A Real-Time Evaluation Framework for Maximizing the Likelihood of Success on Large Public Infrastructure Projects

by

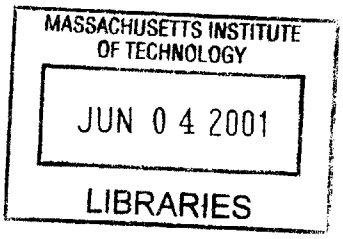
Sheldon L. Lyn

B.S., Civil Engineering
Howard University, Washington, D.C., 1999

Submitted to the Department of Civil and Environmental Engineering in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE IN TRANSPORTATION

at the
Massachusetts Institute of Technology
June 2001



Signature of Author.....
Department of Civil and Environmental Engineering
May 21, 2001

Certified by.....
Frederick P. Salvucci
Senior Lecturer, Department of Civil and Environmental Engineering
Thesis Supervisor

Accepted by.....
Oral Buyukozturk
Chairman, Departmental Committee on Graduate Studies

A Real-Time Evaluation Framework for Maximizing the Likelihood of Success on Large Public Infrastructure Projects

by

Sheldon L. Lyn

Submitted to the Department of Civil and Environmental Engineering on 21 May, 2001, in partial fulfillment of the requirements for the Degree of Master of Science in Transportation

ABSTRACT

This thesis is motivated by the broad objective of identifying ways to maximize the likelihood of success on large public infrastructure projects. The specific objective of the thesis is to develop a conceptual framework for performing real-time evaluations during the implementation stage of these projects. This framework would provide a thoughtful and systematic approach for identifying threats and opportunities that relate to accomplishing long-term goals such that corrective or prescriptive actions can be taken on a real-time basis.

As a starting point for the research an argument is presented to explain why large public infrastructure projects might fail to realize levels of success commensurate with expectations. It is often argued that project proponents, in their effort to gain support create unrealistic expectations, and that expectations should be lowered. However, lowering expectations may suggest an excessive pessimism about the potential of large-scale projects to be important elements in bringing about change. This thesis focuses on the possibility that large projects can be successful in terms of delivering expected results, and where they have failed it is often because of -- *inadequate long-term/system-wide planning throughout the life of the project, and especially during the implementation stage.* We propose that real-time evaluation related to accomplishing project goals can help to facilitate long-term/system-wide planning during the implementation stage of these projects.

To provide a frame of reference on evaluation, this thesis presents a discussion on the theory and practice of evaluation. From this it is possible to extract some general principles for performing real-time evaluations. These principles are used to guide a discussion on some mechanisms that approximate real-time evaluation on public infrastructure projects. Out of this discussion, the factors that suggest how real-time evaluations could be performed effectively in the context of public infrastructure projects are identified and a conceptual real-time evaluation framework proposed. The central components of this framework consist of a trustee for the project goals and a supporting mechanism designed to perform real-time evaluation consistent with these project goals.

This conceptual framework is then applied in the context of the Tren Urbano rail system currently under construction in San Juan, Puerto Rico. This effort reveals that while different elements for performing real-time evaluation exist in the Tren Urbano context, there are limitations to their effectiveness partly because they are structurally fragmented. A consolidated structure for conducting real-time evaluation consistent with the conceptual framework is presented. Finally, some recommendations for large public infrastructure projects in general are proposed.

Thesis Supervisor: Frederick P. Salvucci
Title: Senior Lecturer, Department of Civil and Environmental Engineering

NOTE ON RESEARCH SPONSOR

This thesis was written under the sponsorship of the Tren Urbano UPR/MIT Professional Development Program.

This professional development program is conducted jointly by the University of Puerto Rico (UPR) and the Massachusetts Institute of Technology (MIT) and is funded by the Puerto Rico Highway and Transportation Authority (PRHTA) as part of the Tren Urbano Project, currently under construction in San Juan, Puerto Rico. The Tren Urbano project is a heavy rail rapid transit system to serve the San Juan Metropolitan Area --the first phase of which is expected to begin revenue service by the end of 2003.

Responsibility for implementing and operating this major infrastructure project falls to the PRHTA, which is an agency under the jurisdiction of the Puerto Rico Department of Transportation and Public Works (DTPW). At the outset of this project, it was recognized that Puerto Rico had no substantial expertise in planning, design, construction, and operation of urban rail systems. With this in mind the Commonwealth adopted, as a strategic objective during the first phase, the development of a cadre of young professionals expert in all aspects of major rail infrastructure projects and capable of assuming leadership roles in future expansions of Tren Urbano as well as similar projects. This resulted in the Tren Urbano UPR/MIT Professional Development Program (González-Quevedo, *et. al.*).

The DTPW interfaces and helps to set the program's agenda through the Tren Urbano Steering Committee. The program involves the Tren Urbano Office (TUO), UPR and MIT (two other Boston area schools have also become involved in the program: Northeastern University and Boston University). It began in 1994 and is expected to continue until the start of revenue service on the first phase of the project. The essential elements of the program are: MIT Summer Short Course on Public Transportation in Boston, UPR Short Course on Tren Urbano and Transportation in San Juan, Research Experience, Professional Practice, Tour of Operating Transit System, and Work Opportunity with Tren Urbano Consultant or Contractor.

As part of the research experience element of the program each student chooses a research topic related to any aspect of the project, including (but not limited to) engineering, transportation planning, urban planning, safety, and marketing. The student then conducts research over a period of one to two years under the supervision of a faculty member. For the undergraduate students this research is conducted either for credit hours or for pay as part of their undergraduate program. The graduate students usually conduct research, which often forms the basis of a thesis, designed to be useful to the improvement of Tren Urbano through constant exposure to relevant university based research.

At this point in time, over 110 UPR students and 80 MIT students have successfully completed the program and over 190 theses and reports completed. The author is grateful for the opportunity provided by this unique program.

ACKNOWLEDGEMENTS

First and foremost I would like to thank God, from whom all blessings flow.

As I reflect on my two years at MIT and how much I have learned, Fred Salvucci stands out as one whose commitment to my development went far beyond his role as my thesis supervisor. Fred has been a truly amazing and giving mentor and I would like to extend my deepest gratitude to him for taking me on as an advisee and for the extraordinary level of interest he showed in my professional development. Thank you Fred.

I would also like to thank Nigel Wilson for his involvement in this thesis. His laser sharp insights contributed a great deal to the final product. In his role as my academic advisor and as *de facto* counselor to all MST students I would like to thank him for being, above all else, a teacher committed to the development of his students.

Special thanks are also due to Ken Kruckemeyer, who as the third member of MIT's Tren Urbano program triumvirate (Nigel, Fred, and Ken), played a major role in helping me to clarify my thoughts in the initial stages of this research and continued to offer guidance throughout.

I would also like to thank John-Paul Clarke (JP), who I like to imagine came to Howard University to personally recruit me, and was the first to call me when I was accepted to the MST program. JP we should definitely get together and play some more dominoes.

I would like to thank a few members of the CEE/CTS family for their efforts in creating a student friendly environment: Ginny Siggia, Sydney Miller, Cynthia Stewart, and Jessie Williamson.

I must also make special mention of a few of my classmates who, not only assisted me throughout the program, but made the experience a lot more bearable than it would have otherwise been by the camaraderie they provided. Those who come immediately to mind are: Georges Darido, Jessica Vargas (my Puerto Rican friend), Michael Gilat, and Andre Puong. I would also like to thank Melvin Henry for his encouragement.

I would be remiss if I failed to express my gratitude to the people who helped me along the way to MIT. Of the many I would like to make special mention of Jamel Banton, a friend since high school who has always provided me with moral support. I would also like to say special thanks to Adrian Lawrence, Katus Watson, Neil Lawrence, Marvin Hewitt, Marvin Donaldson, Bill Anderson, and David Ashman, all great friends from the Howard University portion of the struggle. I must also thank Professor Robert Efimba, who was instrumental in making my undergraduate experience one that will continuously have a positive impact on my life.

I would like to thank all the members of my family for supporting and inspiring me to pursue opportunities well beyond what my humble beginnings would have allowed me to dream. I would especially like to thank my father, Ian Lyn, who in many ways inspired me to take this journey. Cambridge, Massachusetts is certainly a long way from St. Elizabeth, Jamaica.

Finally, I would like to thank Renée Bowen who made the trip to MIT especially worthwhile. Renée, you are an amazing person and I look forward to the rest of my life with you. And thanks for the editing, I can't imagine that this document would have been readable without your help. I would also like to extend special thanks to the members of her family who have been very supportive of my efforts.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

THESIS OUTLINE

- **Title:** A Real-Time Evaluation Framework for Maximizing the Likelihood of Success on Large Public Infrastructure Projects.

- **Argument:** Large public infrastructure projects may fail as a result of *inadequate long-term/system-wide planning throughout the life of the project.* The life of the project being defined using the six-stages model proposed by Fred Salvucci.

- **Theory and Practice of Evaluation:** Evaluations can be classified by the time at which they are done, and by the perspective from which they are being done (with overlap in the two approaches to categorizing):

    - By Time of Evaluation
        - *Ex-Ante:* performed prior to the undertaking of a project.
        - *Formative:* performed during the implementation of a project.
        - *Ex-Post:* performed after the completion of a project.

    - By Perspective of Evaluation
        - *Accountability:* to ensure responsible use of resources.
        - *Development:* to improve project based on lessons learned, changes in the environment, new technologies, and so on.
        - *Knowledge*: to gain greater insight into what determines project success.

    Type of Evaluation of interest in this thesis: Overlap of Formative Evaluation (with attention to the importance of relating this to Ex-Ante and Ex-Post Evaluation), and Development Evaluation (with recognition of the importance of Accountability and Knowledge motivated Evaluations).

- **Role that Real-Time Evaluation can Play in the Success of Public Infrastructure Projects:** Facilitate long-term/system-wide planning by:

    - Providing a thoughtful and systematic approach for maintaining/modifying long-term goals.
    - And concomitantly keeping in focus the system-wide (broader) issues that relate to accomplishing long-term goals.

- **Principles for Developing a Real-Time Evaluation Framework: Two Levels of Analysis**

    - Analysis of a Real-Time Evaluation Mechanism
        - *The Scope of the Evaluation*
        - *Performance of Evaluation Activities*
        - *Use of Results/Recommendations*

    - Analysis of a Mechanism to Facilitate Long-Term/System-Wide Planning
        - *Ability to Serve as a Trustee For Project Goals*

- **Case Studies of Formative (Real-Time) Evaluations:** Study of two cases that approximate Formative (Real-Time) Evaluations in the context of large public infrastructure projects.

    - The Central Artery Environmental Oversight Committee (EOC).
    - The FTA's Project Management Oversight Program (PMO).

- **Lessons Learned/Towards the Design of a Conceptual Real-Time Evaluation Framework:**

    - The effectiveness of a Real-Time Evaluation Mechanism is defined by the following:
        - The Scope of the Evaluation
            - Which is a function of: *The interest/stake of the evaluator; and the dominant perspective from which the evaluation is being done.*

        - The Performance of Evaluation Activities
            - Which is a function of: *The availability of resources; the ability of the evaluator; the ease of access to information; and the nature of the issues to be evaluated (subjective versus objective, etc).*

        - The Use of Results/Recommendations coming from the Evaluation
            - Which is a function of: The *credibility of the evaluator; the power of the evaluator; and the constraints on actions.*

    - To be effective in facilitating long-term/system-wide planning the mechanism must be housed or supported by an institution acting as a trustee for project goals. In order to serve as trustee the institution should:

        - Have a Good Understanding/Appreciation of Project Goals
            - Which is a function of: *knowledge of the history of the project; sensitivity to the many interests on the project; and insulation from short-term political currents.*

        - Have the Power to act on Behalf of Project Goals
            - Which is a function of: *the power the trustee has over decisions to be made on the project (narrowly defined); and the power it has to elicit the cooperation of all those who have jurisdiction over the project (broadly defined).*

- **Application of the Framework to the Tren Urbano Project:** Apply the framework to the Tren Urbano project (given its unique context).

