded.

16.j Secretive: A project manager that is not open or outgoing in speech, activity, or purpose much to the detriment of the overall project.

17. Networking: The exchange of information or services among individuals, groups, or institutions.

18. Nonverbal Communication: Involving minimal use of the spoken language; gestures, facial expressions, and verbal fragments that communicate emotions without the use of words; sometimes

skimming known as body language.

19. Olfactory: Relating to, or connected with the sense of smell.

20. Oral: Spoken communication.

21. Persuade: To advise; to move by argument, entreaty, or expostulation to a belief, position, or course of action.

22. Process: A series of actions or operations conducing to an end; (especially a continuous operation).

23. Project Management Information System: The gathering, recording, filtering and dissemination of pertinent information for members of a project team.

24. Public Speaking: The art or science of effective oral communication with an audience.

25. Receiving: To assimilate through the mind or senses (as in new ideas).

26. Semantics: The language used to achieve a desired effect on an audience.

27. Skill: An ability and competence learned by practice.

28. Speed Reading: A method of reading rapidly by skimming.

29. Tactile: Of or relating to the sense of touch; perceptible by touch.

30. Transmit: To send or convey from one person or place to another.

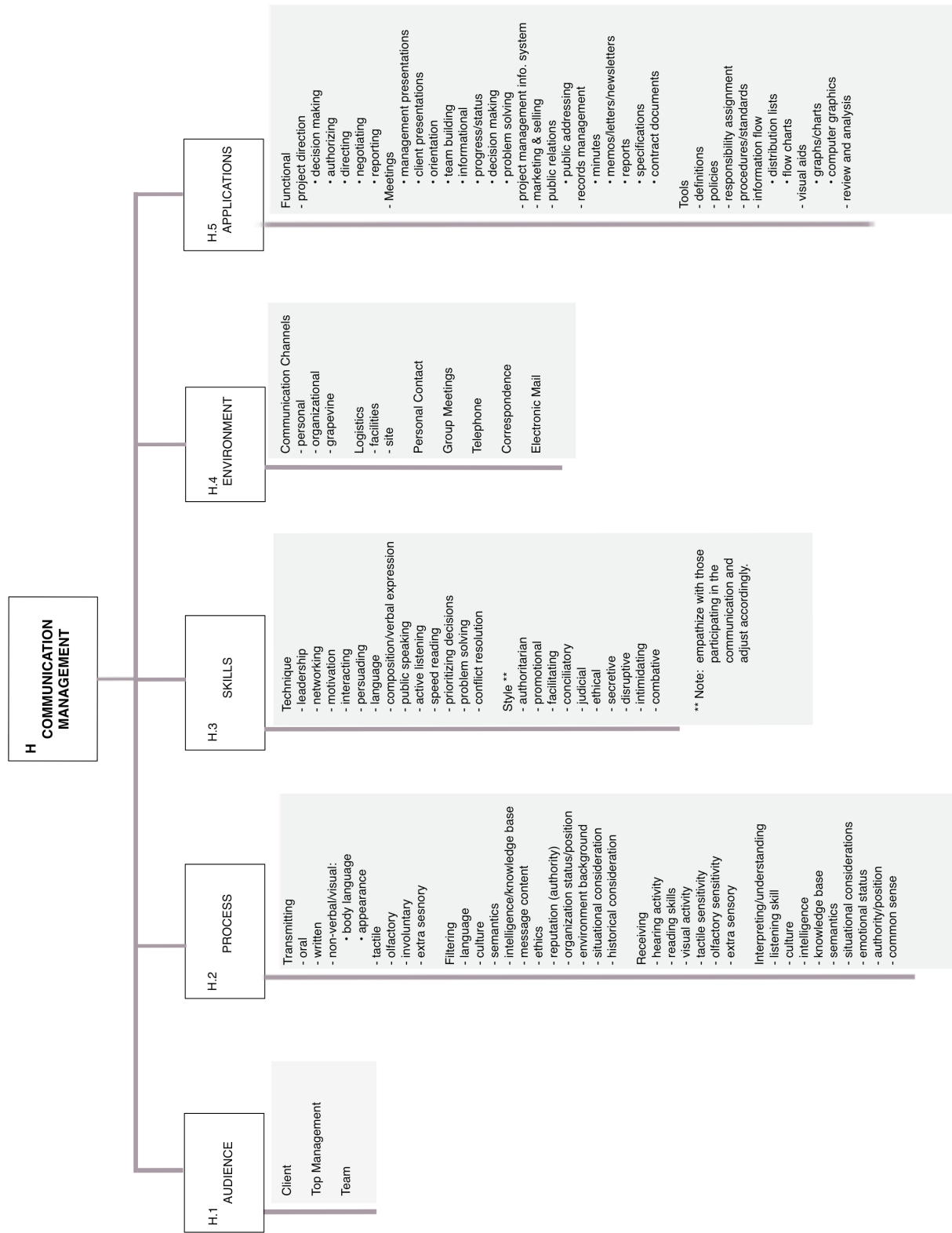
31. Understand: To have thorough or technical acquaintance with expertise in the practice of project management.

32. Write: To express in literary form.

Other communication definitions are more appropriately found in general dictionaries.

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PMBOK GLOSSARY OF TERMS

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EDITOR'S NOTE

The Project Management Institute, a non-profit professional organization dedicated to advancing the state-of-the-art in project management, has expended considerable effort over a number of years in identifying and documenting the project management body of knowledge (PMBOK). This work has been conducted through PMI's Standards Board and supporting committees, and has been published both in the Project Management Journal and in this notebook form.

While the PMBOK itself must always be looked upon as an evolving entity, advancing with the state of our knowledge, it was early recognized that a consensus on standardization of terminology is highly desirable to improve communication in all areas of project endeavor.

This glossary summarizes in alphabetical order the definitions listed in the various "glossaries" contained in the final version of the 1986 PMBOK Report. These local glossaries accompany the report's nine areas of concentrations, namely: PM Framework; Scope, Quality; Time; Cost; Risk; Human Resources; Communications; and Contract-Procurement management.

PMI members come from many fields of project endeavor, and therefore PMI is concerned with project management in a generic sense. For this reason, this Glossary of Project Management Terminology contains by and large only those terms that are generally applicable to all fields of project application.

R. Max Wideman
Past Chairman
PMI Standards Board

Note: Many other terms typically used in project management are more general and can be found in regular public dictionaries or on line.

A

Accountability/Responsibility Matrix. A structure that relates the PROJECT Organization Structure to the WORK BREAKDOWN STRUCTURE; assures that each element of the project SCOPE of work is assigned to a responsible individual.

Acquisition Control. A system for acquiring PROJECT equipment, material and services in a uniform and orderly fashion.

Acquisition Evaluations. Review and analysis of responses to determine supplier's ability to perform the work as requested. This ACTIVITY may include an evaluation of suppliers financial resources, ability to comply with technical criteria and delivery schedules, satisfactory record of performance and eligibility for award.

Acquisition Methods. The various ways by which goods/services are acquired from suppliers Acquisition Negotiations. Contracting without formal advertising. This method offers flexible procedures, permits bargaining and provides an opportunity to prospective suppliers to revise their offers before the award.

Acquisition Process. The PROCESS of acquiring personnel/goods/services for new or existing work within the general definitions of CONTRACTS requiring an offer and acceptance, consideration, lawful subject matter and competent parties.

Active Listening. Standard techniques of active listening are to pay close attention to what is said, to ask the other party to spell out carefully and clearly what they mean, and to request that ideas be repeated if there is any ambiguity or uncertainty.

Activity. A TASK or series of tasks performed over a period of time.

Activity Description. Any combination of characters that easily identifies an ACTIVITY to any recipient of the SCHEDULE.

Activity Duration. The best estimate of the time (hours, days, weeks, months, etc.) necessary for the accomplishment of the work involved in an ACTIVITY, considering the nature of the work and resources needed for it.

Actual Cost of Work Performed (ACWP). The DIRECT COSTS actually incurred and the INDIRECT COSTS applied in accomplishing the work performed within a given time period. These costs should reconcile with the CONTRACTOR's incurred cost ledgers that are regularly audited by the client.

Actual Finish Date. The calendar date work actually ended on an ACTIVITY. It must be prior to or equal to the DATA DATE. The remaining duration of this activity is zero.

Actual Start Date. The calendar date work actually began on an ACTIVITY. It must be prior to or equal to the data date.

ACWP: See ACTUAL COST OF WORK PERFORMED.

Addendum: See PROCUREMENT ADDENDUM

ADM: See ARROW DIAGRAMMING METHOD

Agency. A legal relationship by which one party is empowered to act on behalf of another party. Agreement, Legal. A legal document that sets out the terms of a CONTRACT between two parties. Alternative Analysis. Breaking down a complex SCOPE situation for the purpose of generating and evaluating different solutions and approaches.

Alternatives: Review of the means available and the impact of tradeoffs to attain the OBJECTIVES

Amount at Stake. The extent of adverse consequences that could occur to the PROJECT.

Analysis. The study and examination of something complex and separation into its more simple components. Analysis typically includes discovering not only what are the parts of the thing being studied, but also how they fit together and why they are arranged in this particular way. A study of schedule variances for cause, impact,

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corrective action and results.

Apparent Low Bidder. The CONTRACTOR who has submitted the lowest compliant BID for all or part of a project as described in a set of BID DOCUMENTS.

Application. An act of putting to use (new techniques); an act of applying TECHNIQUES.

Approve. To accept as satisfactory. Approval implies that the thing approved has the endorsement of the approving agency; however, the approval may still require confirmation by somebody else. In management use the important distinction is between APPROVE and AUTHORIZE. Persons who approve something are willing to accept it as satisfactory for their purposes, but this decision is not final. Approval may be by several persons. The person who authorizes has final organization authority. This authorization is final approval.

Approved Bidders List. A list of CONTRACTORS that have been pre-qualified for purposes of submitting competitive BIDS.

Approved Changes. CHANGES that have been APPROVED by higher authority.

Arbitration. A formalized system for dealing with grievances and administering corrective justice as part of collective bargaining agreements.

Archive Tape. A computerized record that contains historical project information.

Area of Project Application. The ENVIRONMENT in which a PROJECT takes place, with its own particular nomenclature and accepted practices, e.g. facilities, products or systems development projects: (to name a few.)

Arrow. The graphic presentation of an ACTIVITY. The tail (see I-NODE) of the arrow represents the start of the activity. The head (see J-NODE) of the arrow represents the finish. Unless a time scale is used, the length of the arrow stem has no relation to the duration of the activity. Length and direction of the activity are usually a matter of convenience and clarity.

As-Built Schedule. The final PROJECT SCHEDULE that depicts actual COMPLETION (FINISH) dates, actual duration dates and start dates.

As-Performed Schedule. The final PROJECT schedule that depicts actual completion (finish) dates, actual durations, and start dates.

Assurance. To examine with the intent to verify

Audits. A planned and documented ACTIVITY performed by qualified personnel to determine by investigation, examination, or evaluation of objective evidence, the adequacy and compliance with established PROCEDURES, or the applicable documents, and the effectiveness of implementation.

Authorize. To give final approval. A person who can authorize something is vested with authority to give final endorsement that requires no further approval.

Authorized Work. An effort that has been approved by higher authority and may or may not be completely described.

B

Back Charge. The cost of corrective action taken by the purchaser, chargeable to the supplier under the terms of the CONTRACT.

Backward Pass. Calculation of late finish times (dates) for all uncompleted network activities. Determined by working backwards through each activity.

Bar Chart. A graphic presentation of work ACTIVITIES shown by a time-scaled bar line (sometimes referred to as a Gantt chart).

Baseline. Management plan and/or SCOPE document fixed at a specific point in time in the PROJECT LIFE CYCLE.

NOTE: Words in capitals within the descriptions indicate that this word is defined elsewhere in the Glossary.

Baseline Concept. Management's project management plan for a PROJECT fixed prior to commencement.

BCWP See BUDGET COST OF WORK PERFORMED.

BCWS See BUDGET COST OF WORK SCHEDULED.

Benefits Administration. The formal system by which the organization manages its non-financial commitment to its employees. Includes such benefits as vacation, leave time and retirement.

Best and Final Contract Offer. Final offer by the supplier to perform the work after incorporating negotiated and agreed CHANGES in the procurement documents.

Bid. An offer to perform the work described in a set of BID DOCUMENTS at a specified cost.

Bid Cost Considerations. Consideration of suppliers' approach and reasonableness of COST, cost realism, forecast economic factors affecting cost and cost RISKS used in the cost proposal.

Bid Documents. A set of documents issued for purposes of soliciting BIDS in the course of the ACQUISITION PROCESS.

