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MANAGEMENT OF URBAN CONSTRUCTION PROGRAMS
Volume I: Guidelines for Developing a Project Management Plan

National Research Council
Commission on Sociotechnical Systems
Building Research Advisory Board
Committee on Management of Urban
Construction Programs
2101 Constitution Avenue, N.W.
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FINAL REPORT

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URBAN MASS TRANSPORTATION ADMINISTRATION
Office of Technology Development and Deployment
Office of Rail and Construction Technology
Washington DC 20590

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16. Abstract

This report of the BRAB Committee on Management of Urban Construction Programs is intended to guide local authorities (such as transportation, water, and sanitary agencies) in developing management plans for executing urban construction projects. BRAB developed the report setting forth the committee's guidance concerning:

a. Developing project management for planning and executing urban construction projects;
b. Assigning responsibility, authority and control in the decision-making process;
c. Developing the communication mechanisms and documentation required for implementation of management and construction; and
d. Identifying procedures for initiating and developing management plans for urban construction projects.

Using information gathered and the knowledge and expertise of its members, the committee prepared a two volume report. In Volume I, the committee sets forth its conclusions and recommendations regarding the purpose of a management plan, the major elements of a management plan, possible alternatives for essential elements, and guidelines for selecting among the alternatives for each element. The Committee made a particular effort to present the guidance in Volume I as concisely as possible without giving detailed procedures of standards for executing a plan.

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PREFACE

This report was prepared by the Building Research Advisory Board (BRAB) Committee on Management of Urban Construction Programs under Contract No. DOT-TSC-1728 managed by the Transportation Systems Center (TSC), Cambridge, Massachusetts. The contract is part of a program sponsored by the Office of Rail and Construction Technology, Office of Technology Development and Deployment, Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation.

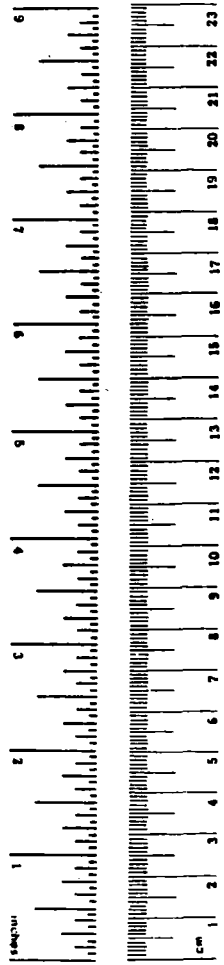
The overall objective of this contract is to develop guidelines that can be used by local governmental authorities in developing sound management plans for the execution of federally funded urban construction projects. The report presents the guidelines from the perspective of the project manager since this position carries the responsibilities for design and construction of a project and, possibly, for activation and operation of a facility or system.

The guidance and suggestions of Mr. Paul Witkiewicz of the Transportation Systems Center, technical monitor, and of Mr. Gilbert Butler of the Urban Mass Transportation Administration, program manager during the study effort, were greatly appreciated.

METRIC CONVERSION FACTORS

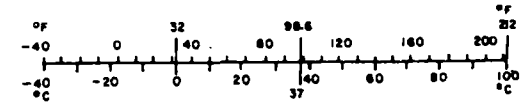
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.036	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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FOREWORD

The management of large-scale public works projects is an increasingly important issue. The major investment of public funds in such projects requires a comprehensive management plan that covers all aspects of a project from initial conception, through the political, financial, design and construction stages, and into actual operation. It is, however, particularly difficult for local governments to assemble the management and engineering capability needed to handle such projects. The work of the BRAB Committee on Management of Urban Construction Programs is specifically oriented toward providing these local entities with a guide that will help them carry out this important and complex function.

Joseph H. Zettel, Chairman
Building Research Advisory Board

TABLE OF CONTENTS

I
INTRODUCTION

The increasingly critical situation arising from failure to deal effectively with inherent risks in construction prompted the Building Research Advisory Board (BRAB), with the support of the U.S. Department of Transportation, to conduct an exploratory study of responsibility, liability, and accountability for risks in construction. Of principal concern, particularly on large-scale public works projects, were rapidly escalating costs and delays in providing or actual denial of vital public services. A series of workshops, one of which was devoted to urban and suburban mass transit construction, and a conference were held to identify problems and potential solutions.