- **Lessons Learned/Towards Performing Real-Time Evaluation Consistent with the Conceptual Framework in the Tren Urbano Context:**

    - Disparate Elements of a Real-Time Evaluation Framework Exist on the Project:
        - Trustees [*DTPW, FTA, Communities*]
        - Real-Time Evaluation Efforts [*Just in Time Research, PMO, Community Relations Office*]

    - A Beginning Option for Tren Urbano:
        - Consolidate the Disparate Elements through a Public Transportation Group answerable to the Secretary of the DTPW.

- **Conclusions:**
    - Recommendations for Large Public Infrastructure Projects in general.

Chapter 1: INTRODUCTION

Not entirely incongruous with my training as an engineer, this work began as a preoccupation with the question: how do you get from an idea to the implementation of a project --what are the stages, and how do you get through them? After doing some exploratory work in relation to this interest, a greatly expanded appreciation for infrastructure projects emerged. The primitive assumption that getting the project implemented would, *ipso facto*, mean success was contradicted by the reality that many implemented projects were not considered successful, not necessarily in terms of engineering functionality, but in terms of what was expected of them. Against the backdrop of several studies and reviews critical of the levels of success that were being achieved by some recent major capital projects, the central question became --how do you ensure that the results that follow implementation are in fact consistent with the founding idea or vision for a project?

This thesis is governed by the broad objective of helping to ensure that the public infrastructure projects that are being implemented stand the best chance of being successful. To borrow a definition from Miller (2000), "infrastructure projects refer to facilities for the movement of people, goods, information, and facilities to meet basic human needs, such as water, sanitation, environmental protection, and shelter" --with public infrastructure projects being the subset of these projects provided by public entities, or on behalf of public entities.

In a democracy where consensus for the most part prevails, getting these projects built requires an agreement by the affected constituents on the long-term goals. They additionally entail, a very high degree of planning from environmental, financial, technical, and economic standpoints, to ensure that the project will be implemented in a manner consistent with these goals. However, during implementation, which can take several years, there is often no formal process to evaluate how the project is

accomplishing its stated goals, and to incorporate new findings in the pursuit of these goals. With this in mind, the primary objective of this thesis is to develop a conceptual framework for conducting real-time evaluations of public infrastructure projects, such that threats and opportunities that relate to long-term goals can be identified and addressed on a real-time basis.

The intent is to present a thesis that will be useful to all those who would take an interest in the field of infrastructure development and in particular public infrastructure development. Some that should readily fall into this group include: federal, state and local government infrastructure agencies[1]; multinational development agencies; engineering professionals; and academics.

This thesis begins by presenting a broad view of how large public infrastructure projects come into being. It describes the life of a large project using a six-stage model. These six stages are defined as: (1) pre-history, (2) project development, (3) procurement, (4) implementation, (5) operations and maintenance, and (6) long-range socio-economic restructuring. A discussion of the different events, activities, players, primary threats, and approaches to planning associated with each of the stages is also presented.

Following this discussion a beginning argument is put forward in Chapter 3 as an attempt to explain the reasons for 'failure' vis-à-vis the long-term goals on some of these projects. This argument is that *large public infrastructure projects may fail as a result of inadequate long-term/system-wide planning throughout the life of the project --with the most significant breakdown occurring during implementation.*

Chapter 4 then presents a discussion on the theory and practice of evaluation. The objective here is to extract, from the existing literature on the theory and practice of evaluation, certain key concepts governing the design and use of evaluation. Although the theory and practice presented were mostly defined and used by social science researchers, it was viewed as providing a good frame of reference for, if not detailed guidance on, the

[1] A particular agency that will be addressed in the thesis is the Puerto Rico Department of Transportation and Public Works (DTPW).

design of evaluation in the context of public infrastructure projects. This chapter concludes with a proposition on the role that real-time evaluation can play in helping to ensure success on a project, in terms of helping to accomplish long-term/system-wide planning objectives.

Having made the proposition that real-time evaluation can help to ensure success on a project, Chapter 5 presents some principles of a conceptual framework for performing evaluation in this regard. The principles are presented in a 'framework for analysis' manner, where there would be two levels of analysis. The principles for the first level of analysis are based on general concepts derived from the theory and practice of evaluation and address the facets of a 'generic' evaluation. These facets were: (1) the scope of the evaluation; (2) the performance of evaluation activities; and (3) the use of results. The second level of analysis presents principles that would directly relate such an evaluation to maintaining the focus on long-term/system-wide planning objectives in a large public infrastructure project.

Guided by the principles put forward in Chapter 5, Chapter 6 then presents a discussion on some mechanisms that approximate real-time evaluation on public infrastructure projects. At the outset it was recognized that no 'complete' mechanism existed to perform evaluation of the exact nature we suggest would facilitate achievement of long-term/system-wide planning objectives on such projects. However, some cases that were deemed as having certain characteristics that resemble such a mechanism, even if just in intent, were identified. The two cases chosen were the Central Artery Environmental Oversight Committee (EOC), and the Federal Transit Administration's Project Management Oversight Program (PMO). In each case the discussion begins with some background and a description of the motivation for the creation of the mechanism. The discussion then proceeds with a description of the characteristics of each case as it relates to the two levels in the 'framework for analysis'. Each case discussion concludes with a summary of the characteristics of the mechanisms.

Chapter 7 attempts to identify the lessons from the cases and refine the initial model ("framework for analysis") based on an integration of the practical observations made from the cases with the principles from the theory. Following the presentation of this refined model, a combined analysis of the case studies was conducted. This chapter concludes with the proposal of a conceptual framework for real-time evaluation in the context of helping to ensure success on a large public infrastructure project by helping to accomplish long-term/system-wide planning objectives.

Chapter 8 then attempts to apply the conceptual framework in the context of the Tren Urbano Rail Transit Project currently underway in San Juan, Puerto Rico. It presents a discussion on the stages in the life of this project and an analysis of the evolution of planning thus far. It concludes by recommending an option for performing real-time evaluation, consistent with the conceptual framework, in this context.

Chapter 9 reviews some of the major lessons derived from the prior chapters and draws some general conclusions on what those concerned with the development of large public infrastructure projects should do to maximize the likelihood of 'success' on these projects.

Chapter 2: THE PROJECT LIFE CYCLE

This chapter describes the life cycle of a typical major public infrastructure project. The description of the various stages in the life of such a project is derived mostly from discussions with Fred Salvucci who, as former Secretary of Transportation of the Commonwealth of Massachusetts, has had first hand experience in seeing large public infrastructure projects evolve from the original idea through to actual operations. Some of these projects include: the relocation of the Orange Line (public transit), the extension of the Red Line to Alewife (public transit), and most of the planning for the Central Artery/Third Harbor Tunnel Project (highway). The main purpose of this chapter is to develop an appreciation for the unique stages that a large public infrastructure has and the role that each stage plays in determining the ultimate success of the project. The activities, players, and primary threats associated with each stage will be outlined; this will serve to introduce the inherent challenges within and across stages, and the difficulty in achieving a consistent and coordinated effort towards project success.

2.1 The Six Stages Model

Large public infrastructure projects can be conceptualized as having distinct stages in their development. They can take as many as fifty years from the time the idea was originated until it becomes a reality. Each of these stages has unique characteristics and presents a variety of challenges that will ultimately affect the shape the project takes and the likelihood of success. The six stages in the life of a rail transit project are[2]:

1. **Prehistory**
2. **Project Development**
3. **Procurement**
4. **Implementation**
5. **Operation and Maintenance**
6. **Long Range Use and Socio-Economic Restructuring**

In each of the stages, tension and ambiguity may exist between "*doing the right job*" and "*doing the job right*". That is between proper conceptualization of the primary task and organizing for effectiveness, and skillful technique and implementation, both of which are important ingredients for success.

2.1.1 Prehistory

This represents the gestation period during which the idea originates and public consciousness of a need for the project emerges. The idea might have originated as a solution to a given problem, but until it displays the crucial elements of technical, economic and political feasibility, it may fail to garner enough support to get off the ground (Cobb and Coughlin, 1997). This gestation period could cover many years while the project is packaged and promoted in different ways to try to satisfy the technical and

[2] It is worth noting that while these stages follow a more or less sequential order, there can be overlap where a stage begins before the preceding stage is completed. This would be, for example, in cases where the project is being done in phases. For example, where a subway system is being built on a per line basis, the stages will tend to overlap where the implementation of a line may begin before the procurement of another ends.

economic criteria, and probably most importantly the political criteria. Of course, many projects fail to survive this stage.

Players and Activities

During this time project champions or advocates keep the idea alive, waiting for windows of opportunity to appear. A window of opportunity could appear as a result of trigger events that push the need for a solution to a given problem to the forefront of public consciousness. For example, the collapse of a major bridge could focus public attention on building new bridges --and suddenly a bridge project on the books for many years gets off the ground. As such, a strategy often adopted by project champions, is to make associations with their project and an event currently focusing public attention -- presenting their project as the solution to a problem that has caught the public's eye. Given the long 'gestation' period of large projects, it is likely that a project needs to be seen as solving a number of different problems, so that as the short-term attention of the media shifts, valid different facets of a project can be highlighted. For example, over the long term gestation period of the Central Artery/Third Harbor Tunnel Project (CA/T) the project has been highlighted as a solution for traffic congestion, for the fact that the old road was crumbling and needed major reconstruction, as a short-term stimulus for jobs in construction, as a necessary action to maintain long term economical attractiveness of the city, as an aesthetic improvement to the city, and as part of a clean air and traffic reduction strategy (Salvucci, 2001). Project champions must therefore remain in a state of readiness, poised to go on the offensive and emphasize the facet of the project that would satisfy a problem that has gained public attention.

Other players that enter the fray at this stage include owners of specific technology, who may be trying to sell a particular solution to a problem as they see it. For example, manufacturers of maglev technology could try to sell this as a solution to inefficient inter city travel, or manufacturers of light rail technology might try to identify mass transit needs that light rail could satisfy. Politicians may also become involved to greater or lesser extents at this stage depending on how they perceive the risk/return ratio of putting their name behind such a project. The media also plays a role in this stage and its role can

be critical in determining whether or not the project emerges from this stage, given their important position in influencing the public's perception and thereby the politicians' views.

Primary Threats

Failure to get and sustain the public's attention is probably the biggest threat that the project will face during this stage. Other competing issues might dominate both the public and political agenda. For example, in cases of war or recession, the project might have a hard time competing for space on the agenda. Ideology also determines what gets on, and then receives favorable treatment on, the political agenda, as depending on their ideology the incumbent political leadership may not be receptive to a given project. For example, a governing administration may not be in favor of promoting or implementing mass transit projects. From a financial standpoint, the threat is that there are simply not enough resources to attempt to undertake such an expensive project even though the public might view it as important. Competition for funds with other projects with different geographic benefits, or packages of many small projects with quick implementation times and multiple beneficiaries are also likely to be a major factor.

Before the project can emerge from the prehistory stage it must be taken on by a government organization that has both the interest and capacity to oversee its implementation. Subsequently one of the major threats facing the project at this stage is a lack of effective government organizations to take on the idea. This would be the case, for example, where a project of a significantly different nature than the ones currently within the existing organizations' inventory is being proposed. From a technical standpoint, the technology for producing the project may not be mature enough, or other technical challenges might make it difficult to undertake.

By the time the three criteria (technical, economic, and political) are met, such that the project has generated enough support to get off the ground, the solution probably has evolved to take a shape very different from what was presented as the original idea. This is sometimes as a result of legitimate changes in the environment that make some aspects

of the project redundant, or simply because of manipulation by the players to get the project more attention. In other words the solution takes a shape that reflects a mix of *"doing the right job"* and *"doing the job right"*, with *"doing the right job"* in this stage consisting of developing a robust conceptualization of problem definition and the appropriate alternative to solve the problem, and *"doing the job right"* consisting of the skills and strategies required for successfully emerging from the pre-history stage. Without the appropriate balance of these sometimes-conflicting elements the project could take a shape that is not the most effective for solving a particular problem or it may fail to get out of this stage. To emerge from this stage, the project must take a shape that is seen as an appropriate solution to a problem or need, and is now worthy and capable of being pursued.

2.1.2 Project Development

If the events that take place during the prehistory period have the effect of bringing the project need to the forefront of the public and political agenda and it takes root, steps are then taken to further conceptualize, and plan the project. This stage requires tremendous expertise to define the project, prepare environmental studies, identify sources of funding, and form support coalitions among citizens, business groups, politicians and others.