Bid Evaluation. Review and analysis of response to determine supplier's ability to perform the work as requested. This activity may include an evaluation of suppliers financial resources, ability to comply with technical criteria and delivery schedules, satisfactory record of performance and eligibility for award.

Bid List. A list of suppliers invited to submit BIDS for goods/services as specified.

Bid Protests. The process by which an unsuccessful supplier may seek remedy for unjust CONTRACT AWARDS.

Bid Response. COMMUNICATIONS, positive or negative from prospective suppliers in response to the INVITATION TO BID.

Bid Time Consideration. Evaluation of suppliers' offer with regard to dates identified for completion of phases of the work and/or total work.

Bid Technical Consideration. Suppliers' technical competency, understanding of the technical requirements and capability to produce technically acceptable goods or services. Generally this evaluation ranks highest among all other evaluations.

Breakdown. Identification of the smallest ACTIVITIES or TASKS in a job according to a defined procedure.

Break-Even Chart. A graphic representation of the relation between total value earned and total costs for various levels of productivity.

Break-Even Point. The productivity point at which value earned equals total cost

Budget. When unqualified, usually refers to an estimate of funds planned to cover a fiscal period. (See PROJECT BUDGET.) Also, a planned allocation of resources.

Budget Costs. The translation of the estimate into man-hour rates, quantity units of production, etc. so that these budget costs can be compared to actual costs and variances developed to highlight performance and alert those responsible to implement corrective action if necessary.

Budget Estimate (-10, +25 Percent). A budget estimate is prepared from flow sheets, layouts and equipment details. This is often required for the owner's budget system. These estimates are established on quantitative information, are a mixture of firm and unit prices for labor, material and equipment. These estimates establish the funds required and are used for obtaining approval for the project. Other terms used to identify a Budget Estimate include Appropriation, Control, Design, etc.

Budgeted Cost of Work Performed (BCWP). The sum of the BUDGETS for completed portions of in-process work, plus the appropriate portion of the budgets for LEVEL OF EFFORT and apportioned effort for the relevant time period. BCWP is commonly

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referred to as "earned value."

Budgeted Cost of Work Scheduled (BCWS). The sum of the budgets for work scheduled to be accomplished (including in-process work), plus the appropriate portion of the budgets for LEVEL OF EFFORT and apportioned effort for the relevant time period.

Bulk Material. Material bought in lots; generally, no specific item is distinguishable from any other in the lot. These items can be purchased from a standard catalog description and are bought in quantity for distribution as required.

C

Calendar. The calendar used in developing a PROJECT plan. This calendar identifies project work days, and can be altered so weekends, holidays, weather days, etc., are not included.

Calendar Range. The span of the CALENDAR from the calendar start date through to the last CALENDAR UNIT performed. The calendar start date is unit number one.

Calendar Start Date. The first CALENDAR UNIT of the working calendar.

Calendar Unit. The smallest unit of the CALENDAR produced. This unit is generally in hours, days, or weeks; can also be grouped in shifts.

Career Path Planning. The process of integrating the individual's career planning and development into the organization's personnel plans with the objective of satisfying both the organization's requirements and the individual's career goals.

Cash Flow Analysis. The activity of establishing cash flow (dollars in and out of the PROJECT) by month and the accumulated total CASH FLOW for the project for the measurement of actual versus the BUDGET costs. This is necessary to allow for funding of the project at the lowest carrying charges and is a method of measuring project progress.

Change. An increase or decrease in any of the PROJECT characteristics.

Change In Scope. A change in OBJECTIVES, work plan, or SCHEDULE that results in a material difference from the terms of an approval to proceed previously granted by higher authority. Under certain conditions (normally so stated in the approval instrument), change in resources application may constitute a change in SCOPE.

Change Order/Purchase Order Amendment. Written order directing the contractor to make CHANGES according to the provisions of the CONTRACT DOCUMENTS.

Changed Conditions (Contract). A change in the CONTRACT environment, physical or otherwise, compared to that contemplated at the time of BID.

Client Quality Services. The process of creating a two-way feedback system to define expectations, in opportunities and anticipated needs.

Close-Out (Phase). See PROJECT CLOSE-OUT.

Code of Accounts. Once the PROJECT has been divided into the WBSWORK PACKAGES, a code or numbering system is assigned to the COST data for cost MONITORING, CONTROL, reports, tax class separations and FORECASTING purposes.

Commissioning. ACTIVITIES performed for the purpose of substantiating the capability of the PROJECT to function as designed.

Commitment. An agreement to consign, or reserve the necessary RESOURCES to fulfill a requirement, until EXPENDITURE occurs. A commitment is an EVENT.

Communicating With Groups. The means by which the PROJECT MANAGER conducts meetings, presentations, negotiations, and other activities necessary to convey the project's needs and concerns to the PROJECT TEAM and other groups.

NOTE: Words in capitals within the descriptions indicate that this word is defined elsewhere in the Glossary.

Communicating With Individuals. Involves all activities by which the PROJECT MANAGER transfers information or ideas to individuals working on the PROJECT.

Communications Management (Framework). The proper organization and CONTROL of information transmitted by whatever means to satisfy the needs of the project. It includes the processes of transmitting, filtering, receiving and interpreting or understanding information using appropriate skills according to the application in the project environment. It is at once the master and the servant of a project in that it provides the means for interaction between the many disciplines, functions and activities, both internal and external to the project, and which together result in the successful completion of that project. (Communications Mgt.) Conducting or supervising the exchange of information.

Compensation and Evaluation. The measurement of an individual's performance and the financial payment provided to employees as a reward for their performance and as a motivator for future performance.

Completed Activity. An ACTIVITY with an ACTUAL FINISH DATE and no remaining duration.

Computer Cost Applications. The computer assisted TECHNIQUES to handle analysis and store the volume of data accumulated during the PROJECT life that are essential to the COST MANAGEMENT function. The areas associated with cost management are: cost estimating data base, computerized estimating, management reports, economic analysis, analysis of risk and contingency, productivity analysis and control, risk management, commitment accounting, and integrated project management information systems.

Concept. An imaginative arrangement of a set of ideas.

Concept (Phase). The first of four sequential PHASES in the generic PROJECT LIFE CYCLE. Also known as Idea, Economics, Feasibility or Pre-Feasibility Phase.

Conceptual Development. A process of choosing/documenting the best approach to achieve PROJECT OBJECTIVES.

Conceptual Project Planning. The PROCESS of developing broad-scope PROJECT documentation from which the technical requirements, estimates, schedules, control procedures and effective project management will all flow.

Configuration (Baseline) Control. A system of procedures that monitors emerging PROJECT SCOPE against the SCOPE BASELINE. Requires documentation and management approval on any CHANGE to the baseline.

Conflict Management. The process by which the PROJECT MANAGER uses appropriate managerial TECHNIQUES to deal with the inevitable disagreements, both technical and personal in nature, that develop among those working toward PROJECT accomplishment.

Conflict Resolution. To seek a solution to a problem, five methods in particular have been proven through confrontation, compromise, smoothing, forcing and withdrawal.

Confrontation. Where two parties work together toward a solution of the problem.

Compromise. Both sides agree such that each wins or loses a few points.

Smoothing. Differences between two groups are played down and the strong points of agreement are given the most attention.

Forcing. The project manager uses his power to direct the solution. This is a type of win-lose agreement where one side gets its way and the other does not.

Withdrawal. One or both sides withdraw from the conflict.

Constraints. Applicable restrictions that will affect the SCOPE. Any factor which affects when an activity can be scheduled. (See RESTRAINT.)

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Construction Management (CM). The PROCESS by which a potential owner of a capital facility engages a professional agent, referred to as a Construction Manager, to coordinate, communicate and direct the entire process of construction from the PROJECT planning stage through design, procurement, construction and start-up, in terms of SCOPE, QUALITY, TIME and COST.

Contingencies. Specific provision for unforeseeable elements of COST within the defined PROJECT SCOPE; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events that will increase costs are likely to occur. If an allowance for escalation is included in the contingency it should be a separate item, determined to fit expected escalation conditions for the project.

Contingency Allowances. Specific provision for unforeseen elements of cost within the defined PROJECT SCOPE; particularly important where previous experience relating ESTIMATES and actual COSTS has shown that unforeseen EVENTS that will increase costs are likely to occur. If an allowance for escalation is included in the contingency it should be as a separate item, determined to fit expected escalation conditions of the project.

Contingency Plan. A plan that identifies key assumptions beyond the PROJECT MANAGER's control, and their probability of occurrence. The plan identifies alternative strategies for achieving PROJECT success.

Contingency Planning. The establishment of management plans to be invoked in the event of specified RISK EVENTS. Examples include the provision and prudent management of a CONTINGENCY allowance in the BUDGET, the preparation of alternative SCHEDULE ACTIVITY sequences or "work-around", emergency responses to reduce and the evaluation of liabilities in the EVENT of complete PROJECT shut down.

Contract. A binding agreement to acquire goods and/or services in support of a project.

Contract Administration. Monitoring and control of performance, reviewing progress, making payments, recommending modifications and approving CONTRACTOR's actions to ensure compliance with contractual terms during contract execution.

Contract Award. The final outcome of the acquisition process in which generally the CONTRACT is awarded to one prospective supplier, through acceptance of a final offer generally either by issuing a purchase order or the signing of a legally binding contract formalizing the terms under which the goods/services are to be supplied.

Contract Award Ranking. Qualitative and/or quantitative determinations of prospective suppliers' BID/tender/ proposal/quotation relative to each other measured against a common base.

Contract Closeout. Contract closeout ACTIVITIES that assure that the CONTRACTOR has fulfilled all contractual obligations and has released all claims and liens in connection with work performed.

Contract Dates. The dates specified in the CONTRACT that impact the PROJECT Plan.

Contract Dispute. Disagreement between the parties. This may occur during CONTRACT execution or at completion and may include misinterpretation of technical requirements and any terms and conditions or due to changes not anticipated at the time of contract award.

Contract Documents. The set of documents that form the CONTRACT

Contract Financial Control. Exercise of CONTROL over CONTRACT COSTS

Contract Guarantee. A legally enforceable assurance of performance of a CONTRACT by a CONTRACTOR.

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- Contract Negotiation.** Method of PROCUREMENT where a CONTRACT results from a BID that may be changed through bargaining.
- Contract Order Modifications.** Changes in a CONTRACT during its execution to incorporate new requirements or to handle CONTINGENCIES that develop after contract placement. Changes may include price adjustments or changes in SCOPE.
- Contract Performance Control.** CONTROL of work during CONTRACT execution.
- Contract Pre-award Meetings.** Meetings with prospective suppliers before final award determination to aid ranking and/or finalize terms of agreement between parties.
- Contract Procurement Management.** The function through which RESOURCES (including people, plant, equipment and materials) are acquired for the PROJECT (usually through some form of formal contract) in order to produce the end product. It includes the PROCESSES of establishing strategy, instituting information systems, identifying sources, selection, conducting proposal or tender invitation and award, and administering the resulting CONTRACT.
- Contract Risk.** The potential and consideration of RISK in procurement actions. Generally the forces of supply and demand determine who should have the maximum risk of CONTRACT performance but the objective is to place on the supplier the maximum performance risk while maintaining an incentive for efficient performance. In a fixed price contract, the supplier accepts a higher risk than in a COST type contract in which supplier's risk is lowest.
- Contract Risk Analysis.** Analysis of the consequences and probabilities that certain undesirable EVENTS will occur and their impact on attaining the contract/procurement OBJECTIVES.
- Contract Types.** The various forms of contracts by which goods/services can be acquired. See COST PLUS FIXED FEE, COST PLUS INCENTIVE FEE, COST PLUS PERCENTAGE OF COST, FIRM FIXED PRICE, FIXED PRICE PLUS INCENTIVE FEE, and UNIT PRICE CONTRACTS.
- Contractor.** A person or organization that undertakes responsibility for the performance of a CONTRACT.
- Contractor Claims Release.** Certificate to release and hold harmless from future claims by the CONTRACTOR.
- Contractor's Performance Evaluation.** A comprehensive review of CONTRACTOR's technical and COST performance and work delivery schedules.
- Control.** The exercise of CORRECTIVE ACTION as necessary to yield a required outcome consequent upon MONITORING performance.
- Control System.** A mechanism that reacts to the current PROJECT status in order to ensure accomplishment of project OBJECTIVES.
- Corporate Business Life Cycle.** A life cycle which encompasses phases of policy-planning and identification-of-needs before a PROJECT LIFE CYCLE, as well as product-in-service and disposal after the project life cycle.
- Corporate Procurement Strategy.** The overall direction set by the corporation of which the PROJECT is a part, and the relationship of specific procurement actions to these corporate directions.
- Corrective Action.** (Cost Mgt.) The development of changes in plan and approach to improve the performance of the PROJECT. (Communications Mgt.) Measures taken to rectify conditions adverse to specified QUALITY, and where necessary, to preclude repetition.
- Cost.** Cash value of PROJECT ACTIVITY
- Cost Applications.** The processes of applying COST data to other techniques that have not been described in the other processes.