The BRAB Committee responsible for this exploratory study identified the administration and management of the construction process as an area in which major problems arise concerning responsibility, liability, and accountability for risks. In its final report (Exploratory Study on Responsibility, Liability, and Accountability for Risks in Construction, 1978), the Committee concluded:

> Delays that cannot be known or predicted adequately result in the greatest losses to all parties to the construction process but most particularly to the owner and the general public. Even predictable delays have a serious impact on the sequencing and efficiency of project execution.
>
> A lack of understanding of authority and responsibility and a lack of coordination and communication generally exist among the parties to the construction process. These differences together with an adversarial relationship that often exists among the parties cause ambiguity or inequity in allocation of liability and increase the likelihood of costs in disputes. Delay and losses due to cost escalation and reduced productivity and beneficial use of a facility also may result.

The Committee recommended that:

> Decision-making roles at all levels in the construction process should be identified and defined and the requisite responsibility

and authority should be assigned in order to improve the badly disjointed decision-making process that now exists. . . . Mechanisms that will provide better communication and development of the team approach among all parties to the process should be explored in order to further minimize escalating adversary relationships.

The increasing size and complexity of many public service projects and the involvement of federal, state, and local governmental grant and regulatory agencies complicate management of the delivery process. Recently developed methods of designing and constructing major urban construction projects and the actions of governmental and nongovernmental public groups have further complicated the process.

Sound management practices, communicated to all participants in the construction process, are essential if the concurrent activities in the process are to be controlled, performance is to be evaluated and measured, and corresponding benefits in time and cost are to be achieved. However, every major construction project is unique, occurring in a specific locale with specific people participating in the process, and no one management plan can be used by all agencies or in all situations. Nevertheless, the primary elements necessary to sound management plans can be identified.

Stimulated by the conclusions and recommendations reached in the BRAB exploratory study, the U.S. Department of Transportation's, Urban Mass Transportation Administration requested that BRAB undertake a study of management of urban construction programs to develop guidance that could be used by local governmental authorities in developing sound management plans for the execution of federally funded urban construction projects. The results of this study are the subject of this report.

A. PURPOSE AND SCOPE OF REPORT

This report of the BRAB Committee on Management of Urban Construction Programs is intended to guide local authorities (such as transportation, water, and sanitary agencies) in developing management plans for executing urban construction projects.

The guidance presented has been developed from the perspective of the "project manager." Because of the unique aspects of every major construction project, it is not possible to define exactly the function and full responsibility and authority vested in the project manager position; however, it is assumed that the position carries responsibility for design and construction of a project and, possibly, for activation and operation of a facility or system. The conceptual planning phase of a project, during which needs, conceptual contentions, social and environmental impacts and local political acceptance are evaluated, is not covered in detail since the results of this phase are taken as givens for the project management plan.

B. CONDUCT OF THE STUDY

The BRAB Committee on Management of Urban Construction Programs was charged with developing a report setting forth the Committee's guidance concerning:

a. Developing project management for planning and executing urban construction projects;

b. Assigning responsibility, authority, and control in the decision-making process;

c. Developing the communication mechanisms and documentation required for implementation of management of construction; and

d. Identifying procedures for initiating and developing management plans for urban construction projects.

The Committee conducted an informal survey to review management guidelines and procedures for executing construction projects that have been developed by both public and private organizations. Included in this survey were 17 local transportation authorities that were asked whether they had a formal management plan for executing urban construction projects. If they did, they were asked to submit a copy and explain when it was instituted and how staff members and other project participants were familiarized with it. If they did not have a formal plan, they were asked to submit copies of memos, reports, or other documents used to execute construction projects. In addition, they were asked to submit an organization chart, if available, that would show the organizational structure and staffing of the authority, how construction activity related to the overall structure, and how responsibility and authority were delegated among the various personnel.