Players and Activities

One or more project champions typically working with the resources of a government agency usually organize the efforts in this stage. He or she must assemble the personnel necessary to address all the issues necessary to bring the project to implementation. At this point organizers have to respond to a multitude of constituents within and outside of the impacted geographic and political area including various citizen organizations, local government agencies, businesses and community organizations. Many of these constituents may not be supportive of the overall goals of the project, and could in fact have interests that are potentially in direct conflict with these goals.

Federal and local government agencies play a crucial part in the approval, permitting, and funding process that begins in this stage. In some projects private sector financial sources are equally important. Citizen organizations tend to enter the process in larger numbers during this stage as they respond to environmental review documents, and make suggestions to improve the project from their standpoint --or try to get the project stopped all together. Local business interests become more involved at this point as they try to exert influence to make the project more favorable to their interests. Politicians also weigh in more at this stage attempting to secure more political capital by pushing for alternatives favorable to their target constituents. Proponents of alternative expenditures may attempt to block the project or become linked to it to advance their interests. The press also plays an important role in keeping the public aware of the developments on the project.

Primary Threats

This stage requires tremendous expertise and a lack of effective government organizations can pose a threat to the successful completion of all the necessary activities. The existing government organizations may not have the administrative or managerial capacity to get these tasks completed. Coordination between and among multiple state, municipal, and federal entities is also an essential part of this stage if the project is to progress and an uncooperative environment can present a significant threat. Strong government leadership is also essential in putting the necessary pieces in place sticking with the project throughout the tough times that will inevitably arise, where the project can be severely delayed or could be terminated. The amount of controversy can overwhelm the project at this stage, as multiple constituents empowered by various government statutes and political leverage can move to delay or stop the project. The active constituents at this stage are often more strongly focused on avoiding adverse environmental impacts, especially on abutters, than on the services to be provided by the project in the future, as the future customers are not yet cognizant of the project. There is also competition for financial support with alternative possible initiatives with different beneficiaries and timeframes, which must be successfully resolved during this stage.

"Doing the right job" during this stage involves developing adequate consensus on problem definition including strong attention to the needs of the eventual customers, and defining a preferred alternative to proceed into procurement effectively, while *"doing the job right"* relates to the efficiency and skill in completing the necessary process. Excessive focus on *"doing the job right"* can obscure the more fundamental issue of defining the *"right job"*, introducing flaws which may not become visible until much later.

If it can successfully navigate this stage, enhancing the design to a point where it can be put out to bid, getting the key approvals, permits, and funding, the project can now move out of this stage and into the procurement stage.

2.1.3 Procurement

Once the activities necessary during the project development stage are successfully completed the focus turns to actually implementing the project. This requires that the services and products needed in order to put the project together will have to be procured. This stage --the procurement stage-- involves designing a strategy to match the project's needs with the producers' capabilities, and designing a bid and award process.

Players and Activities

The magnitude and complexity of tasks involved in these projects precludes them from being implemented solely by government employees, and most of these tasks are in fact, done by private sector companies. From a geographical perspective, much of the specialized capacity may have to come from other regions or countries, but be tailored to the local context. The task of the project champion or government agency then becomes one of developing a procurement strategy that will align the needs of the project with the various private sector capabilities. There are usually many different approaches that can be taken to procuring the services necessary to undertake the project, although there are some instances where government regulations prohibit the use of a given methodology. For example, some states have required by statute that all publicly funded projects be procured using a design-bid-build (DBB) procurement methodology. Some of the other

procurement methodologies that can be used in procuring the services for delivery of a public infrastructure project include: Design-Build (DB), Design-Build-Operate (DBO), and Design-Build-Operate-Maintain (DBOM).

Primary Threats

As opposed to the prior stages the threats in this stage are associated with the difficulty in aligning owner needs, interests, and financial capacity with producer capabilities and interests. These threats will come in the form of limitations in procuring the project, influence of interest groups, and the divergence of owner and producer objectives.

Political figures are usually directly involved in the decisions regarding procurement and they invariably try to ensure that their constituents or political allies get a piece of the 'action'. Often the project has to be procured such that local companies will be guaranteed contracts for the implementation. Contractors and manufacturers have a vested interest in how the project is procured, as this directly relates to the likelihood of them getting business from the project, so they may try to influence the choice of procurement methodology. Because of their heavy dependence on government contracts, large engineering-consultant firms have long relied on political connections and influence (Hughes, 1998). These groups of contractors and manufacturers often belong to large professional organizations that advocate the use of a particular procurement methodology. For example, the American Society of Civil Engineers (ASCE) usually lobbies for infrastructure projects to be built using a Design Bid Build (DBB) approach. Additionally on projects subcontractors will seek "filed sub bid" to ensure access for contractors, disadvantaged business enterprises seek "set aside" elements of work, labor unions seek "project labor agreements" to require use of union workers, while non-union contractors seek "open access". There is also the threat of legal action in this stage should these interest groups and participants in the procurement process believe that they were unfairly treated --it is not uncommon for producers that submit losing bids to file suit claiming an unfair process.

The *"right job"* emphasis during this stage is to conceptualize an approach that will maximize the likelihood of eventual success, and includes developing a strategy for selection of good "partners in implementation" and effective management and oversight mechanisms. Doing the *"job right"* is often perceived as smooth implementation of the process and achieving the lowest bid, within the engineers' estimate. The threat here is that the *"right job"* emphasis may be dangerously constrained by the options available. An apparent successful procurement process may result in a low bidder who becomes adversarial and seeks to make profit through a combination of low quality and change orders. Doing the "*right job*" may involve very clear specifications and quality requirements that may result in higher initial bid, or selecting other than the low bidder, which may be perceived as conflicting with doing the "*job right*".

Once the strategy has been designed and the contracts put out to bid (usually via a request for proposal), and contracts awarded, the private producers set out to deliver the specific aspects for which they are now contractually responsible, and the public overseers set out to oversee and monitor implementation.

2.1.4 Implementation

The implementation stage is defined as the stage where the different elements of the project are brought together. This stage involves performing and managing a wide variety of complex tasks, and may be the most critical in determining whether or not the project will be a success. This is not to ignore the fact that the implementation strategy is actually determined in the preceding stages. However, this is where the project becomes truly exposed and errors occurring here are the most difficult to fix and have the greatest potential to send the project off course.

Players and Activities

Implementation typically entails a wide variety of construction and manufacturing processes requiring a large number of personnel from multiple complex organizations. For example, in a rail transit project construction activities would include building guideways and stations, manufacturing activities would involve building the vehicles and

other system components, these necessarily being done by multiple organizations each with their own customs and interests. This stage usually requires a lot of the agency's resource, mostly in an oversight and coordinating capacity, to ensure that the implementation tasks are completed and coordinated according to plan, that payments to contractors are timely and proper, and costs and schedule control are achieved. In addition on projects receiving funding from external sources, these sources may put in place mechanisms to oversee the use of their funds. Where a Design Build Operate Maintain (DBOM) approach is used to procure the project, the oversight and coordinating requirements are theoretically lessened as a single entity is responsible for more of the project and has longer-term obligations and interest in ensuring that the project is built properly, but in reality this simply moves the location and primary accountability for the integration of these activities from the public to the private sector, potentially making the job of monitoring and oversight more difficult.

Primary Threats

The threats in this stage are associated with getting the project delivered in a manner consistent with what was desired. Threats here include the likelihood of encountering engineering complexity beyond what was foreseen, and that could put a strain on the available pool of resources to implement the project. For example, highway engineers designing the new Woodrow Wilson Bridge did not know that they would ultimately have to dredge half a million more cubic yards of river muck from the Potomac[3]. This added, and almost certain, complexity can raise the cost of the project significantly and if adequate contingencies are not in place could drain resources from other activities, create public embarrassment and controversy, and undermine effective implementation of all the elements in the project.

In addition to the complexity and diversity of tasks that must be completed during this stage, many countervailing forces may exist as the project means different things to different people each pursuing goals born of their own interpretations. For example, construction companies may see this as a construction project where they simple have to

[3] Alan Sipress, Washington Post Staff Writer Thursday, October 5, 2000; Page B01

meet design specifications, and they typically do this in a way to maximize their profits. This is exacerbated where low-bid is used as the basis for awarding contracts and contractors retained on this basis move to aggressively reduce cost delivering whatever quality they can get away with. Even the most carefully worded contract will present contractors with the opportunity to extract more money than what was awarded by using claims as a way to increase their take.

The innate divergence of objectives between the owner and the producers underscores the importance of effective oversight and coordination during this stage. Absent an effective entity representing the public's (owner) interest the contractors (producers) may well behave in a manner detrimental to the owner's interests.

The problem of ambiguity of who is the customer, and how are customer interests protected can become severe at this stage, as producer interests have such a major stake and so dominate sources of information that they can become "surrogate customers", defining the terms of "success".

A particular problem at this stage is that the "culture" of the problem may change, implementation requires the assembly of large numbers of employees new to the project who define 'success' as *"doing the job right"* with cost and schedule compliance. Avoidance of controversy and construction disruption may not be included in the implementation definition of *"doing the job right"* and such things as environmental commitments may be at risk. Also, because the people who will be responsible for operation and maintenance have often not yet been identified, it is often very difficult to maintain focus on *"doing the right job"*. Often accommodation with contractors can be reached which appear desirable to maintain cost and schedule but introduce flaws, which reduce quality or increase cost of operating and maintenance.

The media can be a major and unpredictable factor at this point, often focusing on cost and schedule and seeking controversy. Because the sources of information are

numerically substantially devoted to implementation tasks, the media are likely to focus on cost and schedule, exacerbating the primary threats.

Once this stage is done and the elements of the system that make it functional are in place the operations and maintenance stage begins.

2.1.5 Operations and Maintenance

Upon completion of the implementation stage the project enters into the operations and maintenance stage. This is the period during which the project really undergoes the test of failure or success. In the case of a rail transit project riders start to use the system reflecting the demand for service.

Players and Activities

In most cases the only player that maintains an active role in managing the project at this stage is the agency responsible for operations and maintenance. However, if a DBOM approach was used to procure the project, the DBOM contractor is responsible for at least the first few years of operations. Other players that are involved in this stage and affect the way the project performs are labor unions, and the operations and maintenance staff in general. They are the ones on the front line ensuring that the project remains operational.

This is also the stage where funding agencies typically come in to make an assessment of their investment. The federal government may commission studies to determine how cost effective the project was, in terms of cost per new transit riders, or other standard measures. Other interested parties may also try to make an assessment of how effective the project was, for example, officials from other cities interested in doing a similar project.

Primary Threats

Once these systems are built, their budget is often reduced to a bare minimum, as there is apparent diminishing return on investment --as perceived by politicians who might take

the view that spending money on new projects would provide greater political return. If the operating budget is not adequate then there is the danger of reducing frequency of service to avoid cost, which can reduce the level of service and reduce ridership. The low-budget threat can also lead to failure to perform adequate maintenance. Initially, poor maintenance may not translate into visible problems, as the system is new. But as time goes by this will present a serious problem. High quality bus feeder systems, which may have been a presumption of the initial plans, may be ignored for either lack of jurisdiction or lack of funding. Even more pernicious, if adequate budget for bus services are not available, resources can be prioritized to help support the rail system with feeders, abandoning or cutting levels of bus service in other markets.

Operations personnel who now come to dominate the culture of the organization often define *"doing the job right"* as meeting short-term measurable criteria of cost and operation, focusing on trains and vehicles and staying within budget, rather than on serving customers. Maintaining focus on the less easily measurable *"right job"* of good quality service to customers and long-run customer satisfaction and ridership growth is a major challenge. This problem is exacerbated by the fact that the actual customers are diffuse and not organized, so again "surrogate customers" dominated by producer interests (public employees, labor unions, contractors, and real estate developers) may seek to fill this void.

After a few years of operations, the project becomes absorbed into the environment and the environment around the project begins to be reshaped as a result of (or in spite of) the project's existence and operations.