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Cost Budgeting. The process of establishing BUDGETS, standards and a monitoring system by which the investment COSTS of the PROJECT can be measured and managed, that is, the establishment of the control estimate. It is vital to be aware of the problems "before the fact" so that timely corrective action can be taken.

Cost Controls. The processes of gathering, accumulating, analyzing, reporting and managing the COSTS on an on-going basis. Includes PROJECT PROCEDURES, PROJECT COST CHANGES, MONITORING ACTUAL VERSUS BUDGET, VARIANCE ANALYSIS, INTEGRATED COST/SCHEDULE REPORTING, PROGRESS ANALYSIS and CORRECTIVE ACTION.

Cost Effective. Better value for money, or the best performance for the least cost.

Cost Estimating. The process of assembling and predicting the COSTS of a PROJECT. It encompasses the economic evaluation, project investment cost and predicting or FORECASTING of future trends and costs.

Cost Forecasting. The activity of predicting future trends and costs within the project duration. These activities are normally marketing oriented. However, such items as sales volume, price and operating cost can affect the project profitability analysis. Items that affect the cost management functions are: predicted time/cost, salvage value, etc.

Cost Management. The function required to maintain effective financial control of the PROJECT through the PROCESSES of evaluating, ESTIMATING, BUDGETING, MONITORING, ANALYZING, FORECASTING, and REPORTING the COST information.

Cost Performance Measurement Baseline. The formulation of BUDGET COSTS, measurable goals, (particularly time and quantities), for the purposes of comparisons, analysis and FORECASTING future costs.

Cost Plus Fixed Fee (CPFF) Contract. Provides reimbursement of allowable cost plus a fixed fee which is paid proportionately as the CONTRACT progresses.

Cost Plus Incentive Fee (CPIF) Contract. Provides the supplier for COST of delivered performance, plus a predetermined fee as a bonus for superior performance.

Cost Plus Percentage of Cost (CPPC) Contract. Provides reimbursement of allowable COST of services performed plus an agreed upon percentage of the estimated cost as profit.

Cost Status. See SCOPE REPORTING

Counseling. The PROCESS of advising or assisting an individual concerning career plans, work requirements, or the quality of work performed.

CPFF. See COST PLUS FIXED FEE CONTRACT.

CPIF. See COST PLUS INCENTIVE FEE CONTRACT.

CPM. See CRITICAL PATH METHOD.

CPN. See CRITICAL PATH NETWORK.

CPPC. See COST PLUS PERCENTAGE OF COST CONTRACT.

Crashing. Action to decrease the duration of an ACTIVITY or PROJECT by increasing the expenditure of RESOURCES.

Criteria. A statement that provides OBJECTIVES, guidelines, PROCEDURES, and standards that are to be used to execute the development, design, and/or implementation portions of a PROJECT.

Critical Activity. Any ACTIVITY on a CRITICAL PATH.

Critical Path. The series of interdependent ACTIVITIES of a PROJECT, connected end-to-end that determines the shortest total length of the project. The critical path of a project may change from time to time as activities are completed ahead of, or behind, schedule.

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Critical Path Method (CPM). A scheduling TECHNIQUE using PRECEDENCE DIAGRAMS for graphic display of the work plan. The method used to determine the length of a PROJECT and to identify the ACTIVITIES that are critical to the completion of the project.

Critical Path Network (CPN). A plan for the execution of a PROJECT that consists of ACTIVITIES and their logical relationships to one another.

Culture. The integrated pattern of human knowledge, belief, and behavior that depends upon man's capacity for learning and transmitting knowledge to succeeding generations.

Current Finish Date. The current estimate of the calendar date when an ACTIVITY will be completed.

Current Start Date. The current estimate of the calendar date when an ACTIVITY will begin. Customer/Client Personnel. Those individuals working for the organization that will assume responsibility for the product produced by the PROJECT when the project is complete.

D

Data Application. The development of a database of RISK FACTORS both for the current project and as a matter of historic record.

Data Collection. The gathering and recording of facts, changes and forecasts for reporting and future planning

Data Date (DD). The CALENDAR DATE that separates actual (historical) data from scheduled data. Data Refinements. Rework or redefinition of logic or data that may have previously been developed in the planning sub-function as required to properly input MILESTONES, RESTRAINTS, PRIORITIES and RESOURCES.

DD. See DATA DATE.

Date of Acceptance. The date on which the client agrees to the final acceptance of the PROJECT.

Definitive Estimate (-5, +10 Percent). A definitive ESTIMATE is prepared from well defined data, specifications, drawings, etc. This category covers all estimate ranges from a minimum to maximum definitive type. These estimates are used for BID proposals, bid evaluations, CONTRACT CHANGES, extra work, legal claims, permit and government approvals. Other terms associated with a Definitive Estimate include check, lump sum, tender, post contract changes, etc.

Deflection. The act of transferring all or part of a RISK to another party, usually by some form of CONTRACT.

Delegating. The PROCESS by which authority is distributed from the PROJECT MANAGER to an individual working on the PROJECT.

Deliverable. A report or product of one or more TASKS that satisfy one or more OBJECTIVES and must be delivered to satisfy contractual requirements.

Design. The creation of final approach for executing the PROJECT's work. Design Contract. A CONTRACT for DESIGN.

Design Control. A system for monitoring PROJECT SCOPE, SCHEDULE and COST during the project's design stage.

Design of Experiment. The planning of an experiment to minimize the cost of data obtained and maximize the validity range of the results. Requirements for a good experiment include clear treatment comparisons, controlled fixed and experimental variables and maximum freedom from systematic error. The experiments should adhere to the scientific principles of statistical design and analysis. Each experiment should include three parts: the experimental statement, the design and the analysis.

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Examples of experimental designs include: single/multi factor block, factorial, Latin square and nested arrangements.

Detail Schedule. A SCHEDULE used to communicate the day-to-day ACTIVITIES to working levels on the PROJECT.

Development (Phase). The second of four sequential PHASES in the generic PROJECT LIFE CYCLE. Also known as PLANNING PHASE.

Direct Cost. See DIRECT PROJECT COSTS.

Direct Project Costs. The costs directly attributable to a PROJECT, including all personnel, goods and/or services together with all their associated costs, but not including INDIRECT PROJECT COSTS, such as any overhead and office costs incurred in support of the PROJECT.

Discrimination. The requirements imposed on the organization and the procedures implemented by the organization to assure fairness in hiring and promotion practices.

Discussion. Dialogue explaining implications and impacts on OBJECTIVES. The elaboration and description of facts, findings and alternatives.

Display. A pictorial, verbal, written, tabulated or graphical means of transmitting findings, results and conclusions.

Dispute. Disagreements not settled by mutual consent which could be decided by litigation or ARBITRATION.

Distribution (of Communications). The dissemination of information for the purpose of COMMUNICATION, APPROVAL or decision-making.

Document Control. A system for controlling and executing PROJECT documentation in a uniform and orderly fashion.

Documentation. The collection of reports, user information and references for distribution and retrieval, displays, back-up information and records pertaining to the project.

Dummy Activity. An ACTIVITY, always of zero duration, used to show logical dependency when an activity cannot start before another is complete, but which does not lie on the same PATH through the NETWORK. Normally, these dummy activities are graphically represented as a dashed line headed by an arrow.

Duty and Tax Administration. Action taken to legally minimize duties and taxes applicable to the goods/services supplied.

E

Early Finish Date (EF). The earliest time an ACTIVITY may be completed equal to the early start of the activity plus its remaining duration.

Early Start Date (ES). The earliest time any ACTIVITY may begin as logically constrained by the NETWORK for a given data date.

Earned Value. A method of reporting PROJECT status in terms of both COST and time. It is the BUDGETED VALUE OF WORK PERFORMED regardless of the actual cost incurred.

Economic Evaluation. The PROCESS of establishing the value of a PROJECT in relation to other corporate standards/benchmarks, project profitability, financing, interest rates and acceptance.

EF. See EARLY FINISH DATE

Effective Interest. The true value of interest rate computed by equations for compound interest rate for a 1-year period.

Effort. The application of human energy to accomplish an OBJECTIVE.

Employee Relations. Those formal ACTIVITIES and PROCEDURES used by an organization to administer and develop its workforce.

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Endorsement. Written approval. Endorsement signifies personal understanding and acceptance of the thing endorsed, and recommends further endorsement by higher levels of authority if necessary. Endorsement of COMMITMENT by a person invested with appropriate authority signifies authorization. Also see APPROVE, AUTHORIZE.

Environment (Framework). The combined internal and external forces, both individual and collective that assist or restrict the attainment of the project objectives. These could be business or project related or may be due to political, economic, technological or regulatory conditions. (See Communications Mgt.) The circumstances, objects, or conditions by which one is surrounded.

Environmentally Concerned. Those individuals who align themselves with the views of various groups concerned with issues of protecting the environment.

Equal Opportunity. In the U.S.A., the procedures implemented by the organization to assure that it meets the requirements of the Equal Employment Opportunity sections of the Civil Rights Act. Includes affirmative-action and other programs, as well as the documentation procedures to demonstrate compliance.

Equipment Procurement. The acquisition of equipment/ material to be incorporated into the PROJECT.

ES. See EARLY START DATE.

Estimate. An evaluation of all the COSTS of the elements of a PROJECT or effort as defined by an agreed-upon SCOPE. See ORDER OF MAGNITUDE ESTIMATE, BUDGET ESTIMATE, and DEFINITIVE ESTIMATE.

Estimated Cost to Complete (ECC). The remaining COSTS to be incurred to satisfy the complete SCOPE of a PROJECT at a specific DATA DATE. The difference between the cost to date and the FORECAST FINAL COST.

Estimated Final Cost. See FORECAST FINAL COST.

Ethics. A set of moral principles or values; the principal of conduct governing an individual or a group.

Event. An event is an identifiable single point in time on a project.

Exception Reporting. The process of documenting those situations where there are significant deviations from the quality specifications of a project. The assumption is made that the project will be developed within established boundaries of quality. When the process falls outside of those boundaries, a report is made on why this deviation occurred.

Exception Reports. Documentation that focuses its attention on variations of key CONTROL parameters that are critical rather than on those that are progressing as planned.

Execution (Phase). See IMPLEMENTATION (PHASE)

Expenditure. The conversion of RESOURCES. An expenditure is an EVENT. Conversions of resources may take several forms:

1. Exchange:- conversion of title or ownership (e.g., dollars for materials).
2. Consumption:- conversion of a liquid resource to a less recoverable state, i.e., expenditures of time, human resources, dollars to produce something of value; or the incorporation of inventoried materials into fixed assets.

External Procurement Sources. Extra-firm sources including industry contacts, market data, competitive intelligence and regulatory information which could aid PROCUREMENT decision-making.

Extrasensory. Residing beyond or outside the ordinary senses (instances of perception).

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F

Facilities/Product Life Cycle. A life cycle which encompasses PHASES of operation and disposal, as well as, and following, the PROJECT LIFE CYCLE.

Fast Track. The starting or implementation of a PROJECT by overlapping ACTIVITIES, commonly entailing the overlapping of design and construction (manufacturing) activities.

Feasibility. The assessment of capability of being completed, the possibility, probability and suitability of accomplishment.

Feasibility Studies. The methods and TECHNIQUES used to examine technical and COST data to determine the economic potential and the practicality of PROJECT applications. It involves the use of techniques such as the time value of money so that projects may be evaluated and compared on an equivalent basis. Interest rates, present worth factors, capitalization costs, operating costs, depreciation, etc., are all considered.

Feasible Procurement Alternatives. Reviews of available alternative PROCUREMENT actions that could attain the OBJECTIVES.

Feedback. Information (data) extracted from a PROCESS or situation and used in CONTROLLING (directly) or in planning or modifying immediate or future inputs (actions or decisions) into the process or situation.

FF. See FREE FLOAT

FFP. See FIRM FIXED PRICE CONTRACT

Field Cost. COSTS associated with the PROJECT site rather than with the home office.

Final Completion. When the entire work has been performed to the requirements of the CONTRACT, except for those items arising from the provisions of warranty, and is so certified.

Final Payment. Final settlement paid at CONTRACT completion of the contractually obligated amount including retention.