Using the information gathered and the knowledge and expertise of its members, the Committee prepared this two-volume report. In chapters II and III of this document, Volume 1, the Committee sets forth its conclusions and recommendations regarding the purpose of a management plan, the major elements of a management plan, possible alternatives for essential elements, and guidelines for selecting among the alternatives for each element. The Committee has made a particular effort to present the guidance in Volume 1 as concisely as possible without giving detailed procedures or standards for executing a plan. The results of the Committee's survey of local transportation authorities are presented in an appendix. Volume 2 of the report presents supplemental information compiled by the Committee from material it reviewed and developed during the course of its study. It includes information on conceptual planning and examples of techniques and procedures that have been used that the Committee felt might be helpful to project managers in understanding the management process and in developing and executing project management plans. The information presented is not intended to be all-inclusive and is offered without recommendation of any specific approach.

II
PURPOSE OF A PROJECT MANAGEMENT PLAN

The planning of an urban construction project requires an extensive conceptual planning phase that includes studies of needs, demographics, economics, social and environmental impacts, financing, and public and political support. These studies should result in a general description of the project and the budget and schedule for its completion. Only if they are realistically interrelated can these studies serve as a measure of the successful execution of a project. There also must be a management plan covering execution of the project. A written project management plan sets forth the implementation strategy and serves as an interface document between the conceptual planning and project execution phases.

A written project management plan serves a multitude of management purposes. Initially, it demonstrates that the owner has analyzed the management and execution needs for a project and has considered the methods to be used and the interface problems that will be created among the various participants. A written plan also is a mechanism for communicating the objectives of a project to all project participants (including those whose interests or roles are outside the direct performance of the project) and the methods and resources proposed to be used in meeting these objectives. For participants directly involved, it communicates the overall management strategy and the responsibilities, authorities, and types of mechanisms or procedures that will be used to which their portion of the project must adhere. To participants not directly involved, it provides information to assist in assessing the project's impact on their interests and the appropriate interface with the project to represent their interests. A well-organized plan also will give an indication of the probability of a project's success. It also must be recognized and remembered that the plan establishes for the owner those standards on which he will measure total project performance.

A written plan assists in the creation and maintenance of a team approach. A coordinated effort to meeting the project objectives is essential for executing a major project in a timely and efficient manner. As in all team efforts, each participant must know his role and the role of the others and there must be a leader. During project execution, important decisions must be made and problems are to be expected even though the exact nature of problems cannot be predicted.

Decisions not made and problems not resolved in a timely manner cause delays and tend to stimulate adversary relationships that are destructive to the team approach. Thus, a written project management plan identifies procedures for timely resolution of problems and assigns authority.

It is important that a written plan be as concise as possible, keeping in mind the purposes being served. Detailed procedures and standards can be included in appendixes or referenced documents with their function in the management scheme set forth in the actual plan.

A management plan emphasizes the unique character of a project because even projects that are seemingly alike vary in scope, location, and participants. A plan also must be a vital, current, and progressive management tool. It should be revised or expanded in coverage when revised execution strategies are indicated, participants are added, or design development or permit restrictions create unforeseen needs.

The limitations of a project management plan also should be noted. A plan is not a self-executing document, and a competent, experienced staff at all levels, working as a team to reach a common objective, is essential for successful execution of the project. In addition, regardless of how well-developed a plan may be, factors outside the control of project management--such as delayed funding, political inaction or dissension, injunctive work stoppages, and public actions--can create schedule delays and cost increases.

III
CONTENTS OF MANAGEMENT PLAN FOR URBAN CONSTRUCTION PROGRAMS

The guidance given below for developing a project management plan is intended primarily to identify parameters and constraints and elements that should be considered for inclusion. Neither the sequence nor the grouping of items given below should constrain the developer of a management plan from selecting an arrangement that will better meet his needs to communicate information to project participants. No detailed guidance for developing and executing any portion of a management plan is included because a variety of options may be available for any given project; however, alternative choices and examples of practices and procedures that have been used are given in Volume 2 of this report.

Some decisions may affect many elements of a plan and should be made prior to extensive efforts to develop a plan. These decisions may relate to such factors as: (1) the structure of and legal authority vested in the responsible local agency in relation to other local and state agencies, (2) the extent to which existing agency staff is to be used or new staff is to be developed, and (3) local considerations relating to labor and economic conditions.

A. PARAMETERS AND CONSTRAINTS

The guidance presented in this report does not cover the conceptual planning phase for a project during which needs, conceptual contentions, social and environmental impacts, and local acceptance are evaluated. However, the importance of this phase and how it interfaces with the project management plan must be recognized since the plan serves as the essential link between conceptual planning and project execution.