2.1.6 Long Range Use and Socio-Economic Restructuring

Following a sustained period of operations changes in land use and other socio-economic restructuring may begin to take place as a result of the service being provided. These changes take a long time to occur, but the operating agency must be aware of them in order to adjust service to meet evolving needs and support and facilitate the restructuring

of land use. The types of changes that occur as a result of the project being in operation could also represent the true test of how successful it is.

Players and Activities

Since this stage refers mostly to the environment around the project and not the project itself, the players and activities often occur beyond the project jurisdiction. Citizens may begin to change their travel habits and make employment and residential choices as a result of the project. Private developers and business interests may move to take advantage of the project's existence by building properties in its service area in an attempt to capture some of the value it brings to an area. Local officials may also move to change zoning regulations in view of the changes brought about by the project.

Primary Threats

In most cases, projects were conceived with notions of inducing long-range changes in the socio-economic landscape of a region. However, given that in most cases the operating agency responsible for the project once it is implemented has neither the experience nor the jurisdiction to affect land use changes or actively affect socio-economic conditions, there is a threat that these changes will happen in an independent and possibly counterproductive manner. In cases where high quality pedestrian access, essential for transit oriented development, and high density development conflict with bus operations or park and ride facilities, operations oriented agencies often will focus priority on the bus and park and ride operations, and lack the expertise to develop approaches to accommodate all of these objectives (the Bay Area Rapid Transit is a good example of this problem, where park and ride priority seems to have precluded station area developments).

The dominant operations culture in the organization is likely to perceive *"doing the job right"* in operational terms of carrying the riders who show up within available budget. Maintaining focus on less easily measured long-term definitions of *"doing the right job"* by building customer satisfaction, ridership, mode share, and land use optimization, and securing adequate budget support for effectiveness is typically a major challenge.

Whether by direct and planned or through independent actions the environment will evolve around a project and the landscape will inevitably change for better or worse. For example, what long-term effect did the New York City and the Toronto subways have on the city and its population? What impact did Boston's elevated orange line or central artery have on long-term quality of life? Surely they had some long-term effect on how the social and economic landscape evolved, although the transit and highway agencies might never have seen these issues as falling within their responsibilities.

2.1.7 Summary of the Six-Stages in the Life of a Project

In summary, there are six stages that cover the life of a large public infrastructure project: (1) the prehistory; (2) the project development; (3) procurement; (4) implementation; (5) operations and maintenance; and (6) its long-range use and the related socio-economic restructuring in the surrounding environment. The stages are characterized by the types of activities that are performed, the players that performed them, and the threats that are faced in each stage. Table 2.1 summarizes the stages and the characteristics of each stage in terms of some of the activities, players, and threats associated with each stage.

Table 2-1 Summary of the Characteristics of the Six-Stages in the Life of a Project

Stages	Activities	Players	Threats
Prehistory	- Conceive, study and promote idea	- Project champions - Politicians - Manufacturers - The Media	- Lack of effective government organizations - Competition for space on the agenda - Competition for financial support
Project Development	- Further Conceptualize /Design Project - Build Support Coalitions - Secure Funding - Secure Environmental Permits	- Project Champion - Politicians - Consulting professionals - Lobbyists - Government agencies - Community groups - Businesses - Manufacturing/Construction Interests - The Media	- Lack of effective government structures - Lack of effective government leaders - Controversy - Lack of effective project champion - Costs may be underestimated and/or benefits overestimated in competition for project approval
Procurement	- Design Procurement Strategy - Issue Request for Bids - Award Contracts	- Government agencies - Professional consultants - Politicians - Manufacturing/Construction Interests - The Media	- Restrictions on procurement choices - Limitations of project delivery methods in aligning owner and producer goals
Implementation	- Produce the different elements of the project	- Contractors - Politicians - Consultants - Government agencies - The Media	- "Culture" change with addition of implementation specialists - Low bid problem takes effect - Divergence of producer and owner objectives - Complexity/Uncertainty - Lack of effective oversight - Cost overruns - Lack of cooperation of other jurisdictions
O&M	- Keep project operational (run trains, maintain highways, etc)	- Operating Agency - Unions - Users - The Media	- Low operating budget - Focus on moving trains not people. - Inadequate feeder bus capacity and quality - Inappropriate restructuring of existing bus routes.
Long Range Restructuring	- Adjustment of environment to the project and its service and impacts	- Residents - Businesses, Developers - Other Jurisdictions 'outside of the operating agency	- Operating agency typically has no cross-jurisdictional power and changes occur on a reactionary and most likely independent basis.

2.2 *The Evolution of Planning across the Six Stages*

Planning in such a project is inherently dynamic, and like the project itself, undergoes many different stages. The time a large project takes, the complexity of tasks, and the different political administrations that will preside over it from start to finish, dictates that the planning approach changes from time to time. It is foreseeable that if one person was to be responsible for planning and managing the project for its entire life then a single long-term and system wide planning approach could be adopted. However, from pre-history up through its long-range use, projects tend to outlive many decision-makers, and may undergo planning philosophy changes over time and as they go from stage to stage (see Figure 2-1). We will discuss how the planning processes evolve across each stage, using rail transit projects as the primary focus of the discussion.

During the pre-history stage, the planning of the project can be described as one of *long-term/system-wide* planning where, the project itself is often viewed as a piece of a puzzle, and is envisioned as being part of a long-term solution in the context of the environment in which it will operate. For example, the idea for a mass transit project may emerge as part of a regional economic development plan.

This approach continues into the project development stage where all the alternatives are evaluated and the 'total' effect that the project will have is determined. For rail transit projects seeking federal funding the long-term/system-wide planning that is conducted during the project development stage is somewhat dictated by the *FTA New Start Planning and Project Development Process* (see Appendix I). The first step in the FTA process requires that local officials conduct long-term/system-wide planning that may include regional studies, a major investment study (MIS), a transportation improvement plan (TIP), and a long range plan. The social, economic, and environmental impacts of the project, and of reasonable alternatives, must also be analyzed as part of this process -- hence a broader *long-term/system-wide* approach is adopted for most of this stage.

Once the decision regarding the basic structure of the project is made, and the go ahead (from a regulatory and financial standpoint) is given to undertake the project, the procurement stage begins. This results in a shift from *long-term/system-wide* planning to project planning, where the objective is simply to employ a procurement strategy that will deliver specific elements of the project. This is even more the case in Design Bid Build (DBB) procurement, than it is in DBOM procurement. Nonetheless the objective of the procurement method is mostly limited to the delivery of specific physical aspects of the system at the least cost.

The project planning approach continues into the implementation stage, although, a more apt description of what happens in this stage might be project management. During this stage, a large part of the effort is focused on ensuring that the physical infrastructure is being built according to specifications, and that cost overruns and delays are minimized. At some point towards the end of this stage, as the physical aspects near completion, decision-makers try to get back to a *long-term/system-wide* planning approach, and more attention is given to making preparations for when the actual operations begin. In a rail transit project the elements of *long-term/system-wide* planning that might (belatedly) take place here include the restructuring of bus routes to complement the imminent rail service, establishing a new agency to govern the operation of the service, or advocating policies to encourage station area development.

When the project opens for operations the emphasis is still on *long-term/system-wide* planning as efforts to make the greater environment supportive of the project continue. In the case of rail projects, planners may still be trying to get the modes to act in a complementary fashion or working with various institutions to promote transit friendly policies. When the initial stage of operation and most of the changes that the visibility of the project can inspire are over --the novelty is gone-- the planning may become mostly one of operations planning --making sure the system remains open and functioning effectively. The organization may start to become more bureaucratized where the activities that dominate are auditing and operating, as opposed to marketing, building ridership, system expansion and 'land use and socio-economic restructuring'.

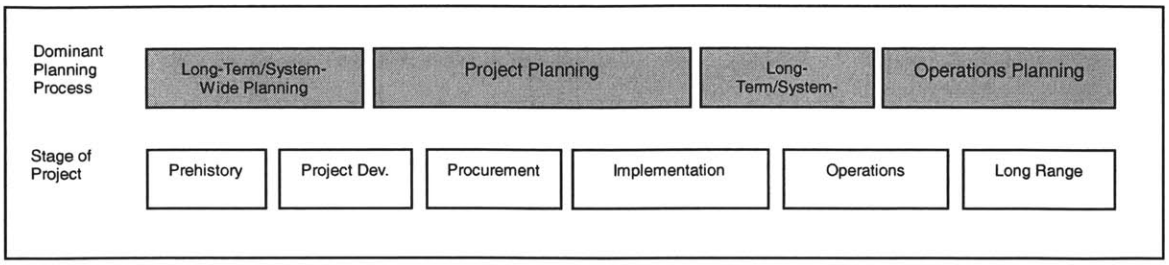


Figure 2:1 The Evolution of Planning Across the Six Stages

Chapter 3: THE REASON PROJECTS MAY 'FAIL' --A BEGINNING ARGUMENT

We will attempt to identify the primary reasons that projects fail to achieve levels of success commensurate with expectations, as a starting point to developing a real-time evaluation framework for improving the likelihood of success in a public infrastructure project (using a rail transit project as the basis for the discussion).

In conducting ex-post evaluations on rail transit projects, some critics have pointed out some of the reasons rail transit projects have not been successful. They have used, as measures of success, how closely a project was able to meet its ridership estimates and at what eventual cost. While we are not suggesting that ridership and costs be the sole determinants of how successful a rail project is, their analysis does highlight some factors that would affect overall success, or at least the perception of success on a project, and hence some useful insights can be gained from their work.

In his report on the "underachievement" of rail transit projects, Pickrell concludes that these projects have failed because they were fundamentally unsound, justified using overly high expectations which were based on faulty forecast assumptions[4]. He conducted his analysis by looking at the inputs used to generate forecasted ridership, putting these into three broad categories:

1. **Demographic Factors**
2. **Transit Service and Fares**
3. **Automobile Costs and Travel Speeds**

[4] "Urban Rail Transit Projects: Forecast Versus Actual Ridership and Cost", Pickrell, 1990

He concludes that errors made in estimating these factors contributed significantly to the shortfall in ridership for the projects he studied[5]. He takes the approach that these forecast were erroneous and unrealistic, however an alternate approach is to say: *these projections were not necessarily erroneous or unrealistic, but simply failed to materialize because the requisite effort and attention was not given to them, especially during the implementation stage*. In other words, the forecasts may have reasonably predicted what levels of ridership could be attained under the stated assumptions, but these assumptions were not addressed with sufficient attention during implementation. For example, in Buffalo, he states that future downtown employment and population in the corridor were over estimated by 39% and 20% respectively. An alternative way to look at this is that, *the efforts needed to promote and achieve these forecasted values of employment and population where inadequate (if at all present) during the implementation of the project*. Of course, it is recognized that these factors may not be entirely controllable, however, greater attention to them than is usually evident could only yield positive dividends.

Contrary to Pickrell's position that these projects probably did not make sense to begin with, we will make the assumption that the project in its basic concept can deliver at least somewhere close to what it was conceived to do --in other words, the project can be successful. It is important to recognize that being overly pessimistic about the potential of large projects can lead to a systematic exclusion of large visionary efforts, and discourage serious efforts at major change, while packages of multiple small projects, possibly of lower value but more readily implemented and with politically distributed benefits, dominate public investments. Therefore, the intent of this thesis is not to discourage optimistic large projects but rather to take steps that would achieve a best-case outcome, while recognizing the danger that the pressure to justify projects in a competitive policy environment can lead to unrealistically high projected benefits and projected low costs, and failure to recognize level of effort required in areas outside the project jurisdiction of transit agencies.

[5] Pickrell conducted his study on ten rail transit projects built with at least partial federal funding during the period 1971-1987. The projects he studied were in the following cities: Washington DC, Atlanta, Baltimore, Miami, Buffalo, Pittsburgh, Portland, Sacramento, and Detroit.

Arguments can be made both for and against the validity of this assumption, but once a project is launched this is the only useful approach to take, and this research is focused on how best to achieve optimal outcomes.

Given this assumption regarding the potential for the project to achieve its goals, we suggest that there are reasons, attributable to conditions at play throughout the project life, that act to prevent or retard the likelihood of success. These conditions are such that, the path from the first stage (setting of goals) to the final stage (actual outcome) of the project is not a linear one. And without a sustained approach based on the long-term goals of the project, in the end the project could be very far from what it was intended to be. The basic argument being that projects may fail because of: *Inadequate Long-Term/System-Wide Planning Throughout the Life of the Project, --with the most significant breakdown taking place during implementation*.