Financial Closeout. Accounting analysis of how funds were spent on the PROJECT. Signifies a point in time when no further charges should be made "against" the project.

Financial Control. Exercise of CONTROL on payments of supplier's invoices.

Financing. Involves the TECHNIQUES and methods related to providing the sources of monies and methods to raise funds (stock, mortgages, bonds, innovative financing agreements, leases, etc.) required for the PROJECT.

Firm Fixed Price (FFP) Contract. A lump sum CONTRACT where the supplier agrees to furnish goods or services at a fixed price.

Fixed Price Plus Incentive Fee (FPIF) Contract. Provides the supplier with a fixed price for delivered performance plus a predetermined fee for superior performance.

Float. See Free Float

Floating Task. A TASK that can be performed earlier or later in the SCHEDULE without affecting the PROJECT duration.

Forecast. An ESTIMATE and prediction of future conditions and EVENTS based on information and knowledge available at the time of the forecast.

Forecast Final Cost. The anticipated COST of a PROJECT or component when it is complete. The sum of the committed cost to date and the ESTIMATED COST TO COMPLETE.

Forecasting. The work performed to estimate and predict future conditions and events. Forecasting is an ACTIVITY of the management function of planning. Forecasting is often confused with BUDGETING, which is a definitive allocation of resources rather than a prediction or ESTIMATE.

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Formal Bid. Bid/quotation/letter/proposal submitted by the prospective suppliers in response to the Request for Proposal, Request for Quotation.

Formative Quality Evaluation. The PROCESS of reviewing the PROJECT data at key junctures during the PROJECT LIFE CYCLE for a comparative analysis against the pre-established QUALITY specifications. This evaluation process is ongoing during the life of the project to ensure that timely changes can be made as needed to protect the success of the project.

Forward Pass. NETWORK calculations that determine the earliest start/earliest finish time (date) of each ACTIVITY. These calculations are from DATA DATE through the logical flow of each activity.

FPPIF. See FIXED PRICE PLUS INCENTIVE FEE CONTRACT.

Free Float (FF). The amount of time (in work units) an activity may be delayed without affecting the early start of the activity immediately following.

Function (PM Function). The series of PROCESSES by which the PROJECT OBJECTIVES in that particular area of PROJECT MANAGEMENT, e.g. SCOPE, COST, time, etc., are achieved.

Function Chart Structure. See PMBOK FUNCTION CHART STRUCTURE.

Function-Quality Integration. The PROCESS of actively ensuring that QUALITY plans and programs are integrated, mutually consistent, necessary and sufficient to permit the PROJECT TEAM to achieve the defined product QUALITY.

Funding (Cost Mgt.). The status of internal fund allocation, or allocation by an external agency, if applicable, to enable payment for the performance of the PROJECT SCOPE. (Contract/ Procurement Mgt.) The status of internal or external monies available for performing the work.

G

Gantt Charts. See BAR CHARTS

General Conditions. General definition of the legal relationships and responsibilities of the parties to the CONTRACT, and how the contract is to be administered. They are usually standard for a corporation and/or project.

General Requirements. Non-technical specifications defining the scope of work, payments, PROCEDURES, implementation constraints, etc., pertaining to the CONTRACT.

General Sequencing. An overview of the order of performing activities.

Government Regulations and Requirements. Those laws, regulations, rules, policies, and administrative requirements imposed upon organizations by government agencies.

Graph (Quality Mgt.). A visual comparison of variables that yield data in numerical facts. Examples include: trend graphs, histograms, control charts, frequency distributions and scatter diagrams. (Time Mgt.) The display or drawing that shows the relationship between ACTIVITIES. Pictorial representation of relative variables.

Group Communication. The means by which the PROJECT MANAGER conducts meetings, presentations, negotiations, and other activities necessary to convey the PROJECT's needs and concerns to the PROJECT TEAM and other groups.

Guarantee. See CONTRACT GUARANTEE

Guideline. A document that recommends methods to be used to accomplish an OBJECTIVE.

H

Hammock. An aggregate or summary ACTIVITY. All related activities are tied as one summary activity and reported at the summary level.

Hanger. A break in a NETWORK PATH

Historic Records. PROJECT documentation that can be used to predict trends, analyze feasibility and highlight problem areas/pitfalls on similar future projects.

Historical Data Banks. The data stored for future reference and referred to on a periodic basis to indicate trends, total COSTS, unit costs and technical relationships, etc. Different applications require different data base information. This data can be used to assist in the development of future ESTIMATES

HRM. See HUMAN RESOURCES MANAGEMENT

HR Compensation and Evaluation. The measurement of an individual's performance and financial payment provided to employees as a reward for their performance and as a motivator for future performance.

HR Organization Development. The use of behavioral science technology, research, and theory, to change an organization's culture to meet predetermined objectives involving participation, joint decision making, and team building.

HR Performance Evaluation. The formal system by which managers evaluate and rate the quality of subordinates' performance over a given period of time.

HR Records Management. The PROCEDURES established by the organization to manage all documentation required for the effective development and application of its work force.

Human Resources Management. The function of directing and coordinating human resources (i.e. people) throughout the life of the PROJECT by applying the art and science of behavioral and administrative knowledge to achieve predetermined project OBJECTIVES of SCOPE, COST, time, QUALITY and participant satisfaction.

I

Impact Analysis. The mathematical examination of the nature of individual RISKS on the PROJECT, as well as potential structures of interdependent risks. It includes the quantification of their respective impact severity, probability and sensitivity to changes in related PROJECT VARIABLES including the PROJECT LIFE CYCLE. To be complete, the analysis should also include an examination of the external "status quo" prior to project implementation as well as the project's internal intrinsic worth as a reference baseline. A determination should also be made as to whether all risks identified are within the SCOPE of the project's RISK RESPONSE PLANNING process.

Impact Interpretation. Clarification of the significance of a variance with respect to overall OBJECTIVES.

Implementation (Phase). The third of four sequential PHASES in the PROJECT LIFE CYCLE. Also known as EXECUTION or Operation Phase.

Implementation, Completion of. Also known as CLOSEOUT PHASE. Completion of implementation means that the PROJECT TEAM has:

1. Provided completed PROJECT ACTIVITIES in accordance with the PROJECT requirements.
2. Completed PROJECT CLOSE OUT.

Imposed Date (External). A predetermined calendar date set without regard to logical considerations of the NETWORK.

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Indirect Project Costs. All COSTS that do not form a part of the final PROJECT, but which are nonetheless required for the orderly completion of the project and that may include, but not necessarily be limited to, field administration, direct supervision, incidental tools and equipment, startup costs, contractor's fees, insurance, taxes, etc.

Individuals Outside the Project. Refers to all those individuals who impact the project work but who are not considered members of the PROJECT TEAM.

Inflation/Escalation. A factor in COST evaluation and cost comparison that must be predicted as an allowance to account for the price changes that can occur with time and over which the PROJECT MANAGER has no control (for example: cost of living index, interest rates, other cost indices, etc.)

Information Flow (Distribution List). A list of individuals that would receive information on a given subject or project.

Information Gathering. Researching, organizing, recording and comprehending pertinent information/ data.

Information Systems. A structured, interacting, complex of persons, machines, and procedures designed to produce information that is collected from both internal and external sources for use as a basis for decision-making in specific contract/procurement activities.

Initial Operation. See OPERATION

In-Progress Activity. An ACTIVITY that has been started but is not completed on a given date. Input Limits. Imposition of limitations to the resources through which the PLAN will be executed.

Input Milestones. Imposed target dates or target EVENTS that are to be accomplished, and that control the PLAN with respect to time.

Input Priorities. Imposed priorities or sequence desired with respect to the scheduling of ACTIVITIES within previously imposed CONSTRAINTS.

Input Restraints. Imposed external restraints, such as dates reflecting input from others and target dates reflecting output required by others, and such items as float allocation and CONSTRAINTS.

In-Service Date. That point in time when the PROJECT is placed in a state of readiness or availability when it can be used for its specifically assigned function.

Inspection. Examination or measurement of work to verify whether an item or ACTIVITY conforms to a specific requirement.

Integrated Cost/Schedule Reporting. The development of reports that measure actual versus BUDGET, "S" CURVES, BCWS, BCWP and ACWP.

Integrated Project Progress Reports. Documentation that measures actual (COST/SCHEDULE) vs. budget by using BCWP, BCWS, ACWP.

Intelligence. The ability to learn or understand or to deal with new or trying situations.

Intention for Bid (IFB). Communications, written or oral by the prospective organizations and/or individuals indicating their willingness to perform the specified work. This could be a letter, statement of qualifications or response to a request for proposal/quotation.

Interaction. Mutual action or reciprocal action or influence.

Interest Rate of Return. See PROFITABILITY INDEX.

Interface Activity. An ACTIVITY connecting a node in one SUBNET with a NODE in another subnet, representing logical interdependence. The activity identifies points of interaction or commonality between the PROJECT activities and outside influences.

Interface Management. The management of communication, coordination and responsibility across a common boundary between two organizations, PHASES, or physical entities that are interdependent.

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Interface Program. A computer program that elates status system line items to their parent ACTIVITIES in the PROJECT PLAN.

Internal Procurement Sources. Intra-firm sources and records including historical data on similar procurements, cost and performance data on various suppliers and other data that could assist in proposed procurements.

Interpret. Present in understandable terms

Interpretation. Reduction of information to appropriate and understandable terms and explanations

Inventory Closeout. Settlement and credit of inventory if purchased from PROJECT funds.

Investor's Method. See DISCOUNTED CASH FLOW.

Invitation to Bid. The invitation issued to prospective suppliers to submit a BID/QUOTATION/ PROPOSAL for the supply of goods/services.

Involuntary. Contrary to or without choice, not subject to control of the will (reflex).

J

Job Descriptions (Scope Mgt.). Documentation of a PROJECT participant's job title, supervisor, job summary, responsibilities, authority and any additional job factors. (Human Resources Mgt.) Written outlines of the skills, responsibilities, knowledge, authority, environment, and inter-relationships involved in an individual's job.

K

Key Event Schedule. A schedule comprised of key EVENTS or MILESTONES. These events are generally critical accomplishments planned at time intervals throughout the PROJECT and used as a basis to monitor overall project performance. The format may be either NETWORK or BAR CHART and may contain minimal detail at a highly summarized level. This is often referred to as a milestone schedule.

L

Labor Relations. Those formal activities developed by an organization to negotiate and bargain with its workforce, whether or not that workforce is unionized.

Lag. The logical relationship between the start and/or finish of one activity and the start and/or finish of another activity

Lag Relationship. The four basic types of lag relationships between the start and/or finish of a work item and the start and/or finish of another work item are:

1. Finish to Start
2. Start to Finish
3. Finish to Finish
4. Start to Start

Language. A systematic means of communicating ideas or feelings by the use of conventionalized signs, sounds, or gestures.

Late Finish (LF). The latest time an ACTIVITY may be completed without delaying the PROJECT FINISH DATE.

Late Start (LS). The latest time an ACTIVITY may begin without delaying the PROJECT FINISH DATE of the NETWORK. This date is calculated as the LATE FINISH minus the duration of the activity.

Leadership. The process by which the PROJECT MANAGER influences the PROJECT TEAM to behave in a manner that will facilitate PROJECT goal achievement.

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Learning Curve. A concept that recognizes the fact that PRODUCTIVITY by workers improves as they become familiar with the sequence of ACTIVITIES involved in the production process.

Legal Tape. A computer tape that contains the contract base PROJECT PLAN as the first entry, and the (resource leveled) Target Project Plan as the second entry. Also, all approved major changes to logic, time, or RESOURCES will be added, as a separate entity, to the Legal Tape. No other entries will be made to this tape.

Legally Concerned. Those individuals who are concerned with assuring that the PROJECT complies with all aspects of the law.

Level Finish/Schedule (SF). The date when the ACTIVITY is scheduled to be completed using the RESOURCE ALLOCATION PROCESS.

Level Float. The difference between the level finish and the late finish date.

Level of Detail. A policy expression of content of plans, schedules and reports in accordance with the scale of the breakdown of information.

Level of Effort (LOE). Support type effort (e.g. vendor liaison) that does not readily lend itself to measurement of discrete accomplishment. It is generally characterized by a uniform rate of ACTIVITY over a specific period of time.

Level Start Schedule (SS). The date the ACTIVITY is scheduled to begin using the RESOURCE ALLOCATION PROCESS. This date is equal to or later in time than EARLY START.

LF. See LATE FINISH

Life Cycle Costing. The concept of including all COSTS within the total life of a PROJECT from concept, through implementation, start up to dismantling. It is used for making decisions between alternatives and is a term used principally by the government to express the total cost of an article or system. It is also used in the private sector by the real estate industry.