During the conceptual planning phase for a project, certain parameters are established that must be recognized and considered as the scope and limitations of the environment within which the project will be executed. These parameters serve as the general basis on which the project was authorized for funding and implementation. In addition, the legal considerations that will constrain the environment within which the project is to be developed and executed must be recognized and communicated. Should any of these "givens" be altered

during the course of the project, the management plan may have to be adjusted accordingly. The products described below are normally developed during the conceptual planning phase and should be included in the written project management plan.

1. Project Description

The narrative description of the project should include a physical description of the project and a discussion of those aspects of the project's history and background that will contribute to understanding of the project's objectives and management strategies. Those aspects of other projects that are dependent on or supportive of activities covered by the management plan also should be described. Also included should be a description of those portions of project planning, financing, design, acquisition (e.g., real estate, services, materials, equipment,), permitting, licensing, construction, and operations covered by the plan and the status of the project at the time the plan is issued.

a. Physical Description and Function

System components should be described in terms of physical and functional requirements and overall design criteria. The conceptual design developed in the conceptual planning phase should set forth the intended performance characteristics of the completed project.

b. Budget

Budget estimates should be provided for the overall project and should be broken down by major physical components and/or functions in accordance with the project physical description developed during the conceptual planning phase.

c. Schedule

A projected schedule for project completion should be provided giving target dates for completion of major system components and/or functions, and all major milestone events (e.g., those that may relate to critical functions or funding requirements) should be identified.

2. Legal Authority and Requirements

All applicable legal constraints must be clearly recognized by the persons formulating, evaluating, and implementing a project management plan. These constraints will apply to individual program components but should be set forth collectively.

a. Statutory Authority

The authority and requirements for real estate acquisition (including condemnation), local financing, procurement, and implementation of the project should be identified.

b. Regulations

Key government regulations that must be adhered to (e.g., environmental, health and safety, civil rights, codes, and ordinances) should be identified.

c. Existing Governmental Structure

All authorities having power over decision-making, approvals, and the issuance of permits or licenses with which channels of communication and a working relationship will have to be established (e.g., building, planning, fire, health, public works, and transportation departments) should be identified.

B. ORGANIZATION AND STAFFING

Organizational arrangements are highly dependent on the decision made concerning use of in-house staff or outside organizations. The size, qualifications, and availability of existing staff must be considered. The desirability of developing an adequate in-house staff depends on the range and level of expertise needed, the duration of need (including the operational phase), the costs, the amount of control needed, the diversity of experience that can be brought to bear, and the time available to develop a working team. Even when an outside organization is used, the owner must have an organization to maintain overall control of the project, to provide for timely decision-making that must come from the owner, and to maintain appropriate communication channels to all participants. Needless to say, any organizational arrangement that would result in duplication of effort or that would tend to undermine authority should be avoided.

An owner may elect to procure project management, design, construction management, construction, legal, inspection, and data processing services from outside sources. Those portions of the project for which existing staff participants will be responsible and those portions for which outside services will be sought should be identified clearly in the scope of work assigned to participants.

The main organization and staffing functions are outlined in this report as separate elements; however, these functions can be combined or responsibilities can be shifted among organizational units depending on the experience and capabilities of the individuals and organizations that are available to carry out the functions identified.

The organization and staffing elements of the project plan should be developed along the following lines:

1. Project organization charts showing the complete organization should be developed and should cover all project functions and all project personnel, regardless of affiliation. Staffing levels should be indicated. Charts may be time-oriented to show different organizational arrangements if these will be changed for different phases of the project.

2. Key personnel in all organizations should be identified and their principal duties, reporting relationships, and assigned responsibility and delegated authority should be defined.

3. Interface points within and outside the project organization should be identified.

4. Company organization charts showing the organizational placement of personnel assigned to the project and the interface points with the project should be required for all major companies participating.

5. A staff mobilization plan that incorporates a schedule of milestone events should be developed.

6. The philosophy that governs the development of the project organization should be stated and decisions to contract for or use in-house services should be explained.

C. MANAGEMENT CONTROL SYSTEMS

Three elements are essential in every project: quality, cost, and schedule. All are variables, and if one element is changed in some way, the others are affected. It is therefore essential that the initial assumptions (baselines) be identified and controlled.