3.1 Inadequate Long-Term/System-Wide Planning

As discussed earlier large public infrastructure projects undergo several different stages prior to their operations, during which time in addition to the complexity of tasks to be performed, dynamic short-term external forces and conditions intervene to influence the eventual outcome. Without sustained *long-term/systemwide* planning throughout the project life, these forces left unchecked have the potential to dangerously divert the direction in which the project goes.

There are many reasons why it is difficult to maintain a *long-term/system-wide* planning perspective throughout the life of a major public infrastructure project, and especially during implementation. Most of these reasons can be defined as falling under the following categories: *political, organizational, jurisdictional, and technical complexity.* Using rail transit projects as the primary case, we will explore the way these factors manifest themselves as barriers to maintaining a *long-term/system-wide* planning perspective during the implementation stage. These factors are not necessarily mutually exclusive in their effects.

3.1.1 Barriers to Long-Term/System-Wide Planning During Implementation

The barriers mentioned above are not limited to the implementation stage, and in fact manifest themselves to varying extents in several stages of the project. However, we will look at them mostly in terms of how they affect the ability to accomplish *long-term/system-wide* planning objectives during implementation. This is because many of the risks to implementation of the original concept are most severe at this stage. Public debate about the achievability of project goals during project conceptualization can lead to either modifications of the goals or commitment of additional resources to achieve them, but once a project is into the implementation stage there is often great disinclination to engage in such discussions. Success is defined as being "on time and within budget" even if that means quietly placing at risk the long-term and system-wide goals.

3.1.1.1 The Political Barrier

Although seldom formally addressed in project planning, political forces can play a major role in any public works projects (Linhart and Kennedy, 1985). In the American democratic system of government, where an electoral term typically lasts four years, large public projects that take a long time from conception to actual operations can become a victim of extreme shifts in governing philosophy as a result of changing political administrations. Over time these projects invariably become exposed to different leadership and the vision under which the project was begun often becomes lost or altered as new leaders with their own priorities emerge from the political process. In addition to the almost inevitable change in political leadership on the project, there is the likelihood that political leadership in affected jurisdictions at the city, state, and federal level, will also change, contributing to the difficulty of maintaining a consistent effort outside of the project jurisdiction towards accomplishing long-term/system-wide planning objectives. The changing political leadership surrounding such a project is illustrated below in figure 3.1 where Boston's CA/T project, which is now in the implementation stage, has seen

since the latter part of the prehistory stage six different governors, three different mayors, and seven different presidents.

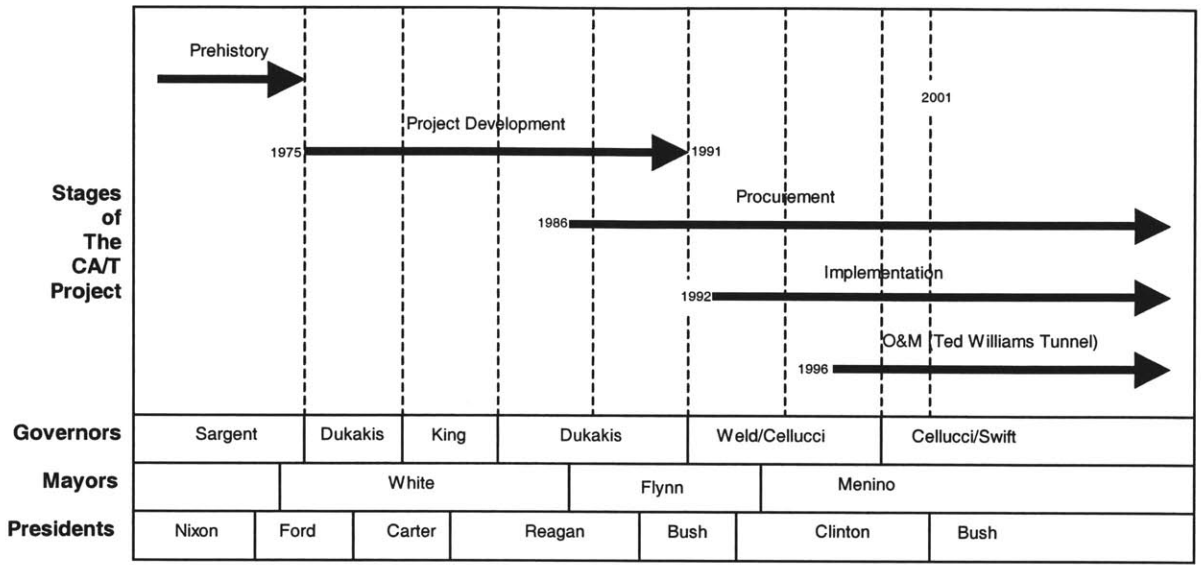


Figure 3:1 Changing Political Landscape Surrounding the CA/T Project

In this operating paradigm, and given that politics and public projects are inextricably linked, it is quite likely that constituents, who feel as though they were not given a fair share of the spoils from the project will align themselves with a candidate who they think will represent their concerns with regards to the project. In addition, the tremendous amount of money expended during implementation generates substantially expanded political pressures by producer interests. The corollary is that members of the opposition (non-incumbent) party are likely to play to these constituents' concerns and should they be elected, act to, in as much as possible, appease these concerns. This is not to say that the concerns of these constituents are not legitimate, however, there are potentially dangerous implications if the project is to alter its vision or direction every four years solely based on politics, and this is definitely not conducive to *long-term/systemwide* planning.

Projects that have been able to maintain a sustained approach to accomplishing *long-term/systemwide* planning objectives are often those that had a project champion or visionary behind the project who was able to stay close to the project throughout. This project champion usually internalizes the vision for the project and uses this vision to establish and manage an appropriate organizational structure to guide the project in a manner consistent with this vision. However, in most cases this visionary or project champion is subjected to a change in the political environment and could lose some or all control over the project.

Another direct consequence of the way the political process works, is the need for short-term tangible results as elections draw near. Much attention is focused on these projects, which requires expenditure of millions of dollars of public funds, and they almost invariably become a part of the political debate. In this environment, project leaders try to "protect" and represent themselves as doing a good job of implementing the project. This often translates into: *withholding of information such as cost overruns; embellishment of accomplishments; or attempts to deliver some short-term tangible results sometimes to the detriment of the longer-term goals of the project.* Contractors can also take advantage of this reality by making demands that will yield a favorable response, given that project leaders are concerned about "perception" around election time.

These are not intended as arguments against the political process since as Levy (2000) put it "saying politics is the problem is like saying gravity is the problem". However, these arguments do illustrate the realities surrounding public works projects that tend to retard *long-term/system-wide* planning.

3.1.1.2 The Organizational Barrier

Once implementation begins the number of players and tasks involved explodes drastically and a suitable organization is now needed to manage and coordinate these multiple players and tasks. The organizational barrier is represented by the challenge in creating an organization to preside over the vision of the project. The ability of an

organization to effectively preside over the implementation of the vision of the project is function of: *governing philosophy, resources, and knowledge and experience.*

Organizational Options

There are two extremes of approaches that can be taken in arriving at the organizational setting within which the project is to be planned and managed. At one end of the spectrum the responsibility for implementing the project could be designated to an existing government agency, for example a construction agency with a State Department of Transportation. At the other end a new public or quasi-public agency could be created for the specific purpose of overseeing the implementation of the project and taking charge of its operations once it is completed. Of course, there are several gradations of approaches between these two extremes for instance: an existing agency may be overhauled and in-house capacity enhanced or a new entity may be created within an existing government agency.

In the first extreme, where the responsibility falls to an existing government agency, the barrier could manifests itself in the form of organizational structures and cultures defined by years of habit, and lacking the necessary experience and understanding needed to manage the new undertaking. This could be a problem, in a case where, for example, a transit agency that has traditionally only overseen the operation of buses, is asked to take responsibility for a rail transit project. They may be ill prepared to oversee a major infrastructure project, and make the adjustments necessary to run a public transportation system, that will have to operate very differently once rail service is added. They have a difficult time making the adjustments, partly because, existing organizations and their existing programs and routines constrain their behavior (Allison and Zelikow, 1999).

On the other hand, where a new agency is created for the specific purpose of overseeing the implementation and operations of the project, the people brought in may have very different views of the project and varying levels of commitment to the local context in which the project exists. These people may have accumulated the necessary experience to

get the job done, but the way they see the project will determine how they interpret their responsibilities and hence affect the outcome of the project.

The importance of having an effective and appropriate organization preside over the project's implementation is induced, in part, by the manner in which the projects are delivered. For all practical purposes, the various elements of a project cannot be packaged together, and are instead broken up into multiple parts. Even when a Design Build Operate Maintain (DBOM) approach to project delivery is used, the project is still essentially produced in parts by contractors who make up a joint venture or partnership. This segmentation of the project into multiple parts underscores the importance of an effective organization to coordinate the delivery of the various elements of the project. Another consequence of the way projects are delivered is the difficulty in aligning the producer's goals with those of the owners. There is often a divergence of objectives between the owners and the producers, and as much as procurement strategies such as DBOM, have tried to mitigate the effects of this separation of objectives by tying the producers' success to the success of the overall project, this gap is often a reality that has to be accommodated. This divergence of objectives requires tremendous diligence on the part of the governing organization in trying to secure the goals of the project and absent an appropriate organization to do this the producers will perform consistent with their own goals and the project delivered will be reflective of this and not necessarily of what the public owner wants.

The Influence of Resource, Knowledge and Experience, and Philosophy

A shortfall in resources or knowledge and experience can much more readily be identified than can a potentially dangerous organizational philosophy. However, an organizational philosophy not consistent with project goals may be more pervasive and insidious in such large and complex undertakings. The nature of a 'new start' rail project is such that an *ad hoc* management team has to be put together to govern its development --hence philosophy is more of an issue as people of various backgrounds and experiences usually form the 'managerial' team. These itinerant managers usually have individual

ideas of what the project means, and although these ideas may not be in direct conflict with the owner's vision they may not be altogether consistent with it either.

Contrasting Views of the Same Project: MARTA, a Case in Point

In retrospective papers on the Metropolitan Atlanta Rapid Transit Authority (MARTA) organization, former general manager Alan Kiepper and project consultant Robert Golembiewski shed some light on the contrasting views that can exist within an organization during the implementation of a 'new start' rail transit project. Kiepper and Golembiewski found that there were three distinct kinds of executives in the organization each of whom related to the overall objectives of the project in very different ways. They classified the groups as:[6]

I. *Those committed to the broad view of MARTA as a means of reshaping the urban form and as a major social and political experiment, with reduction of the potential for racial and class conflict as major priorities.*

II. *Those who accepted MARTA as a vehicle for meeting narrow needs --moving large numbers of people expeditiously.*

III. *Those whose basic way of work and even of life was to see MARTA as an interlude after the previous project and before the next one.*

The sharpest differences occurred between those with the technical responsibilities -- engineering, construction, and operations --and those specializing in relationships with a complex set of external politics[7]. In an interview with the authors (Kiepper and Golembiewski) one executive's comments exemplified the kinds of division of thoughts that existed between these two groups:

> *"I'm a technician; I'm a sort of mercenary, I guess. I open rapid transit systems, and I really don't care about the politics or the philosophy of them. And I don't feel pushed by them."*

---

[6] "Lessons From a Fast-Paced Public Project: Perspectives on Doing Better the Next Time Around", Golembiewski and Kiepper, Public Administration Review, November 1983.

[7] "Perspectives on a Fast-Paced Public Project: Personal Reactions of MARTA Executives", Golembiewski and Kiepper, Public Administration Review, May 1983

Indeed, selling the vision of a project to self-described 'mercenaries', who are hired to do highly specialized tasks may represent an impossible burden, and often the best that can be hoped for is that they do not despoil the vision for the project through mercenary-like actions. Given that the number of professionals engaged to perform and monitor implementation duties will far outnumber the project development team, and that much of the project development team may be dismantled once a project enters implementation, the risk of a significant culture shift in the project at this point is high.