Limitation of Funds. The value of funds available for expenses beyond which no work could be authorized for performance during the specified period.

Line/Functional Manager. Those responsible for ACTIVITIES in one of the primary functions of the organization, such as production or marketing, with whom the PROJECT MANAGER must relate in achieving the PROJECT's goals.

Line Item. The smallest unit of product whose status is tracked in a status system.

Lists, Project. The tabulations of information organized in meaningful fashion.

Logic. The interdependency of the ACTIVITIES in a NETWORK.

Loop. A PATH in a NETWORK closed on itself passing through any NODE more than once on any given path. The network cannot be analyzed, as it is not a logical network.

LS. See LATE START.

M

Macro Environment. Consideration, inter-relationship and action of outside changes such as legal, social, economic, political or technological that may directly or indirectly influence specific PROJECT actions.

Macro Procurement Environment. Consideration, interrelationship and action of outside changes such as legal, social, economic, political or technological which may directly or indirectly influence specific procurement actions.

Management. The process of planning, organizing, executing, coordinating, MONITORING, FORECASTING and exercising CONTROL.

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Management Plan. Document that describes the overall guidelines within which a PROJECT is organized, administered and managed to assure the timely accomplishment of project OBJECTIVES.

Management Styles. The PROJECT MANAGER may adopt several different MANAGEMENT styles, according to circumstances, in the PROCESS of LEADERSHIP and TEAM MOTIVATION. These include: authoritarian, combative, conciliatory, disruptive, ethical, facilitating, intimidating, judicial, promotional, and secretive. Management styles include the following:

Authoritarian. Lets individuals know what is expected of them, gives specific guidance as to what should be done, makes his part of the group understood, schedules work to be done, and asks group members to follow standard rules and regulations.

Combative. A project manager that is marked by an eagerness to fight or be disagreeable over any given situation.

Conciliatory. A project manager that is friendly and agreeable; one who attempts to assemble and unite all project parties involved to provide a compatible working team.

Disruptive. A project manager that tends to break apart the unity of a group; one that tends to be an agitator and causes disorder on a project.

Ethical. A project manager that is honest, sincere, able to motivate and to press for the best and fairest solution; one who generally goes "by the book."

Facilitating. The project manager is available to answer questions and give guidance when needed; s/he does not interfere with day to day tasks, but rather maintains that status quo.

Intimidating. A project manager that frequently reprimands employees for the sake of an image as a "tough guy," at the risk of lowering department morale.

Judicial. A project manager that exercises the use of sound judgment or is characterized by applying sound judgment to most areas of the project.

Promotional. Encourages subordinates to realize their full potential, cultivates a team spirit and lets subordinates know that good work will be rewarded.

Secretive. A project manager that is not open or outgoing in speech activity, or purpose much to the detriment of the overall project.

Management Time. Man hours related to the PROJECT MANAGEMENT TEAM.

Managerial Quality Administration. The managerial PROCESS of defining and monitoring POLICIES, responsibilities and SYSTEMS necessary to retain QUALITY standards throughout the PROJECT.

Managerial Reserves. The reserve accounts for allocating and maintaining funds for contingency purposes on over- or under-spending on project activities. These accounts will normally accrue from the CONTINGENCY and other ALLOWANCES in the PROJECT BUDGET ESTIMATE.

Manpower Planning. The PROCESS of projecting the organization's manpower needs overtime, in terms of both numbers and skills, and obtaining the human resources required to match the organization's needs. See HUMAN RESOURCES MANAGEMENT.

Master Schedule. An executive summary-level SCHEDULE that identifies the major components of a PROJECT, and usually also identifies the MAJOR MILESTONES.

Matrix (PMBOK Matrix). A two-dimensional structure in which the horizontal and vertical intersections form cells or boxes. In each cell may be identified a block of knowledge whose interface with other blocks is determined by its position in the structure.

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Matrix Organization. A two dimensional organizational structure in which the horizontal and vertical intersections represent different staffing positions with RESPONSIBILITY divided between the horizontal and vertical authorities.

Method. The manner or way in which work is done. When formalized into a prescribed manner of performing specified work, a method becomes a PROCEDURE.

Micro Environment. Consideration of company, PROJECT or client imposed POLICIES and PROCEDURES applicable to project actions.

Micro Procurement Environment. Consideration of firm, project or client imposed policies and procedures applicable in the procurement actions.

Milestone. A significant EVENT in the PROJECT (Key Item or Key Event.)

Milestone Schedule. See SUMMARY SCHEDULE.

Milestones for Control. Interim OBJECTIVES, points of arrival in terms of time for purposes of progress management.

M.I.S. Management Information Systems.

M.I.S. Quality Requirements. The PROCESS of organizing a PROJECT's OBJECTIVES, strategies and RESOURCES for the M.I.S. data systems.

Mitigation. The act of revising the PROJECT's SCOPE, BUDGET, SCHEDULE or quality, preferably without material impact on the PROJECT's OBJECTIVES, in order to reduce UNCERTAINTY on the PROJECT.

Monitoring. The capture, analysis and reporting of actual performance compared to planned performance.

Monitoring Actuals versus Budget. One of the main responsibilities of COST MANAGEMENT is to continually measure and monitor the actual COST versus the BUDGET in order to identify problems, establish the VARIANCE, analyze the reasons for variance and take the necessary corrective action. Changes in the FORECAST FINAL COST are constantly MONITORED, managed and CONTROLLED.

Motivating. The PROCESS of inducing an individual to work toward achieving the organization's OBJECTIVES while also working to achieve personal objectives.

N

Near-Critical Activity. An ACTIVITY that has low TOTAL FLOAT.

Near-Term Activities. ACTIVITIES that are planned to begin, be in process, or be completed during a relatively short period of time, such as 30, 60, or 90 days.

Negotiating. The PROCESS of bargaining with individuals concerning the transfer of RESOURCES, the generation of information, and the accomplishment of ACTIVITIES.

Net Present Value. See PRESENT VALUE.

Network Diagram. A schematic display of the sequential and logical relationship of the ACTIVITIES that comprise the PROJECT. Two popular drawing conventions or notations for scheduling are ARROW and PRECEDENCE diagramming.

Networking. The exchange of information or services among individuals, groups, or institutions.

Node. One of the defining points of a NETWORK; a junction point joined to some or all of the others by dependency lines.

Non-Conformance. A deficiency in characteristics, documentation or PROCEDURE that renders the quality of material/service unacceptable or indeterminate.

Nonverbal Communication. Involving minimal use of the spoken language: gestures, facial expressions, and verbal fragments that communicate emotions without the use of words, sometimes known as body language.

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Non-Work Unit. A CALENDAR UNIT during which work may not be performed on an ACTIVITY, such as weekends and holidays.

Normal Operation. See OPERATION

Notice to Proceed. Formal notification to the supplier, requesting the start of the work.

O

Objective (In Contract/Procurement Mgt.) To define the method to follow and the service to be contracted or resource to be procured for the performance of work.

Objective (Time Mgt.). A predetermined result: the end toward which EFFORT is directed.

Olfactory. Of, relating to, or connected with, the sense of smell.

Operation. The operation of a new facility is described by a variety of terms, each depicting an EVENT in its early operating life. These are defined below, in chronological order:

1. Initial Operation:- the PROJECT MILESTONE date on which material is first introduced into the system for the purpose of producing products.
2. Normal Operation:- The project milestone date on which the facility has demonstrated the capability of sustained operations at design conditions and the facility is accepted by the client.

Oral. Spoken communication.

Order of Magnitude (-25,+75 Percent). This is an approximate ESTIMATE made with out detailed data, that is usually produced from cost capacity curves, scale up or down factors that are appropriately escalated and approximate cost capacity ratios. This type of estimate is used during the formative stages of an expenditure program for initial evaluation of the PROJECT. Other terms commonly used to identify an Order of Magnitude estimate are preliminary, conceptual, factored, quickie, feasibility and SWAG.

Organization Development. The use of behavioral science technology, research, and theory to change an organization's culture to meet predetermined objectives involving participation, joint decision making and team building.

Organization Structure. Identification of participants and their hierarchical relationships.

Organizational Politics. The informal PROCESS by which personal friendships, loyalties, and enmities are used in an attempt to gain an advantage in influencing PROJECT decisions.

Original Duration. The first estimate of work time needed to execute an ACTIVITY. The most common units of time are hours, days and weeks.

Other Bid Considerations. An evaluation of personnel and financial RESOURCES, facilities, performance record, responsiveness to CONTRACT terms and conditions and the general willingness to perform the work.

Overall Quality Philosophy. The universal belief and performance throughout the company, based on established QUALITY POLICIES and PROCEDURES. Those policies and procedures become the basis for collecting facts about a PROJECT in an orderly way for study (statistics).

P

Parametric Cost Estimating. An estimating methodology using statistical relationships between historical COSTS and other PROJECT variables such as SYSTEM physical or performance characteristics, contractor output measures, or manpower loading, etc. Also referred to as "top down" estimating.

Pareto Diagrams (Quality). A GRAPH, particularly popular in non-technical PROJECTS,

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to prioritize the few change areas (often 20% of the total) that cause most QUALITY deviations (often 80% of the total).

Path, Network. The continuous, linear series of connected ACTIVITIES through a NETWORK.

Payment Authorization. The PROCESS of allocated fund transfer to an account from which the supplier can be paid for delivered goods/services as per contractual terms.

PDM. See PRECEDENCE DIAGRAM METHOD

PDM Finish to Finish Relationship. This relationship restricts the finish of the work ACTIVITY until some specified duration following the finish of another work activity.

PDM Finish to Start Relationship. The relationship where the work ACTIVITY may start just as soon as another work activity is finished.

PDM Start to Finish Relationship. The relationship restricts the finish of the work ACTIVITY until some duration following the start of another work activity.

PDM Start to Start Relationship. This relationship restricts the start of the work ACTIVITY until some specified duration following the start of the preceding work activity.

Percent Complete. A ratio comparison of the completion status to the current projection of total work.

Performance. The calculation of achievement used to measure and manage PROJECT QUALITY

Performance Control. Control of work during CONTRACT execution.

Performance Evaluation. The formal system by which managers evaluate and rate the quality of subordinates' performance over a given period of time.

Personal Recognition. The public acknowledgement of an individual's performance on the PROJECT.

Personal Rewards. Providing an individual with psychological or monetary benefits in return for his or her performance.

Personnel Training. The development of specific job skills and TECHNIQUES required by the individual to become more productive.

Persuade. To advise, to move by argument, entreaty, or expostulation to a belief, position, or course of action

PERT. Program Evaluation and Review Technique. An event and probability based NETWORK analysis SYSTEM generally used in the research and development field where, at the planning stage, ACTIVITIES and their durations between EVENTS are difficult to define. Typically used on large PROGRAMS where the PROJECTS involve numerous organizations at widely different locations.

Phase. See PROJECT PHASE.

Plan. An intended future course of action.

Plan Development. Stage of planning during which the PLAN is initially created.

Planned Activity. An ACTIVITY which has not started or finished prior to the DATA DATE.

Planner Time. Man hours related to the planning function.

Planning (Phase). See DEVELOPMENT (PHASE).

Plug Date. A date externally assigned to an ACTIVITY that establishes the earliest or latest date on which the activity is allowed to start or finish.

PM. See PROJECT MANAGEMENT.

PMBOK. See PROJECT MANAGEMENT BODY OF KNOWLEDGE.

PMBOK Function Chart Structure: Each of the PMBOK management functions is depicted by a WORK BREAKDOWN STRUCTURE (WBS) Chart broken down as follows:

NOTE: Words in capitals within the descriptions indicate that this word is defined elsewhere in the Glossary.

WBS	Descriptor	Level
0	Discipline	i.e. the complete PROJECT MANAGEMENT MATRIX
1	Function	i.e. SCOPE, COST, time, etc.
	2	Process i.e. the specific series of ACTIVITIES which lead to an output that is the title in the process box, e.g. budgeting, scheduling, organization, quality in design, etc. In other words, the "what" in "what is project management."
3	Activity	i.e. the series of tasks which lead to the specific process output. In other words, the "how" in "how to get there."
4	Techniques	i.e. the specific tools available to aid or accomplish the activity.

PMBOK Matrix. See MATRIX.

PM Function. See FUNCTION

PMI. See PROJECT MANAGEMENT INSTITUTE.

Policy. Directives issued by management for guidance and direction where uniformity of action is essential. Directives pertain to the approach, TECHNIQUES, AUTHORITIES and RESPONSIBILITIES for carrying out the management function.