A major work breakdown structure (WBS) should be prepared to serve as the basis on which work is divided into work packages that must be manageable and should be managed. A WBS normally is prepared in an hierarchical or multitiered fashion with the lower tiers being defined during design and project execution. However, the WBS should be developed to best suit project management purposes, not those of the control or information system specialties. The WBS should be used as the basis for technical, cost, and schedule control; therefore, the packages of the WBS and their assigned costs and schedules must be entirely consistent with the overall physical and functional project description, cost estimate, and schedule. All work packages must be identified in both the estimate and the schedule.

The use of logic or network diagrams can be a valuable tool in developing the management plan. This tool, which can display graphically the intent of the plan, will highlight critical areas that must be dealt with in the plan (e.g., critical decisions, potential conflicts, and restraints). Simple activity-oriented network diagrams (using the major work packages) can define the project scope and reflect the interdependencies among various design, procurement and construction activities, the phases of work, and the impact of outside work groups. The network diagrams should reflect all facets of the project from authorization to operation of the facility or system.

1. Functional and Technical Control

a. Technical Baseline

Responsibility should be assigned for providing clear design criteria and required quality and other standards to those performing design and for coordinating individual design packages with system-wide design. The authority to make changes or waive requirements also should be identified.

b. Design Review

Responsibility should be assigned for providing for and coordinating design reviews by the owner, consultants, and operational staff to assure that project objectives are being met. During design review, attention should be directed to consistency with design criteria, possible errors and omissions, and constructability. Determining the extent of review or multiple reviews required should be based on consideration of the consequences of failure, the owner's experience with the design organization's in-house checking capability, and other aspects of the quality assurance programs.

c. Quality Assurance Programs

Responsibility should be assigned for establishing and implementing individual and organizational quality assurance (QA) programs to provide an effective system for ensuring that: (1) all work performed is in accordance with engineering requirements; (2) all equipment is tested throughout development, manufacture, and installation to verify that it will function as specified; (3) undesirable conditions are detected early and positive corrective action is taken in a timely manner; and (4) control over the system hardware configuration is maintained at all times to define the acceptability of equipment (as established by design reviews, drawing approvals, and design verification testing), to control the configuration during retrofits and modification work, and to ensure that the system will be safe for public use.

The QA programs should meet the stated objectives and should provide for documentation to support such requirements as contractor quality assurance, management quality assurance audit, surveillance of contractor work, and testing and configuration control.

2. Cost Control

a. Cost Baseline

Responsibility should be assigned for developing a baseline cost budget for managers of work packages and for maintaining that baseline consistent with the WBS, schedule, and overall costs. Authority to revise the baseline should be identified.

b. Performance Measurement

A system should be provided for comparing the actual costs to the planned costs of elements of work and for analyzing any variances from the planned costs that may occur.

c. Cost Forecast and Estimate Reviews

A system should be provided for routinely forecasting the expected costs of work packages at completion and of the total

project. In addition to routine cost forecasting, as design develops and contracts for materials, equipment and services are awarded, provision should be made for periodic reviews and updates (conducted from an overall management perspective and preferably on a quarterly or semiannual basis) of the system-wide estimate. Elements of the project cost estimate should be subject to varying degrees of re-estimating depending on the status of project development, changes in previously predicted economic conditions, unfavorable experience in contract awards, or refinement of quantities. Project management should determine the degree to which re-estimating is to be performed, recognizing its cost and the extent to which it will interfere with ongoing performance.

Schedule impacts should be considered in conjunction with these periodic cost estimate reviews.

d. Contingency Management

A system should be provided for determining and distributing contingency funds to provide for cost escalation caused by such factors as inflation, changed conditions, design revision, and estimating errors. The contingency allowances can be held at the project level or can be distributed to lower levels of management in the WBS.

3. Schedule Control

a. Schedule Baseline

Responsibility should be assigned for developing baseline schedules for the managers of work packages and for maintaining those baselines consistent with the technical, cost, and overall schedule baselines. Authority to revise the baselines should be identified.

b. Performance Measurement

A system should be provided for comparing actual work performed with the scheduled work to be performed and for analyzing any variances that may occur.

c. Schedule Forecast and Review

A system should be provided for routinely forecasting the expected schedule for completion of work packages and the total project. Schedules should be reviewed and updated in conjunction with the periodic cost estimate reviews.