3.1.1.3 The Jurisdictional Barrier

Major projects invariably involve a host of affected agencies; these may include federal agencies, state and local governments, utilities, railroads, public interest groups, private developers, property owners and others (Linhart and Kennedy, 1985). Passive cooperation among these multiple affected agencies is a pre-requisite if the project is to be implemented at all, and in order to accomplish the broader goals that these projects often espouse, active cooperation is essential. The management of public infrastructure projects is traditionally highly centralized and the managing entity has an implicit responsibility to coordinate with and solicit the cooperation of the affected jurisdictions surrounding the project. The jurisdictional barrier here is that in most instances this level of cooperation is difficult to achieve and strategies to accomplish this are often treated as an afterthought.

Distinguishing between Active and Passive Jurisdictional Coordination

Cooperation across jurisdictions can come about either through active or passive participation by the various organizations affecting different areas of the project. Passive cooperation involves such things as a city allowing for expedited permits concerning construction, the relocation of utilities, traffic and curbside loading, and parking adjustments. This kind of cooperation is required at the very minimum if a rail transit project is to be implemented. Public transportation projects, which inherently include several jurisdictions, epitomize the situation in which effective coordination is crucial to a project's completion (Shiels, Moshofsky and Lall, 1985). Securing the necessary

passive cooperation of other jurisdictions often triggers negotiations designed to "leverage" additional payments by the project, driving up project costs. Private owners whose property is subject to full or partial use do the same.

Active cooperation is much less forthcoming, and deliberate actions by local government agencies or private entities to make a city more project friendly is often woefully lacking, especially during the implementation stage. Relevant local government agencies, through the use of zoning ordinances, parking policies, and building codes can help to induce changes that would make a city more transit friendly and thereby increase the likelihood of a successful project. Different ways of promoting greater transit use through local ordinances are described in the Appendices. Private entities such as developers can play their part by undertaking transit-oriented development. Unfortunately these actions are often taken on a reactionary basis after transit has been well established, whereas they could have been used to induce greater transit use from the onset of service --by in effect jumping on board further upstream.

3.1.1.4 The Technical Complexity Barrier

The shear complexity of the tasks that have to be done to create a functional system acts to retard *long-term/systemwide* planning. Tasks such as implementing: tunnels, elevated guideways, stations, and electrical systems, among other things, entail great complexity and are the most obvious ones and they therefore command a lot of attention. Attention to these 'obvious' engineering tasks narrows the focus of project leaders and organizers preventing them from maintaining a *long-term/systemwide* outlook for much of the implementation stage. In addition to the challenges that these complex tasks will present are the unexpected technical problems, which will almost certainly arise during the implementation of these large projects.

3.1.1.5 Summary

In summary, it is difficult to sustain *long-term/system-wide* planning on a project because of: political, organizational, jurisdictional, and technical complexity barriers. The way these manifests themselves is summarized in the table below.

Table 3-1 Barriers to Long-Term/System-Wide Planning

Barrier	Implications for Long-Term/System-Wide Planning
Political	▪ It is difficult to maintain continuity of vision on a project when key decision-makers are likely to be replaced with each new election. ▪ Decisions can be politically motivated, with biases towards political constituencies and allies.
Organizational	▪ The passing of the torch to an organization does not necessarily mean that it can effectively implement the vision of the project.
Jurisdictional	▪ The necessary level of cooperation and coordination across multiple jurisdictions is difficult to accomplish.
Technical Complexity	▪ The complexity of tasks associated with putting in the physical infrastructure has a tendency to narrowly focus resources around such.

3.2 Summary

This chapter began with a look at what some critics have said were reasons for the failure of rail-transit projects. In concluding their studies, these critics have suggested that some of the recent projects had overly optimistic benefits and unrealistic costs, and probably could not be successful in terms of realizing the projections that justified them. An alternative interpretation of their findings formed the basis of our beginning argument that: *'projects may fail as a result of inadequate long-term/system-wide planning throughout its life'*. We presented an argument that all projects in their basic concept can come close to realizing their original goals, and where they have fallen short is as a result of breakdowns in long-term/system-wide planning --the most significant of which occurs during implementation. This breakdown during implementation is attributed to several barriers, which conspire to retard long-term/system-wide planning; these barriers being identified as: political, organizational, jurisdictional, and technical complexity barriers. It

is the hypothesis of this thesis that a continuous process of evaluation during implementation to keep projects focused on long-term/system-wide planning can help overcome these barriers.

"It is impossible to evaluate anything (including evaluation itself)."
---Michael Scriven

Chapter 4: THEORY AND PRACTICE OF EVALUATION

Notwithstanding this scathing indictment of the efficacy of evaluation by one of the leaders in the field, we will use this chapter to present some of the theoretical aspects of evaluation. This will provide a scholarly frame of reference for the investigation and design of evaluation with which this thesis is concerned. From this we should be able to derive some guiding principles for conducting real-time evaluations to help keep projects focused on long-term goals.

At this point, it is worth noting that the theory of evaluation is not well developed in the context of public infrastructure projects, and the literature is reflective of this shortcoming. In contrast, there is a large body of literature concerning the theory of evaluation in the social sciences, and even though social scientists might use different tools to perform evaluations, we believe the underlying theory and core concepts are somewhat universal. As such, the effort here is simply to extract concepts from the theory presented by social science researchers without going into the details of the methods they employ --these often being dictated by context of use. Some of the literature on the practice of evaluation does, however, present contextual evidence from the use of evaluation in government and international development programs and projects -- illustrating some of the unique considerations associated with evaluation in those contexts.

A Brief Discussion on Definitions and use of Terms in the Evaluation Field

One caveat worth brief mention before we enter into the discussion on theory and practice of evaluation is the apparent inconsistency in the definition of certain key terms and concepts by practitioners, including the definition of evaluation itself. It is apparent that although the classic definition of evaluation, which seemed to have gained

widespread acceptance, is "*to assess merit or worth*", the context in which practitioners "*asses merit or worth*" has often had an impact on how key terms are used.

Notably, while such terms as evaluation, appraisal, and monitoring have been used interchangeably by some practitioners, others make a clear distinction between the three. For example, Dale (1998) uses appraisal, in the context of development programs and projects, to mean *'a critical examination of a proposal of a project or program...'* He makes the distinction between monitoring and evaluation by defining the former as: *'frequent largely routine-wise collection and analysis of and reporting on of information on the performance of the work in a program or project, comparison of this with the program or project plans, and connected discussions about and proposals for any corrective action'*. And the latter being defined as *'a more thorough examination, at specified points in time, of programs or projects or parts of them, usually with emphasis on impacts....'*

On the other hand Rossi and Freeman (1993) takes a broader view suggesting that evaluation is inclusive of both appraisal and monitoring, defining evaluation as: *'the systematic application of social research procedures for assessing the conceptualization, design, implementation and utility of social intervention programs'*.

These differences are not significant to our efforts, as the governing definition to *"assess merit or worth"* still prevails, so we will avoid the trap of getting distracted by the nuances of definitions adopted by different practitioners in different contexts. We will instead simply look to extract from the theory and practice some general guiding principles for conducting real-time evaluations. The discussion will be kept at a more general level, only going into the detail (or the contextual) level where this is deemed illustrative, in terms of what we ultimately hope to accomplish.

We will begin by looking at two different approaches to classifying evaluation --one by the perspective from which it is being done (why are we doing evaluation?), and the other by the time at which this evaluation is being done (when are we doing evaluation?). We

will then enter into greater discussion on a sub section of evaluation, which is most applicable to our ultimate objective --bringing this theory to bear on the design of evaluation for use in real-time on infrastructure projects.

4.1 Classification of Evaluation

Evaluation, as a field; covers diverse disciplines, is done in a wide variety of ways, and for an even wider variety of reasons. There are, however, logical categories towards which all evaluations will naturally coalesce depending on the angle from which they are being analyzed. Two separate angles were taken to classifying evaluations in this section. First, they were classified by the perspective from which they are being done, and secondly they were categorized by the time at which they are done.

These two approaches do not lead to mutually exclusive categories, and in fact there is significant dependence between the two, for example, an evaluation from a particular perspective might dictate the time at which it be done. Nevertheless taking these two approaches to classifying evaluations provides a triangulation effect where the appropriate intersection of *'evaluation by perspective'* and *'evaluation by time'* should give rise to the set of principles most applicable to our objectives.

4.1.1 Classification by Perspective of Evaluation

A review of the literature on the use of evaluation in government settings has yielded a shortlist of some of the common purposes for evaluation, these include: *to measure and account for the results of public policies and programs; to strengthen institutions and improve managerial performance; and to gain explanatory insights into social and other public problems and into past and present efforts to address them*[8].

[8] Chelimsky, E. "The Coming Transformations in Evaluation" Evaluation for the 21st Century, 1997.

These purposes differ with regards to the questions they ask and the choice of methods to conduct the evaluation. For example, *"to measure and account for results"* implies asking questions and choosing methods to determine what results were obtained from a particular effort and at what cost. The second purpose listed, *"to strengthen and improve managerial performance"* implies that evaluation is more of a participatory exercise where the evaluator must engage the 'client' in the evaluation with a view to identifying deficiencies and recommending potential areas for improvement. To gain *"explanatory insights"* suggests that the evaluator has to extend his or her questions to explore the fundamental nature of problems and the capacity of a particular effort to address that problem.

These three distinct purposes can be categorized in accordance with a particular perspective on evaluation --the view with which they are being done. The first purpose mentioned above suggests an accountability perspective for evaluation --looking back, did we achieve what we set out to achieve, and at what cost? The second suggests a development perspective --making an assessment to improve ongoing undertakings. The third suggests a knowledge perspective for evaluation --what have we learned about the fundamental nature of problems and the capacity of certain projects and programs to solve them? These are the three general perspectives towards which practitioners in the field of evaluation (as it relates to government settings) conclude all evaluations will tend to coalesce:

1. **Accountability**
2. **Development**
3. **Knowledge**

4.1.1.1 Accountability

Of cardinal concern to entities that have a stake in any endeavor, but most especially to sponsors of such an endeavor, is establishing accountability. To borrow a definition from the use of evaluation in social development programs but one that seems to speak to the essence of accountability in all settings --accountability is[9]:

> *"...the capability and the responsibility to account for the commitment of resources in terms of program results or outcomes. This accounting involves both the stewardship of resources and the evaluation of achievements in relation to specific outcomes."*

This form of evaluation is probably most pervasive and well documented in government settings --a government entity spending millions of dollars of taxpayer money on a project or program needs to account for how this money was spent, the value that was obtained, and to assess efficiency (comparative costs for similar projects). This need for accountability in government settings has been institutionalized in the form of offices of inspector generals, auditors, oversight agencies and others. Accountability evaluations also exist in the private sector, although formal institutions to conduct such are often made unnecessary by the discipline induced in a competitive market environment.

Accountability evaluations may involve fairly straightforward tasks such as analysis and comparison of payments on a project with the payment schedule laid out at the beginning or on comparable projects. It could, however, be as extensive as measuring the impact of a government welfare program, where the variables that go into the model are neither easily identified nor easily measured. Given the complex considerations that often motivate government projects and programs, conducting accountability evaluations is often at best a crude approximation as societal benefits and costs are not always easy to identify and quantify, and depending on their nature cause and effect relationships might be impossible to isolate.

---

[9] Boone, E. J. *Developing Programs in Adult Education.* Englewood Cliffs, NJ: Prentice-Hall, Inc., 1985.

Evaluators charged with conducting accountability evaluations are expected to be objective and independent of the project or program they are supposed to be evaluating, this means they should not be advocates for or against the project/program. These evaluators are typically not extended much welcome by the targets of their evaluations and their findings are often a source of controversy.

4.1.1.2 Development

The desire to improve performance of projects, programs, and organizations, is what drives decisions to undertake evaluations from the development perspective. In the development perspective evaluation is intended as a tool to provide insights for improving performance. This is usually from the standpoint of, among other things, lessons learned, experience gained, change in environment, and technological innovation. In performing this kind of evaluation evaluators might look at the processes by which outcomes are produced or look at the specific outcomes themselves to determine areas in need of improvement.