Policies/Procedures. See PROJECT POLICIES

Post Contract Evaluations. Objective review and analysis of the performance of both parties' performance, realistic technical problems encountered and the corrective actions taken.

Post Project Analysis and Report. A formal analysis and documentation of the PROJECT's results including COST, SCHEDULE and technical performance versus the original PLAN.

Post Project Evaluation. An appraisal of the COSTS and technical performance of a completed PROJECT and the development of new applications in PROJECT MANAGEMENT methods to overcome problems that occurred during the project life to benefit future projects.

Pre-Award Meetings. Meetings to aid ranking of prospective suppliers before final award determination and to examine their facilities or capabilities.

Precedence Diagram Method (PDM). A method of constructing a logic NETWORK using NODES to represent the ACTIVITIES and connecting them by lines that show dependencies.

Precedence Diagram Method Arrow. A graphical symbol in PDM networks used to represent the LAG describing the relationship between work ACTIVITIES.

Predecessor Activity. Any ACTIVITY that exists on a common path with the activity in question and occurs before the activity in question.

Prescribe. To direct specified action. To prescribe implies that action must be carried out in a specified fashion.

Priorities. The imposed sequences desired with respect to the SCHEDULING of ACTIVITIES within previously imposed CONSTRAINTS.

Problem/Need Statement/Goal. Documentation to define the problem; to document the need to find a solution; and to document the overall aim of the sponsor.

Problem Resolution. The interaction between the PROJECT MANAGER and an individual team member with the goal of finding a solution to a technical or personal problem that affects PROJECT accomplishment.

Procedure. A prescribed method of performing specified work.

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Process (Framework). The set of activities by means of which an output is achieved. (Communications Mgt.) A series of actions or operations conducing to an end; (esp. a continuous operation).

Procurement. See CONTRACT-PROCUREMENT MANAGEMENT

Procurement Addendum. A supplement to bidding documents issued prior to the receipt of BIDS, for the purpose of clarifying, correcting, or adding to the BID DOCUMENTS issued previously.

Procurement Advertising. Method of PROCUREMENT where a CONTRACT results from the solicitation of competitive BIDS through the media.

Procurement/Contract Negotiations. A PROCESS of communication, discussions, and agreement between the parties for supply of goods/services in support of the PROCUREMENT OBJECTIVES.

Procurement Cost Considerations. A reckoning of a supplier's approach, realism, and reasonableness of COST, forecast economic factors affecting cost and cost RISKS used in the cost proposal.

Procurement Environment. The combined internal and external forces, both individual and interacting with one another that assist or restrict the attainment of the objective. These could be business or project related or may be due to political, economic, technological or regulatory conditions. See also MACRO PROCUREMENT ENVIRONMENT, MICRO PROCUREMENT ENVIRONMENT.

Procurement Invitation. A method of PROCUREMENT where a CONTRACT results from the selected invitation of competitive BIDS.

Procurement Identification. The identification of the different categories of PROCUREMENT of which one or more may be required during PROJECT EXECUTION.

Procurement: Other Considerations. Includes an evaluation of staff and financial resources, facilities, performance record, responsiveness to CONTRACT terms and conditions and a general willing-ness to perform the work.

Procurement Performance Evaluation. A comprehensive review of the original specification, STATEMENT OF WORK, SCOPE and CONTRACT modifications, for the purpose of avoiding pitfalls in future procurements.

Procurement Pre-Qualifications. The experience, past performance, capabilities, resources and current work loads of the potential sources.

Procurement Qualifications. See QUALIFICATIONS, CONTRACTOR.

Procurement Ranking. Qualitative or quantitative determinations of prospective supplier's capabilities and qualifications in order to select one or more sources to provide proposed material/service.

Procurement Relationship with CWBS (Contract Work Breakdown Structure). The relationship of services or items to be procured with the overall work, and their interface with any other PROJECT ACTIVITIES.

Procurement Response. Communications, positive or negative from prospective suppliers in response to the request to supply material/ services.

Procurement: Sole Source. Only one source that could fulfill the requirements of the PROCUREMENT.

Procurement Source Evaluation. Overall review of capabilities and ranking of prospective suppliers either to request proposals or to enter into negotiations for the award of the CONTRACT.

Procurement: Sources Selection. The PROCESS of selecting organizations and for individuals whose RESOURCES, credibility and performance are expected to meet the CONTRACT/ PROCUREMENT OBJECTIVES.

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Procurement Strategy. The relationship of specific PROCUREMENT actions to the operating ENVIRONMENT of the PROJECT.

Procurement Supplier Valuation. Assessment of suppliers' qualifications in order to identify those from whom proposals/BIDS are to be requested or those who are to be invited to enter negotiations for the award of a CONTRACT.

Procurement Technical Considerations. Suppliers technical competency, understanding of the technical requirements and capability to produce technically acceptable material or services. Generally this evaluation ranks highest among all other evaluations.

Procurement/Tender Documents. The documents issued to prospective suppliers when inviting BIDS/quotations for supply of goods/services.

Product. See DELIVERABLE.

Productivity. The measurement of labor efficiency when compared to an established base. It is also used to measure equipment effectiveness, drawing productivity, etc.

Profitability. A measure of the total income of a PROJECT compared to the total monies expended at any period of time. The TECHNIQUES that are utilized are Payout Time, Return on Original Investment (ROI), Net Present Value (NPV), Discounted Cash Flow (DCF), Sensitivity and Risk Analysis.

Program. An endeavor of considerable SCOPE encompassing a number of PROJECTS.

Program Management. The management of a related series of PROJECTS executed over a broad period of time, and that are designed to accomplish broad goals, to which the individual projects contribute.

Progress. Development to a more advanced state. Progress relates to a progression of development and therefore shows relationships between current conditions and past conditions.

Progress Analysis (Time Mgt.). The evaluation of calculated progress against the approved SCHEDULE and the determination of its impact.

Progress Analysis (Cost Mgt.) The development of performance indices such as:

1. Cost Performance Index = $CPI = \frac{BCWP}{ACWP}$
2. Schedule Performance Index = $SPI = \frac{BCWP}{BCWS}$
3. Productivity

Progress Payments. Interim payment for delivered work in accordance with CONTRACT terms generally tied to meeting specified performance MILESTONES.

Progress Trend. An indication of whether the progress rate of an ACTIVITY or of a PROJECT is increasing, decreasing, or remaining the same (steady) over a period of time.

Project. Any undertaking with a defined starting point and defined OBJECTIVES by which completion is identified. In practice most PROJECTS depend on finite or limited RESOURCES by which the objectives are to be accomplished.

Project Accounting. The process of identifying, measuring, recording and communicating actual PROJECT COST data.

Project Archive Tape. A computer tape which contains the CONTRACT base PROJECT PLAN, the target project plan and every subsequent update of the project plan.

Project Brief. See PROJECT PLAN.

Project Budget. The amount and distribution of money allocated to a PROJECT.

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Project Change. An approved CHANGE to PROJECT work content caused by a SCOPE of work change or a special circumstance on the project (weather, strikes, etc.). See also PROJECT COST CHANGES.

Project Close-Out. A PROCESS that provides for acceptance of the PROJECT by the project sponsor, completion of various project records, final revision-and issue of documentation to reflect the "as-built" condition and the retention of essential project documentation. See PROJECT LIFE CYCLE.

Project Close-Out and Start-Up Costs. The estimated extra costs (both capital and operating) that are incurred during the period from the COMPLETION OF PROJECT IMPLEMENTATION to the beginning of normal revenue earnings on operations.

Project Cost. The actual COSTS of the entire PROJECT.

Project Cost Changes. The changes to a PROJECT and the initiating of the preparation of detail estimates to determine the impact on PROJECT COSTS and SCHEDULE. These changes must then be communicated clearly (both written and verbally) to all participants that approval/rejection of the project changes have been obtained (especially those that change the original project intent)

Project Cost Systems. The establishment of a PROJECT COST accounting SYSTEM of ledgers, asset records, liabilities, write offs, taxes, depreciation expense, raw materials, pre-paid expenses, salaries, etc.

Project Data Gaps. Identification of data gaps in available information in reference to a particular procurement.

Project Data Review. Review of qualification data to determine its adequacy.

Project Data Verification. Verification of qualification data to check its accuracy.

Project Duration. The elapsed time from PROJECT start date through to project finish date.

Project Environment. See ENVIRONMENT

Project Finish Date/Schedule. The latest SCHEDULE calendar finish date of all ACTIVITIES on the PROJECT derived from NETWORK or RESOURCE allocation PROCESS calculations.

Project Goods. Equipment and/or materials needed to implement a PROJECT.

Project Information Sources. Identification and listing of various available sources, internal as well as external, to provide relevant information on specific PROCUREMENTS.

Project Integration. The bringing together of diverse organizations, groups or parts to form a cohesive whole to successfully achieve PROJECT OBJECTIVES.

Project Investment Cost. The activity of establishing and assembling all the COST elements (capital and operating) of a PROJECT as defined by an agreed SCOPE of work. The ESTIMATE attempts to predict the final financial outcome of a future investment program even though all the parameters of the project are not yet fully defined.

Project Life Cycle. The four sequential phases in time through which any PROJECT passes, name]y: CONCEPT, DEVELOPMENT, EXECUTION (IMPLEMENTATION) and FINISHING (TERMINATION or CLOSE OUT). Note that these PHASES may be further broken down into STAGES depending on the area of project application.

Project Management (PM). The art of directing and coordinating human and material RESOURCES throughout the life of a PROJECT by using modern management TECHNIQUES to achieve predetermined OBJECTIVES of SCOPE, QUALITY, TIME, and COST, and participant satisfaction.

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Project Management Body of Knowledge (PMBOK). All those topics, subject areas and intellectual processes that are involved in the application of sound management principles to the collective execution of any type of EFFORT that qualifies as a PROJECT.

Project Management Framework. The name given by PMI to an area of concentration that provides the opportunity to document the broader issues of project management, and the inter-relationship with the eight major PM FUNCTIONS of: SCOPE; QUALITY; TIME; COST; RISK; HUMAN RESOURCES; CONTRACT-PROCUREMENT (including materials and equipment); and COMMUNICATIONS. Thus, PMI espouses and recommends a total of nine areas of concentration for educational purposes.

Project Management Information System. The gathering, recording, filtering and dissemination of pertinent information for members of a project team.

Project Management Institute (PMI). A non-profit organization dedicated to advancing the state-of-the-art in the profession of PROJECT MANAGEMENT.

Project Manager. The individual appointed with responsibility for PROJECT MANAGEMENT of the PROJECT.

Project Manual. See PROJECT POLICIES/PROCEDURES.

Project Objectives. PROJECT SCOPE expressed in terms of outputs, required RESOURCES and timing.

Project Organization. The orderly structuring of PROJECT participants.

Project Personnel. Those members of a PROJECT TEAM employed directly by the organization responsible for a PROJECT.

Project Phase. The division of a PROJECT time frame (or PROJECT LIFE CYCLE) into the largest logical collection of related ACTIVITIES.

Project Plan. A management summary document that gives the essentials of a PROJECT in terms of its objectives, justification, and how the objectives are to be achieved. It should describe how all the major ACTIVITIES under each PROJECT MANAGEMENT function are to be accomplished, including that of overall project CONTROL. The Project PLAN will evolve through successive stages of the project life cycle. Prior to project IMPLEMENTATION, for example, it may be referred to as a PROJECT BRIEF. See also BASELINE and BASELINE CONCEPT.

Project Planning. The identification of the PROJECT OBJECTIVES and the ordered ACTIVITY necessary to complete the project. The identification of RESOURCE types and quantities required to carry out each ACTIVITY or TASK.

Project Policies. General guidelines/formalized methodologies on how a PROJECT will be managed.

Project Pre-Selection Meetings. Meetings held to supplement and/or verify qualifications, data and specifications.

Project Procedures. The methods, practices and policies (both written and verbal communications) that will be used during the PROJECT life.

Project Procurement Strategy. The relationship of specific PROCUREMENT actions to the operating ENVIRONMENT of the PROJECT.

Project Reporting. A planning ACTIVITY involved with the development and issuance of (internal) TIME MANAGEMENT analysis reports and (external) PROGRESS reports.

Project Risk. The cumulative effect of the chances of uncertain occurrences that will adversely affect PROJECT OBJECTIVES. It is the degree of exposure to negative EVENTS and their probable consequences. Project Risk is characterized by three FACTORS: RISK, EVENT, RISK PROBABILITY and the AMOUNT AT STAKE.

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Project Risk Analysis. Analysis of the consequences and probabilities that certain undesirable EVENTS will occur and their impact on attaining the CONTRACT/PROCUREMENT OBJECTIVES.