4. Financial-Receipts and Disbursements

A system should be established and responsibility assigned for predicting cash flow requirements and for providing for timely receipts and payments.

5. Change Control

Procedures should be developed and responsibility assigned for identifying, evaluating, and accommodating changes that may occur during project design and construction. Procedures should be clear, should permit results to be achieved rapidly, and should provide for full evaluation of the impact of the changes. The avoidance of changes and the prompt settlement of change orders and potential or actual claims must be emphasized. Judicious delegation of monetary authority to approve change orders at the field level can expedite this process. A mechanism should be provided for timely resolution of claims. (See also, section F, Dispute Resolution.)

D. HUMAN RESOURCE AND LABOR RELATIONS POLICY

It is essential that human resource factors be considered in both initial project development and project execution. Human resource considerations include all elements that are related to the recruitment, selection, and utilization of all levels of personnel under a coordinated and planned administrative procedure. Human resource considerations that can have an impact on the project even though they do not deal directly with employment of personnel at the project also should be considered.

1. Statutory and Regulatory Requirements

Federal, state, and local statutory requirements should be identified and incorporated in administrative procedures. Consideration should be given and reference should be made to wage and hour requirements and compliance with state and local regulations and equal employment opportunity regulations (including a local plan if one exists). In addition, potential federal, state and local labor legislation (e.g., right--to-work and common situs laws, changes in the Taft-Hartley Act, and Workmen's Compensation) that could have an impact on project development should be identified and referenced.

2. Labor Relations

An assessment should be made of prevailing labor practices and conditions. Policy should be established with regard to the factors listed below, and responsibility should be assigned accordingly.

a. Use of Union or Open Shop

It must be decided whether organized labor or open shop labor will be used as well as whether this decision can be left as a discretionary matter for the construction phase.

b. Use of Locally Negotiated Labor Agreements or Project Agreements

It must be decided whether locally negotiated agreements or project agreements should be used if organized labor is employed. Where building trades have been well organized, local agreements have a history of being effectively managed and a cooperative relationship has existed between collective bargaining parties. Where building trades are well organized but on an individual craft basis and contractor bargaining is more individual and divided by labor agreements having different expiration dates, varied hours, different holidays and different conditions, a project agreement may be most appropriate. (The project agreement's strength is that it provides for uniformity of conditions and the elimination of work stoppages and presents a uniform procedure for dispute resolution.)

3. Local Conditions

Provision should be made for assessing local community and manpower funtions to determine advantageous relations to be pursued to enhance project development (e.g., transportation and parking facilities, organizations assisting in minority employment opportunities, vocational and manpower training programs, panels and groups dealing with employment and other human resource concerns).

E. RISK MANAGEMENT

Risk management implies control of events, and this means that events should be anticipated and responded to in advance or as they occur. Procedures should be established for identifying risks, for evaluating the consequences of occurrences, for assigning responsibility and accountability, and for distributing liabilities. In addition, a program to avoid risk and minimize the consequences of occurrences should be established. Consideration should be given to alternate modes of insurance, which should be reviewed periodically to assess the impact of inflationary pressures.

F. DISPUTE RESOLUTION

Responsibility should be assigned and procedures clearly defined for resolving disputes in a timely manner. Disputes generally should be resolved at the lowest administrative level possible. Among the dispute resolution procedures to be considered are litigation, mediation, arbitration, an independent board of consultants, and a contract board of appeals. Of course, the best way to deal with disputes is to avoid them by mitigating the conditions that cause them.

G. PROCUREMENT

1. Policy and Procedures

General policies and procedures for procurement of services, materials, and equipment should be established consistent with applicable governmental regulations. These should address requests for procurement, solicitation, selection criteria for contract award, types of contracts, schedule, price and cost estimates, insurance requirements, and special bonding requirements, if any.

2. Negotiation and Administration

Responsibility and authority should be assigned for negotiating and entering into and for administering commitments.

3. Procurement Plan

A procurement plan should be developed for procurement of the major packages of services, materials, and equipment that will be sought. The size and content of each package, the schedule for delivery, and an estimate of cost should be included.