Public sector entities typically have some sort of internal evaluation to assess how well they are performing, and ostensibly to guide improvements in performance. They may additionally hire external evaluators to assess their performance; this would tend to happen where a new political administration or new director takes charge of an entity. Development evaluation in the private sector is arguably a lot more common given the pressures of a competitive market environment that forces private sector companies to continually look for ways to improve their performance lest they be pushed out of the market.

In this kind of evaluation the evaluator is viewed as a close friend of the program, project, or organization seeking to assist it in improving its performance. In many ways the evaluator is an advocate of the 'general mission' and is simply looking for ways to improve the likelihood of achieving this mission. In this regard development evaluators are considered by some accountability or knowledge perspective evaluators as more like "consultants" than "evaluators". This kind of evaluation implies that there is a feedback

loop for evaluation whereby results are used to improve a project while it is being implemented, a program while it is still underway, and organization as it is still functioning.

4.1.1.3 Knowledge

The knowledge perspective of evaluation is where evaluation is used to gain greater insight and understanding into the issues that determine how effective a project or program will be. This enhanced understanding is often used to improve the design of future projects or programs. These knowledge seeking kinds of evaluation often "change the way social issues and programs are framed: they change the level of realism about what might be expected to result from a certain type of program; or they foster generalizations about how programs operate".[10]

Knowledge perspective evaluations are often commissioned or performed by sponsors or researchers who have an interest in developing new methods for solving problems. Ideally evaluators performing knowledge perspective evaluations should be independent, having no advocacy biases that could taint their efforts.

4.1.1.4 Summary of the Classification of Evaluation by Perspective

To summarize, there are three distinct perspectives from which all evaluations are done -- accountability, development, and knowledge. Accountability could be succinctly stated as *'evaluation to ensure responsible use of resources'*, development as *'evaluation to improve an ongoing initiative'*, and knowledge as *'evaluation to enhance understanding'*.

Table 4-1 Summary of Evaluations Classified by Perspective

Accountability	Development	Knowledge
Make assessment of how responsibly resources were spent.	Improve projects, programs or organizations.	Enhance understanding of the issues that affect project/program effectiveness.

[10] "Lessons Learned in Evaluation over the Past 25 Years", T.D. Cook, 1997.

The table below summarizes these three different perspectives on evaluation looking at them along nine dimensions.

Table 4-2 Perspective-Based Evaluations and their Position along Nine Dimensions[11]

Dimension	Accountability	Development	Knowledge
Purpose:	To measure results or value for funds expended, to determine costs, to assess efficiency.	To strengthen institutions, to build agency or organizational capability in some evaluative dimension.	To generate insights about public problems, policies, programs and processes; to develop new methods and critique old ones.
Need for use to fulfill purpose:	No.	Yes.	No.
Typical Use:	Policy use, debate and negotiation, enlightenment, governmental agency reform, public use.	Institutional or agency use as part of the evaluative process, public and policy use.	Enlightenment use, policy, research and replication, education, knowledge base construction.
Evaluator Role re Client:	Distant.	Close: the evaluator is a "critical friend" or may be part of a team.	Distant or close, depending on evaluation design and methods.
Independence:	A pre-requisite.	Little need.	Critical.
Advocacy:	Unacceptable.	Often inevitable, but correctable through independent, outside review.	Unacceptable, but now being debated.
Acceptability to clients or users:	Often difficult but may be helped by negotiation.	Easy if no threat is posed.	Clients may ignore or shelve findings they do not like.
Objectivity:	High.	Uncertain (based on independence and control).	High (when advocacy is not present).
Position under policy debate:	Can be strong (depending on leadership).	Uncertain (based on independence and control).	Can be strong (if consolidation and dissemination channels exist).

[11] "The Coming Transformations in Evaluation," Eleanor Chelimsky, 1997.

4.1.2 Classification by Time of Evaluation

An alternate, albeit directly related, approach to classifying evaluation, is a classification based on the time at which they are done --with the time at which evaluations are conducted being a function of their desired use. For example, an evaluation intended at gaining greater insight (the knowledge perspective) would be done after a project/program has been completed and outcomes have been generated. An evaluation from the development perspective would necessarily be done during the implementation of the project or program, while evaluation from the accountability perspective could be done during or after the project or program is completed. Looking at the way evaluations are classified by time offers opportunities beyond what looking at them solely from the perspectives angle would have. Specifically, we can immediately identify the kind of evaluation (by time), which is of obvious applicability to our ultimate objective --the design of real-time evaluation.

With regards to a project or program there are three distinct times at which an evaluation can be done: before the project, during the project, or after the project. The literature identifies these three categories as:

1. **Ex-Ante/Preformative**
2. **Ongoing/Formative**
3. **Ex-Post/Summative**

4.1.2.1 Ex-Ante/Preformative

Ex-ante or pre-formative evaluations are conducted prior to the implementation of a project or program, often as an essential part of the decision-making process where decision-makers use the results of this evaluation to guide their decisions on design or appropriateness of a project or program. In deciding whether or not a project/program is worth undertaking decision-makers look to this kind of evaluation to gain some presumptive estimate of the potential costs and benefits, using the information coming out of the evaluation to support their decisions and refine project/program design.

An advocate, who may then commission an independent assessment, typically does the 'first' ex-ante evaluation of a project or program. Additionally, depending on the funding and regulatory environment advocates may have their project or program evaluated by funding or regulatory entities. In the context of new start rail transit projects, an ex-ante evaluation is akin to the candidate appraisals[12] done by the FTA, where the decision to approve or provide funding for a project is made based on its projected effectiveness *vis-à-vis* other competing projects. From the standpoint of the local entity advocating these projects a formal ex-ante evaluation allows them to substantiate their claims regarding the needs and benefits of their project.

In the public sector there are often several layers of ex-ante evaluations by internal as well as by external evaluators, the former usually being from an advocacy standpoint and the latter from an objective standpoint[13]. This multi-layered ex-ante evaluation process may result in changes in the design of a project/program or could result in a decision to abandon the project/program.

4.1.2.2 Formative

Formative evaluation is typically done on a recurring basis during the implementation of a project or program. It would normally be a follow on from the ex-ante evaluation, and is primarily aimed at making improvements to the project/program by identifying deviations from guidelines and more generally identifying aspects of the project/program that can be improved based on lessons learned or changes in the environment.

It is safe to say that this kind of evaluation exists, at least informally, on almost all projects/programs, where members of the in-house staff are continually doing formative evaluations. In most cases key decision makers internalize the evaluation function, using the 'results' to guide their decisions from the top without initiating any formal process. However, in some cases it is institutionalized and formal evaluation mechanisms are

[12] Please note that some practitioners differentiate between evaluation and appraisal while still others see evaluation as inclusive of appraisal.
[13] The natural tension that will exist between advocate and independent reviewer could be an opportunity to introduce an institutional framework to represent these two positions throughout the project or program.

implemented by internal managers or by external parties such as funding or regulatory entities.

The extent and applicability of formative evaluations usually vary depending on, among other things, whether it is being done on project or program, the nature of the project or program, the philosophy of internal managers, and the external pressures to do them. The difference in extent and applicability of formative evaluations on projects versus programs is partly due to the fact that the scope for improvements on a project (which usually involves significant fixed infrastructure) tends to be limited, while programs (which usually have more flexible elements) tend to have greater scope for evaluation-induced improvements. For example, a dam building project has a fairly narrow scope for improvement once implementation gets underway, since substantive improvements might mean re-planning the entire project. On the other hand, a program to reduce infant mortality rate in a developing country can be substantially improved, based on lessons learned throughout the program. Probably for this reason as well as some of the other reasons mentioned above, formal processes for performing formative evaluations are mostly associated with development programs sponsored by some external agency.

Given that formative evaluations are primarily conducted for improvement purposes the potential for controversy and tension to arise from the process is somewhat limited. However, since inevitably formative evaluations, if done right, will identify deviations from guidelines that may exist in the implementation of the project or program there is the chance that it could be viewed negatively and the evaluators position as a 'critical friend' undermined. It is important to recognize this when performing formative evaluations so that steps can be taken to improve the likelihood of having evaluators viewed in the more idealistic 'critical friend' sense.

4.1.2.3 Ex-Post/Summative

Summative evaluations are undertaken after the completion of a project or program and are aimed at making a judgment on effectiveness (Dale, 1998). This it does by relating

the end results (outcomes) to the beginning expectations (goals), often by quantifying and assessing the costs and benefits.

These evaluations are often done internally, although advocacy in evaluation in this case could lead to a less than objective analysis. For funding or regulatory agencies an external (non-advocacy) evaluation might also be required, since once an agency sponsors an initiative its interest might be to present it as being successful in justification of its sponsorship decision.

4.1.2.4 Summary of the Classification of Evaluation by Time

To summarize, evaluations can be categorized in accordance with the time at which they are done, falling into the following three distinct categories: Ex-ante, Formative, and Ex-post. Ex-ante being done prior to implementing a project or program, formative during the implementation of a project or program, and ex-post after the completion of a project or program.

Table 4-3 Summary of Evaluations By-Time

Ex-Ante	Formative	Ex-Post
Before project/program.	During implementation of a project/program.	After the completion of a project/program.

4.2 Reconciling the Different Approaches to Classifying Evaluations

As was mentioned earlier, it is readily obvious that the two approaches to categorizing evaluations presented have significant overlap while at the same time provide an opportunity for us to zero in on the area (the appropriate overlap of the two approaches) of most potential applicability to our efforts. Using evaluation by-time as the lead we will highlight the intertwining nature of the two approaches before moving on to discuss in greater detail the most applicable kind of evaluation (arrived at by the right combination of evaluation by-time and by-perspective).

4.2.1 Ex-Ante Evaluation from Different Perspectives

Where an ex-ante evaluation is being done to justify a project to stakeholders it overlaps with evaluation from the accountability perspective in the sense that it sets up the accountability parameters for use both during and after the project. Said another way, promoters of a project can be held accountable for the results their ex-ante evaluations predicted. An ex-ante evaluation is related to evaluation from the knowledge perspective in the sense that it usually draws on insights gained from knowledge perspective evaluations on prior projects of a similar nature. Conversely, knowledge perspective evaluations on a given project often revisit what was presented in the ex-ante evaluations to determine what the objectives were to start the project.

4.2.2 Formative Evaluation from Different Perspectives

Having as its primary objective, the improvement of a project or program, formative evaluations are predominantly done from the development perspective[14]. However, since formative evaluations implicitly involve making a determination of possible deviations

[14] Conversely, evaluations from the development perspective imply that the evaluation is being done during the implementation of the project/program.

(or slippages) relative to some guidelines, greater accountability can be an outcome of this kind of evaluation. The findings of formative evaluations can be an input to accountability mechanisms --so that managers can be held accountable for the performance of the activities, which they manage (Mackay, 1998).

However, with the primary motivation of formative evaluations being to improve a project of program (consistent with the development perspective), and the possibility that in using the findings in an accountability sense the 'critical friend' role can be undermined, an appropriate balance is necessary. Should managers feel that the findings lead to greater pressure on them to be accountable rather than assist them in locating areas for improvement they will be much less receptive to the evaluation. At the same time, should the evaluations downplay significant deficiencies in the performance of activities, it could lose credibility with external parties such as the media. In reality formative evaluations involves an inherent challenge in balancing the need for credibility with the need to be viewed as a 'critical friend' so that internal managers will be receptive to the evaluation and at the same time external parties will accept it as an honest assessment.

Formative evaluations can be considered as being related to evaluations from the knowledge perspective in the sense that the findings from formative evaluations can be an input when conducting knowledge evaluations at the end of a project/program. Again, this could raise the issue of 'critical friend' versus potential adversary, where internal managers might be fearful that they will be criticized in knowledge evaluations if they failed to effectively incorporate the findings of formative evaluations.

4.2.3 Ex-Post Evaluation from Different Perspectives

Ex-post evaluations are done after the completion of a project or program and can be performed from either the accountability or knowledge perspective or both. In performing ex-post evaluations from the accountability perspective, the essential question is: how effectively and efficiently was implementation done? These can be commissioned

internally with the findings used as, among other things, performance incentives for managers or contractors, or to justify the decision to undertake the project/program to begin with. In seeking to evaluate the decision to sponsor or otherwise support a project, external agencies may also commission an ex-post evaluation that attempts to measure the results obtained.