Project Risk Characterization. Identifying the potential external or internal RISKS associated with PROCUREMENT actions using estimates of probability of occurrence.

Project Segments. PROJECT subdivisions expressed as manageable components.

Project Services. Expertise and/or labor needed to implement a PROJECT but not available directly from the PROJECT MANAGER's organization.

Project Stage. A sub-set of a PROJECT PHASE.

Project Start Date/Schedule. The earliest calendar start date among all ACTIVITIES in the NETWORK.

Project Team (Framework). The central management group . . . of the PROJECT.

Project Team (Human Resources Mgt.). The group of people, considered as a group, that shares responsibility for the accomplishment of project goals and who report to the project manager either part-time or full-time.

Proposal Project Plan. Usually the first PLAN issued on a PROJECT and accompanies the proposal. It contains key analysis, PROCUREMENT, and IMPLEMENTATION MILESTONES; historical data; and any client-supplied information. Usually presented in BAR CHART form or summary level NETWORK, and used for inquiry and CONTRACT negotiations.

Prospectus. The assembly of the evaluation profitability studies and all the pertinent technical data in an overall report for presentation and acceptance by the owner and funders of a PROJECT.

Public Speaking. The art and science of effective oral communication with an audience.

Public, The (Project External). All those that are not directly involved in the PROJECT but who have an interest in its outcome. This could include for example, environmental protection groups, EQUAL EMPLOYMENT OPPORTUNITY groups, and others with a real or imagined interest in the project or the way it is managed.

Public, The (Project Internal). All personnel working directly or indirectly on the PROJECT.

Public Relations. An activity designed to improve the ENVIRONMENT in which an organization operates in order to improve the performance of that organization.

Punch List. A list made near to the completion of a PROJECT showing the items of work remaining in order to complete the project SCOPE. Some times referred to as a deficiency list.

Purchase. Out-right acquisition of items, mostly off-the-shelf or catalog, manufactured outside the purchaser's premises.

Q

Qualifications: Contractor. A review of the experience, past performance, capabilities, resources and current workloads of potential service RESOURCES. See also QUALITY MANAGEMENT.

Quality. The composite of all attributes or characteristics, including performance, of an item or product required to satisfy stated or implied needs. Conformance to requirements.

Quality Assurance (Contract/Procurement Mgt.). Planned and systematic actions necessary to provide adequate confidence that the performed service or supplied goods will serve satisfactorily for its intended and specified purpose. (Managerial). The development of a comprehensive program that includes the processes of

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identifying OBJECTIVES and STRATEGY, of client interfacing and of organizing and coordinating planned and systematic CONTROLS for maintaining established standards. This in turn involves measuring and evaluating performance to these standards, reporting results and taking appropriate action to deal with deviations.

Quality Control (Technical). The planned PROCESS of identifying established SYSTEM requirements and exercising influence through the collection of specific (usually highly technical and itself standardized) data. The basis for decision on any necessary CORRECTIVE ACTION is provided by ANALYZING the data and reporting it comparatively to SYSTEM STANDARDS.

Quality Evaluation Methods. The technical PROCESS of gathering measured variables or counted data for decision making in QUALITY PROCESS REVIEW. Normally these evaluation methods should operate in a holistic context involving proven statistical analysis, referred to previously as "statistical process control". A few example methods are: GRAPHS and CHARTS; PARETO DIAGRAMS; and EXCEPTION REPORTING.

Quality Management. QUALITY itself is the composite of material attributes (including performance features and characteristics) of the product, process or service that are required to satisfy the need for which the PROJECT is launched. Quality policies, plans, procedures, specifications and requirements are attained through the sub-functions of QUALITY ASSURANCE (Managerial) and QUALITY CONTROL (Technical).

Quality Process Review. The technical PROCESS of using data to decide how the actual PROJECT results compare with the quality specifications/requirements. If deviations occur, this analysis may cause changes in the PROJECT design, development, use, etc., depending on the decisions of the client, involved shareholders and the PROJECT TEAM.

R

Real Time. The application of external time constraints that might affect the calendar time position of execution of each ACTIVITY in the SCHEDULE.

Receiving. To assimilate through the mind or senses (as in new ideas).

Recommend. To offer or suggest for use. Recommendation describes the presentation of plans, ideas, or things to others for adoption. To recommend is to offer something with the option of refusal.

Record Retention. The necessity to retain records for reference for a specified period after CONTRACT CLOSE-OUT, in case they are needed.

Records Management. The procedures established by an organization to manage all documentation required for the effective development and application of its work force.

Recovery Schedule. A special SCHEDULE showing special efforts to recover time lost compared to the MASTER SCHEDULE.

Recruitment, Selection and Job Placement. The attraction of a pool of potential employees, determining which of those employees is best suited for work on the PROJECT, and matching that employee to the most appropriate TASK based on his or her SKILLS and abilities.

Refinement. The rework, redefinition or modification of the logic or data that may have previously been developed in the PLANNING PROCESS as required to properly input MILESTONES, RESTRAINTS and PRIORITIES.

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Regulatory Personnel. Those individuals working for government regulatory AGENCIES whose TASK it is to assure compliance with their particular AGENCY's requirements.

Release Claims. Certificate to release and hold harmless from future claims by the CONTRACTOR.

Remaining Available Resource. The difference between the RESOURCE AVAILABILITY POOL and the LEVEL SCHEDULE resource requirements. Computed from the RESOURCE ALLOCATION PROCESS.

Remaining Duration. The estimated work units needed to complete an activity as of the DATA DATE.

Remaining Float (RF). The difference between the EARLY FINISH and the LATE FINISH DATE.

Reporting. Planning ACTIVITY involved with the development and issuance of (internal) time management analysis reports and (external) progress reports.

Request for Proposal. A formal invitation containing a SCOPE OF WORK which seeks a formal response (proposal) describing both methodology and compensation to form the basis of a CONTRACT.

Request for Quotation. A formal invitation to submit a price for goods and/or services as specified.

Reschedule. The PROCESS of changing the logic, duration, and/or dates of an existing SCHEDULE in response to external imposed conditions.

Resource. Any factors, except time, required or consumed to accomplish an ACTIVITY. Any substantive requirement of an activity that can be quantified and defined, e.g. manpower, equipment, material, etc.

Resource Allocation Process. The scheduling of activities in a NETWORK with the knowledge of certain resource constraints and requirements. This PROCESS adjusts activity level start and finish dates to conform to resource availability and use.

Resource Availability Date. The calendar date when a RESOURCE pool becomes available for a given resource.

Resource Availability Pool. The amount of RESOURCE availability for any given allocation period.

Resource Code. The code used to identify a given RESOURCE type.

Resource Description. The actual name or identification associated with a RESOURCE CODE.

Resource Identification. Identification of potential sources that could provide the specified material or services. These sources could be identified either from the firm/PROJECT list of vendors or by advertising the need of PROCUREMENT.

Resource-Limited Planning. The planning of ACTIVITIES so that predetermined **RESOURCE availability pools are not exceeded.** Activities are started as soon as resources are available (subject to logic CONSTRAINTS), as required by the activity.

Resource Plots. A display of the amount of RESOURCES required as a function of time on a graph. Individual, summary, incremental, and cumulative resource curve levels can be shown.

Response Planning. The process of formulating suitable RISK MANAGEMENT strategies for the project, including the allocation of RESPONSIBILITY to the project's various functional areas. It may involve MITIGATION, deflection and CONTINGENCY PLANNING. It should also make some allowance, however tentative, for the completely unforeseen occurrence.

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Response System. The on-going process put in place during the life of the project to monitor, review, and update PROJECT RISK and make the necessary adjustments. Examination of the various risks will show that some risks are greater in some stages of the project life cycle than in others.

Responsibility. Charged personally with the duties, assignments, and ACCOUNTABILITY for results associated with a designated position in the organization. Responsibility can be delegated but cannot be shared.

Responsibility Charting. The ACTIVITY of clearly identifying personnel and staff RESPONSIBILITIES for each TASK within the PROJECT.

Restraint. An externally imposed factor affecting when an ACTIVITY can be SCHEDULED. The external factor may be labor, cost, equipment, or other such RESOURCE.

Review. To examine critically to determine suitability or accuracy.

RF. See REMAINING FLOAT.

Risk Assessment. REVIEW, examination and judgment whether or not the identified RISKS are acceptable in the proposed actions.

Risk Data Applications. The development of a database of RISK FACTORS both for the current PROJECT and as a matter of historic record.

Risk Deflection. The act of transferring all or part of a RISK to another party, usually by some form of CONTRACT.

Risk Event. The precise description of what might happen to the detriment of the PROJECT.

Risk Factor. Any one of RISK EVENT, RISK PROBABILITY or AMOUNT AT STAKE, as defined above.

Risk Identification. The PROCESS of systematically identifying all possible RISK EVENTS that may impact on a PROJECT. They may be conveniently classified according to their cause or source and ranked roughly according to ability to manage effective responses. Not all risk events will impact all projects, but the cumulative effect of several risk events occurring in conjunction with each other may well be more severe than the examination of the individual risk events would suggest.

Risk Management. The art and science of identifying, analyzing and responding to RISK FACTORS throughout the life of a PROJECT and in the best interests of its OBJECTIVES.

Risk Mitigation. The act of revising the PROJECT's SCOPE, BUDGET, SCHEDULE or QUALITY, preferably without material impact on the project's OBJECTIVES, in order to reduce UNCERTAINTY on the project.

Risk Probability. The degree to which the RISK EVENT is likely to occur.

Risk Response Planning. The process of formulating suitable RISK MANAGEMENT strategies for the PROJECT, including the allocation of responsibility to the project's various functional areas. It may involve RISK MITIGATION, RISK DEFLECTION and CONTINGENCY PLANNING. It should also make some allowance, however tentative, for the completely unforeseen occurrence.

Risk Response System. The on-going PROCESS put in place during the life of the PROJECT to monitor, review and update PROJECT RISK and make the necessary adjustments. Examination of the various RISKS will show that some risks are greater in some stages of the PROJECT LIFE CYCLE than in others.

S

S Curves. Graphical display of the accumulated COSTS, labor hours or quantities, plotted against time for both BUDGETED and actual amounts.

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Salary Administration. The formal SYSTEM by which an organization manages its financial commitments to its employees. It includes man-hour accounting and the development of a logical structure for compensation.

Schedule. A display of PROJECT time allocation.

Schedule: Pictorial Display. A display in the form of a still picture, slide or video, that represents scheduling information.

Schedule Refinement. The rework, redefinition or modification of the LOGIC or data that may have previously been developed in the PLANNING PROCESS as required to properly input MILESTONES, RESTRAINTS and PRIORITIES.

Schedule Status. See SCOPE REPORTING.

Schedule Revision. In the context of SCHEDULING, a change in the NETWORK LOGIC or in Schedule Update Revision of the SCHEDULE to reflect the most current information on the PROJECT.

Schedule Variance. Any difference between the projected duration for an ACTIVITY and the actual duration of the activity. Also the difference between projected start and finish dates and actual or revised start and finish dates.

Schedule Work Unit. A calendar time unit when work may be performed on an ACTIVITY.

Scheduling. The recognition of realistic time and resource RESTRAINTS that will, in some way, influence the execution of the PLAN.

Scope. The work content and products of a PROJECT or component of a project. Scope is fully described by naming all ACTIVITIES performed, the RESOURCES consumed and the end products that result, including QUALITY standards. A statement of scope should be introduced by a brief background to the project, or component, and the general OBJECTIVE(S).

Scope Baseline. Summary description of the PROJECT or component's original content and end product including basic BUDGETARY and time CONSTRAINT data.

Scope Baseline Approval. Approval of the SCOPE BASELINE by the appropriate authority (PROJECT sponsors and senior PROJECT MANAGEMENT staff).

Scope Change. A deviation from the originally agreed project SCOPE.

Scope Constraints. Applicable restrictions that will affect the SCOPE.

Scope Cost. Basic BUDGETARY CONSTRAINTS.

Scope Criteria. Standards or rules composed of parameters to be considered in defining the PROJECT.

Scope Interfaces. Points of interaction between the project or its components and its/their respective ENVIRONMENTS.

Scope Management. The function of controlling a PROJECT in terms of its goals and OBJECTIVES through the PROCESSES of conceptual development, full definition or scope statement, execution and termination.

Scope of Work. A narrative description of the work to be accomplished or RESOURCE to be supplied.

Scope Performance/Quality. Basic OBJECTIVE of the PROJECT. Defines the characteristics of the project's end product as required by the sponsor.

Scope Reporting. A process of periodically documenting the STATUS of basic PROJECT parameters during the course of a project. The three areas of scope reporting are:

- Cost Status: as affecting financial status.
- Schedule Status: as affecting time constraint status.
- Technical Performance Status: as affecting quality.