H. DESIGN PROGRAM

Prior to beginning preliminary design, a program should be developed that clearly identifies the organization and key personnel responsible for all design functions. Management policies and procedures should be established with respect to delegation of review and approval authority for controlling design and construction quality and costs and for monitoring the schedule. It must be recognized that in public projects consideration should be given to sufficient public participation to ensure necessary cooperation and to minimize disruptions to the schedule. (See also, section C.5, Change Control)

A system should be developed and authority assigned for maintaining detailed coordination of individual design packages and the total project design. Procedures should be established for maintaining continuous review of all phases of design jointly carried out by the owner, consultants, and operational personnel.

I. REAL ESTATE ACQUISITION AND DISPOSAL PROGRAM

Responsibility should be assigned for developing a real estate program that identifies: (1) required permanent and temporary interests in real estate and their purpose in relation to the project; (2) required utility and railroad easements and re-arrangement agreements; (3) procedures for acquisition, development, and disposal of real estate, including cost scheduling and funding; and (4) procedures for property management.

A system should be developed for executing the program and should include policies and procedures for executing such functions as legal

certification, property appraisal, property management, relocation assistance for displaced people, demolition or disposal of property not required, and scheduling and funding of activities to meet project requirements.

J. COMMUNICATIONS PROGRAM

A program should be developed and responsibility assigned for maintaining communications among all participants, affected organizations, and the general public. The communications program should support all project functions (e.g., management control, real estate, design, construction), should establish policies and procedures for reporting project progress, and should include schedules for periodic meetings and reports.

K. CONSTRUCTION PROGRAM

It is essential that construction concerns be dealt with adequately in the design and procurement phases early in project development. A construction program should be developed that clearly identifies all major construction functions and the organization and key personnel responsible for each of these functions. Management policies should be established and procedures developed for delegating responsibility and authority for construction management, including the handling of change orders and the resolving of disputes. A work plan should be developed and responsibility assigned for developing cost estimates that are tied to related schedules for all construction work packages and for establishing procedures for coordinating, monitoring, and reporting on construction operations in relation to quality, cost, and schedule.

L. LEGAL REQUIREMENTS

Responsibility should be assigned and procedures and channels of communication should be established for fulfilling all applicable legal requirements including the following:

1. Permits--Identification of the permits needed, the responsible governmental agency, the procedures for liaison, the responsibility for filing, and the time required for issurance.
2. Approvals--Identification of each authority involved, the procedures for liaison, the nature of approval required, and the details of communication and coordination.
3. Disputes Resolution--Procedures for resolution and identification of responsibility and authority at all levels of management. (See also, section F, Dispute Resolution.)

M. SAFETY PROGRAM

A safety program should be established to ensure maximum accident prevention and protection of employees, property, and the general public.

Policies and procedures should be developed in compliance with federal, state, and local safety and health regulations and standards, and specific contract and client obligations and facility requirements for safety, first aid, and medical attention should be identified clearly.

Responsibility and authority should be assigned for executing the program. A system should be developed to provide for: (1) review and approval of enforcement procedures; (2) safety orientation and training; (3) reporting, investigating, and recordkeeping; (4) environmental monitoring to detect and control hazardous conditions; and (5) proper documentation of all tests.

N. OPERATION AND MAINTENANCE INTERFACE

Provision should be made for incorporating operation and maintenance concerns in design and construction solutions, particularly during the design phase. Procedures should be established to provide for a continuous review of all design stages carried out jointly by owners, consultants, and operation and maintenance personnel to ensure that the final design incorporates those features that are consistent with projected operation and maintenance needs and costs. Consideration should be given to evaluating economy of design, system continuity and safety, reliability, and constructability in relation to budgeted construction costs and forecast operating costs.

O. COMMUNICATION INTERFACE MANAGEMENT

The major interfaces at which performance failure could result in serious disruption of project continuity or efficiency or could prevent timely completion of the project should be addressed. These interfaces exist between the companies involved as partners and under contracts, between functional units, between project locations, between project phases, between project and governmental regulatory agencies, and between private and other public interests.