Scope Schedule. Basic time CONSTRAINTS.

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Scope Statement. A documented description of the PROJECT as to its output, approach and content.

Screening. TECHNIQUES used for reviewing, analyzing, ranking and selecting the best alternative for the proposed action.

Secondary Float (SF). The difference between the CPM calculated early finish and the imposed finish date.

Semantics. The language used to achieve a desired effect on an audience.

Service and Support Personnel. Those individuals working in functions such as personnel, accounting, maintenance, and legislative relations that are needed to keep the "primary functions" operating effectively.

SF. See SECONDARY FLOAT.

Short Term Plan. A short duration SCHEDULE, usually 4 to 8 weeks, used to show in detail the ACTIVITIES and RESPONSIBILITIES for a particular period. A management TECHNIQUE often used "as needed" or in a critical area of the PROJECT.

Short Term Schedule. See SHORT TERM PLAN

Skill. An ability and competence learned by practice.

Specification (Time Mgt.). An information vehicle that provides a precise description of a specific physical item, procedure, or result for the purpose of purchase and/or implementation of the item or service.

Specification (Contract/Procurement Mgt.) Written, pictorial or graphic information that describes, defines or specifies the services or items to be procured.

Specification Control. A SYSTEM for assuring that PROJECT specifications are prepared in a uniform fashion and only changed with proper AUTHORIZATION.

Speed Reading. A method of reading rapidly by skimming.

Stabilization. The period of time between continuous operation and normal operation. This period encompasses those ACTIVITIES necessary to establish reliable operation at design conditions of capacity, product quality, and efficiency.

Staff Personnel. Those individuals working in departments that are not directly involved in the organization's mainstream ACTIVITY, but rather perform advising, counseling, and assisting duties for the line/functional departments.

Stage. See PROJECT STAGE.

Standard. A basis for the uniformity of measuring performance. Also, a document that prescribes a specific consensus solution to a repetitive design, operating, or maintenance problem. Standard Procedure. Prescribes that a certain kind of work be done in the same way wherever it is performed.

Standard Proposal Schedule. A pre-established NETWORK on file.

Start-up. That period after the date of initial operation, during which the unit is brought up to acceptable production capacity and quality. Start-up is the ACTIVITY that is often confused (used interchangeably) with date of initial operation.

Statistics. The mathematical methods used to determine the best range of probable values for a project and to assess the degree of accuracy or allowance for unpredictable future EVENTS such as accidents, technological innovations, strikes, etc. that can occur during the PROJECT life. The TECHNIQUES that can be used are RISK ANALYSIS with Monte Carlo simulation, confidence levels, range analysis, etc.

Status. The condition of the PROJECT at a specified point in time.

Status System. System for tracking STATUS at lowest level of detail.

Statusing. Indicating most current PROJECT STATUS.

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Strategic Plan. The target PLAN prioritized by critical TOTAL FLOAT from the current SCHEDULE.

Strategy. A framework guiding those choices that determine the nature and direction to attain the OBJECTIVE.

Stop Work Order. Request for interim stoppage of work due to non-conformance, or funding or technical limitations.

Study. The methodical examination and/or analysis of a question or problem.

Subnet. The subdivision of a NETWORK into fragments, usually representing some form of subproject.

Substantial Completion. The point in time when the work is ready for use or is being used for the purpose intended and is so certified, with outstanding items identified for 100% completion.

Successor Activity. Any ACTIVITY that exists on a common path with the activity in question and occurs after the activity in question.

Summary Schedule. A single page, usually time-scaled, PROJECT SCHEDULE. Typically included in management level progress reports. Also known as MILESTONE SCHEDULE.

Summative Quality Evaluation. The PROCESS of determining what lessons have been learned after the PROJECT is completed. The OBJECTIVE is to document which behaviors helped determine, maintain or increase QUALITY standards and which did not (for use in future projects).

Supplementary Agreement. CONTRACT modification that is accomplished by the mutual action of parties.

Supplementary Conditions. Modifications, deletions and additions to standard GENERAL CONDITIONS developed for particular goods/services.

Supplementary Information. Identification and collection of additional information from supplementary sources and its review and analysis.

Supplier Default. Failure on the part of a supplier to meet technical or delivery requirements of the CONTRACT.

Supplier Expediting. Actions taken to ensure that the goods/services are supplied in accordance with the SCHEDULE documented in the CONTRACT.

Supplier Ranking. Qualitative and/or quantitative determinations of prospective suppliers' qualifications relative to the provision of the proposed goods/services.

System. A methodical assembly of actions or things forming a logical and connected scheme or unit.

T

Tactile. Of or relating to the sense of touch; perceptible by touch.

Take-Off. A term used for identifying and recording from drawings the material and quantities required for ESTIMATING the time and COST for the completion of an ACTIVITY.

Target Date. The date an ACTIVITY is desired to be started or completed; accepted as the date generated by the initial CPM schedule operation and resource allocation process.

Target Plan. The target PLAN prioritized by critical TOTAL FLOAT from the current SCHEDULE.

Target Reporting. A method of reporting the current SCHEDULE against some established base line schedule and the computation of variances between them.

Task Types. Characterization of TASKS by RESOURCE requirement, responsibility, discipline, jurisdiction, function, etc.

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Team Building. The process of influencing a group of diverse individuals, each with their own goals, needs, and perspectives, to work together effectively for the good of the project such that their team will accomplish more than the sum of their individual efforts could otherwise achieve.

Team Decision Making. The PROCESS by which the PROJECT MANAGER and his team determine feasible alternatives in the face of a technical, psychological, or political problem, and make a conscious selection of a course of action from among these available alternatives.

Team Members. The individuals reporting either part-time or full-time to the PROJECT MANAGER who are responsible for some aspect of the PROJECT's ACTIVITIES.

Team Motivation. The PROCESS by which the PROJECT MANAGER influences his PROJECT TEAM to initiate EFFORT on the PROJECT TASKS, expend increasing amounts of effort on those tasks, and to persist in expending effort on these tasks over the period of time necessary for project goal accomplishment.

Team Reward System. The PROCESS by which the PROJECT TEAM receives recognition for their accomplishments.

Technical Performance Status. See SCOPE REPORTING.

Technical Quality Administration. The technical PROCESS of establishing the PLAN for MONITORING and CONTROLLING the PROJECT's satisfactory completion. This plan also includes POLICIES and PROCEDURES to prevent or correct deviations from quality specifications/requirements.

Technical Quality Specifications. The PROCESS of establishing the specific PROJECT requirements, including execution criteria and technologies, project design, measurement SPECIFICATIONS, and material PROCUREMENT and CONTROL that satisfy the expectations of the client, shareholders and PROJECT TEAM.

Technical Quality Support. The PROCESS of providing Technical training and expertise from one or more support group(s) to a PROJECT in a timely manner. Effects of these groups could generate considerations for future client needs or warranty services.

Technical Specifications. Documentation that describes, defines or specifies the goods/services to be supplied. See also SPECIFICATIONS.

Technique. Skilled means to an end.

Tender Document. See PROCUREMENT TENDER DOCUMENT.

Termination (phase). The fourth and final PHASE in the generic PROJECT LIFE CYCLE. Also known as Final or CLOSE-OUT PHASE.

TF. See TOTAL FLOAT.

Tied Activity. An ACTIVITY that must start within a specified time or immediately after its predecessor's completion.

TIME. See TIME MANAGEMENT.

Time Delay Claim. A request for an extension to the CONTRACT DATES.

Time Estimate Unit. See CALENDAR UNIT.

Time-Limited Scheduling. The SCHEDULING of ACTIVITIES so predetermined RESOURCE AVAILABILITY POOLS are not exceeded unless the further delay will cause the PROJECT FINISH to be delayed. Activities can be delayed only until their LATE START DATE. However, activities will begin when the late start date is reached, even if resource limits are exceeded. NETWORKS with negative TOTAL FLOAT TIME should not be processed by time-limited scheduling.

Time Management. The function required to maintain appropriate allocation of time to the overall conduct of the PROJECT through the successive stages of its natural life-cycle, (i.e., CONCEPT, DEVELOPMENT, EXECUTION, and TERMINATION) by means of the processes of time planning, time estimating, time scheduling, and schedule control.

Time Now (Line). See STATUS LINE.

Time Periods. Comparing calculated time versus specified time in relation to CONSTRAINTS and time span objectives.

Top Down Estimating. See PARAMETRIC COST ESTIMATING.

Top Management. From the view of the PROJECT MANAGER, Top Management includes the individual to whom he or she reports on PROJECT matters and other managers senior to that individual.

Total Float (TF). The amount of time (in work units) that an activity may be delayed from its EARLY START without delaying the project FINISH DATE. Total float is equal to the LATE FINISH or the LATE START minus the early START of the activity.

Transmit. To send or convey from one person or place to another.

Trend Analyses. Mathematical methods for establishing trends based on past project history allowing for adjustment, refinement or revision to predict COST. Regression analysis techniques can be used for predicting cost/schedule trends using data from historical PROJECTS.

Trend Monitoring. A SYSTEM for tracking the estimated COST/SCHEDULE/RESOURCES of the PROJECT vs. those planned.

Trend Reports. Indicators of variations of PROJECT CONTROL parameters against planned OBJECTIVES.

Trending. The REVIEW of proposed changes in RESOURCES allocation and the FORECASTING of their impact on BUDGET. To be effective, trending should be regularly performed and the impacts on budget plotted graphically. Used in this manner, trending supports a decision to AUTHORIZE a CHANGE.

U

Uncertainty. Lack of knowledge of future EVENTS. See also PROJECT RISK.

Understand. To have thorough or technical acquaintance with expertise in the practice of project management.

Unit Price (UP) Contract. A fixed price CONTRACT where the supplier agrees to furnish goods/ services at unit rates and the final price is dependent on the quantities needed to carry out the work.

UPC. See UNIT PRICE CONTRACT.

Update. To revise the SCHEDULE to reflect the most current information on the PROJECT.

V

Value Analysis. An ACTIVITY devoted to optimizing cost performance. It is the systematic use of TECHNIQUES that identify the required functions of an item, establish values for those functions and provide the functions at the lowest overall COST without loss of performance (optimum overall cost).

Variance. Any actual or potential deviation from an intended or budgeted figure or plan. A variance can be a difference between intended and actual time. Any difference between the projected duration for an ACTIVITY and the actual duration of the activity. Also, the difference between projected start and finish dates and actual or revised start and finish dates.

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Variance Analysis. The analysis of the following:

1. Cost Variance = $BCWP - ACWP$
2. % Over/Under = $\frac{ACWP - BCWP}{BCWP} \times 100$
3. Unit Variance Analysis:
 - Labor Rate
 - Labor Hours/Units of Work Accomplished
 - Material Rate
 - Material Usage
4. Schedule/Performance = $BCWP - BCWS$

Variance Reports. Documentation of PROJECT performance about a planned or measured per-formance parameter.

Verbal Bid. Undocumented quotation by telephone or other verbal means of communication.

Verification. The confirmation of data, application of judgment and comparison with other sources and previous monitor results.

W

WBS. See WORK BREAKDOWN STRUCTURE.

Work Acceptance. Work is considered accepted when it is conducted, documented and verified as per acceptance criteria provided in the TECHNICAL SPECIFICATIONS and CONTRACT documents.

Work Authorization. Process of sanctioning all PROJECT work.

Work Authorization/Release. In cases where work is to be performed in segments due to technical or funding limitations, work authorization/release AUTHORIZES specified work to be performed during a specified period.

Work Breakdown Structure (WBS). A TASK-oriented "family tree" of ACTIVITIES that organizes, defines and graphically displays the total work to be accomplished in order to achieve the final OBJECTIVES of a PROJECT or MAJOR COMPONENT there of. Each descending level represents an increasingly detailed definition of the projected objective. It is a SYSTEM for subdividing a project into manageable WORK PACKAGES, components or elements to provide a common framework for SCOPE/COST/SCHEDULE COMMUNICATIONS, allocation of RESPONSIBILITY, MONITORING and management.

Work Packages/Control Point. WBS elements of the PROJECT isolated for assignment to "work centers" for accomplishment. Production control is established at this element level.

Work Plan. "Designer's" schedule PLAN, BUDGET and MONITORING SYSTEM utilized during the design STAGE.

Work Unit. A calendar time unit when work may be performed on an ACTIVITY.

Working Calendar. The total calendar dates that cover all PROJECT ACTIVITIES, from start to finish.

Workload. A REVIEW of planned work demand on RESOURCES over time spans versus acceptable limits and their availability.

Written. To express in literary form.