To enhance interface management, the following should be defined clearly: (1) responsibility, authority, and accountability at the interfaces between various project functions; (2) inputs and outputs in terms of content and schedule; and (3) lines and procedures for communication. Procedures for communication within the project organization should include authorizations, reports, meetings, and reviews supported by records management. Procedures for communication with elements external to the project should include public relations; applications for permits and licenses; and reporting requirements imposed by contracts, grants, regulations, and other legal requirements.

P. MAINTENANCE OF THE PLAN

Responsibility should be assigned to ensure that the portions of the management plan incomplete at the time the original plan is issued are

completed and that revisions required by changes are made. Periodic reviews of the plan should be made to ensure its currency and appropriateness.

APPENDIX
SURVEY OF LOCAL TRANSIT AUTHORITIES

The Committee contacted 17 local transportation authorities to determine what methods currently are being used to develop formal management plans for urban construction work. The authorities were asked whether they had a formal management plan for executing urban construction projects. If they did, they were asked to submit a copy and explain when it was instituted and how staff members and other project participants are familiarized with it. If they did not have a formal plan, they were asked to submit copies of memos, reports, or other documents used in implementing construction projects. In addition, they were asked to submit an organization chart, if available, that would show the organizational structure and staffing of the authority, how construction activity was related to the overall structure, and how responsibility and authority was delegated among the various personnel.

Of the 17 authorities surveyed, 11 submitted such documents as organization charts, functional statements, and complete planning documents used in funding requests. Three indicated that some of the requested information was not available at the time because the plan was being revised or the authority was being reorganized. Two indicated that the construction function was performed by some other municipal organization and was not their responsibility. One did not respond.

After reviewing the survey responses, the Committee found that each contained many of the primary elements of a model comprehensive written project management plan. One authority submitted drafts of two relatively comprehensive procedural manuals, and an application for state funds for construction of a light rail transit system prepared by another authority satisfied almost all the Committee's criteria for a model comprehensive written project management plan. Several other extensive and elaborate documents that included construction project management procedures also were submitted.

The Committee also found that the organizations comprising the transit management authorities of cities vary greatly in terms of their origins, their responsibilities, and their methods of operation. Political factors and considerations appear to have a great influence on metropolitan transit systems. This influence becomes particularly

complex when systems serve multiple political jurisdictions. Most transit authorities operate under a board of directors, and the members, who serve for varying terms, usually are appointed by some elected official or group of officials (e.g., governor, mayor, city council, or a combination of these). In some cases, the members may be elected officials from a local government who bring close political ties to the management function.

Each board usually has an executive director or general manager with a staff reporting to him. The functions of planning, design, engineering, and construction usually can be identified within the staff organization. Generally, however, the actual performance of these functions is accomplished under contract and the board's staff serves in the role of contract supervisor. The degree of active participation by the boards also varies from almost complete reliance on the general manager and staff to one of close supervision of project progress.

One transit authority operates as an administration under a state department of transportation, and planning for a construction project originates in a planning and program development division with an initial funding action, which is required for inclusion in the governor's budget. Once approved by the legislature, the lead role shifts from the planning and program development division to the rapid transit development division. At this point, a project manager assumes responsibility for management of the project with the support of contract design and construction managers. A third division, the metropolitan transit system division, is responsible for operations and maintenance and has the greatest number of employees. The managers of these divisions and several of their immediate staff are contract employees, but all others are state employees.

In another case, transportation and construction are separate functions of a city government. A transportation department is responsible for operating the city's bus and rapid transit system, providing traffic engineering, performing maintenance, and providing for traffic safety while a public works department is responsible for major construction projects. This arrangement prompted the two departments to formulate a "statement of understanding" that identifies the powers, duties, responsibilities, and functions of each with respect to construction activities.

Most of the information received by the Committee indicates that the design, engineering, and construction functions are directed by one manager while planning is handled by another. Exactly how the planning process is carried out appears to vary greatly from authority to authority. In general, however, extensive coordination between planners and technical staff appears to be required, but the technical staffs usually are small and limited in terms of actual design, engineering, or construction capability. Once large-scale construction projects have been approved and funded, most of the day-to-day design and construction work is performed under contract by engineering and construction firms.

Although there were many similarities, marked differences were found in the management approaches reported by the authorities. These can be attributed in part to the varying conditions imposed by legislative requirements under which authorities operate.

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