Ex-post evaluations from the knowledge perspective are aimed at providing insights into how to best achieve favorable outcomes from similar projects/programs in the future -- how to do it better next time around?

4.2.4 Summary of the Relationship between the two Approaches to Classifying Evaluation

In summary, the two approaches to classifying evaluation that we presented have significant overlap and in many cases are simply two sides of the same coin. The table below (Table 4-4) shows how the two are related, and the figure (Figure 4-1) is an expanded summary that includes some additional dimensions.

Table 4-4 Matrix Relating the two Approaches to Classifying Evaluations

By-Perspective \ By-Time	Ex-Ante	Formative	Ex-Post
Accountability	- Set up accountability parameters.	- Ensure performance/ responsible use of resources.	- Determine what was accomplished and at what cost.
Development	- N/A	- Improve project/program.	- N/A
Knowledge	- Ex-Ante Evaluations typically, at least implicitly, incorporate lessons from prior Knowledge Evaluations, and typically forms the basis for new Knowledge evaluations.	- Formative Evaluations can provide some early insights for use in Knowledge Evaluations.	- Draw conclusions on the effectiveness of a particular project/program design.

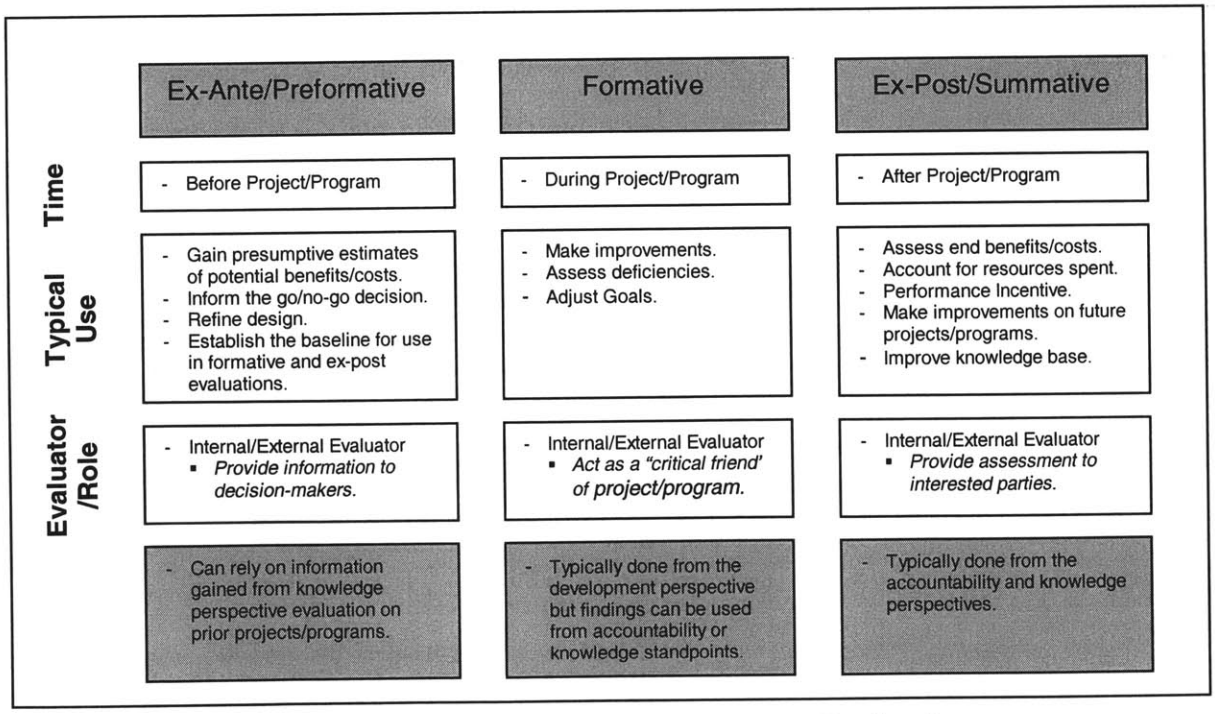


Figure 4:1 Characteristics of Time-Based Evaluations

4.3 Formative Evaluations in Focus

In looking to do real-time evaluations during the implementation stage of a project, and based on the discussion on the different types of evaluations presented, formative evaluation is the one that is of obvious relevance to our efforts. And in fact another way to describe formative evaluations might be as real-time evaluations during the implementation of a project aimed primarily at making improvements to that same project. Therefore we will focus on formative evaluations as the kind of evaluation that most closely resembles what we want to do.

To give greater direction and provide a more disciplined way to look at formative evaluation as the kind of evaluation that can be applied during the implementation of public infrastructure projects we will present a discussion on the kinds of evaluations that currently exist on public infrastructure projects. This will better illustrate where formative evaluations might fit in on these projects. Following this we will discuss a formal process for doing formative evaluations.

Evaluations on Public Infrastructure Projects

Typically at the front end of all large public infrastructure projects extensive ex-ante evaluation processes must be completed. During the prehistory stage of these projects, proponents or project champions as they are described in the six-stage model, implicitly perform evaluations to determine whether or not their project idea can in fact solve a problem as they see it. Others may also perform formal and/or informal evaluations during this stage to determine whether the project is an idea worth supporting or is one that should be opposed.

If the project gets to the project development stage ex-ante evaluations become a lot more formal, as required by statutes or as required by funding agencies. This is the case, for example, with the FTA's candidate appraisal process where in addition to proving its worth for funding, ex-ante evaluations must also be performed to determine

environmental impacts as required by NEPA and other such statutes. Unfortunately the emphasis on performing extensive ex-ante evaluations during the project development stage to gain relatively broad consensus on the appropriate design of the project is not extended to conducting formative evaluations during (in real-time) the implementation of the project.

While it is safe to say that disparate elements of formative evaluation exist on all these projects it is usually not nearly as formal and well coordinated as the ex-ante evaluation processes are. Instead there is an apparent assumption by the agencies that required an extensive ex-ante evaluation that the project design coming out of these evaluations is robust enough to reduce the need for formative evaluations.

Ex-post evaluations may be commissioned and performed by internal and/or external parties on the project. Federal or multinational agencies that sponsor projects usually require that an ex-post evaluation be done. This is mostly aimed at making a judgment on how effective the project was in terms of accomplishing its stated objectives and at what eventual cost. There are also times where researchers working with some independence perform such evaluations (see John Kain[15], Don Pickrell[16], etc), typically drawing conclusions about the effectiveness of the project relative to other alternatives.

Given the extensive and very formal nature of ex-ante and ex-post evaluations, and the challenges that each project will inevitably face in between these two evaluations it seems as though a formative (real-time) evaluation with the same level of emphasis should be carried out during the implementation of the project. Unfortunately, this is often not the case, although at the end of the ex-ante evaluation process logical steps can be taken to conducting such formative evaluations.

[15] "Cost Effective Alternatives to Atlanta's Rail Rapid Transit System", Journal of Transport Economics and Policy, John Kain, 1997
[16] "Urban Rail Transit Projects: Forecast Versus Actual Ridership and Cost", Don Pickrell, 1990

Formative Evaluation as a Continuation of Ex-Ante Evaluation

During ex-ante evaluations the goals of the project/program are presented and its "*merit or worth*" determined based on the value of the goals and its potential to achieve these goals. In other words, the need for the project/program is identified and evaluated, and then the design of the project is evaluated to determine whether the goals can in fact be accomplished through a particular project or program. In this sense, the ex-ante evaluation is a starting point for all formative evaluations since this is where the goals are formally defined and the component factors that affect these goals are designed and analyzed. Formative evaluations are then merely a continuation from the ex-ante evaluation, using the criteria established in the ex-ante evaluation process to guide the evaluation efforts, while acknowledging that the environment is dynamic and both expected and unexpected problems and opportunities will emerge, and this should be incorporated in the formative evaluation process.

Moving from ex-ante to formative evaluation a set of indicators can be identified, which will form the basis of what is to be evaluated during this evaluation. The mechanism that connects ex-ante evaluation to formative evaluation can be a matrix for systematizing the project goals, the elements and factors that will deliver these goals, and a set of indicators for these elements and factors. In the practice of evaluation in the development context this is sometimes referred to as the project matrix[17] or logical framework[18]. This project matrix can then be a guide for performing evaluation activities related to accomplishing the goals of the project. Out of these evaluation activities should come a set of results and or recommendations, which can be used in a development as well as an accountability sense.

Formative evaluations can therefore be considered as a three-step process (iterative) -- that begins with a project matrix (the evaluation scope), then has a monitoring /environmental scanning function (performance of evaluation activities), and thirdly the

[17] *Evaluation Frameworks for Development Programmes and Projects.* Reidar Dale, 1998.
[18] World Bank, Operations Evaluation Department

set of results/recommendations can be used in different ways (use of results). In the following sections we will go into some detail on how a project matrix might be set up, what monitoring/environmental scanning might entail, and how the findings may be used to guide decisions on the project or program.

4.3.1 The Facets of Formative Evaluation

4.3.1.1 Setting the Parameters (Scope) of the Evaluation --The Project Matrix

As mentioned earlier the project matrix can be considered as a bridge connecting ex-ante with formative evaluations. Typically coming out of an ex-ante evaluation are a hierarchy of project goals, the outputs that must be produced by the project to achieve these goals, the implementation tasks required to produce these outputs, and the inputs that are required to perform implementation tasks.

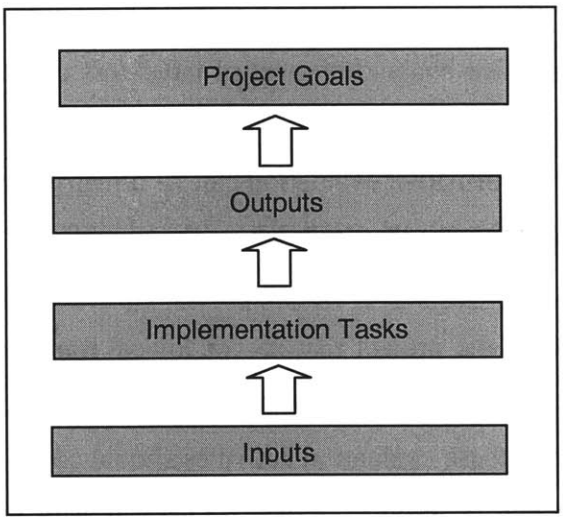


Figure 4:2 Hierarchy of Project Goals, Outputs, Tasks, and Inputs

Project Goals

The project goals are the highest level of benefits that the project is being designed to deliver. Some of these goals could be very specific and measurable depending on the nature of the projects. For example, in building a rail transit project a stated goal may be

to attract and carry 100,000 riders per day. An additional goal might be to increase the level of interaction between upper and lower income communities, which is obviously a much less measurable goal. In order for these goals to be achieved and sustained, not only does the project have to be implemented effectively but the environment also has to remain supportive in the long-term. For example, if a transit project is to remain a well-used system then supportive conditions such as high population and employment densities in the corridor have to be sustained.

Outputs

The outputs are those things that have to be 'produced' in order for the project goals to be achieved. Of course, not all these outputs are necessarily within the project definition or the responsibility of a single entity. In other words some outputs may only come about through complementary actions not within the purview of the project, but are nonetheless recognized as important to the project goals. For example, in rail transit projects, there are typically two categories of outputs. First, there are the outputs that are contractually defined as part of the project -- the guideways, the stations, the vehicles, and other such elements that make the system functional. Secondly, there are outputs that can only be produced by actions outside the boundaries of the project --transit friendly parking and zoning policies, station area developments, employment centers concentrated along the service corridors, and other such outputs that project proponents often assume will be produced when stating the goals of the project.

However, during the 'production' stage there is a tendency to neglect the outputs that are 'external' to the project definition, as multiple jurisdictions may preside over them, and these jurisdictions may not recognize them as priorities. To overcome this hurdle one suggestion has been to define separate projects to be done in coordination with the main project, rather than simply define a major project with the assumption that other actions that could be considered 'smaller' projects will occur concurrently. For example, one may use a transit project to provide the transportation service, a zoning and permitting

program to get the desired land use, and a program to meet environmental goals (UMTA and APTA, 1991).

Implementation Tasks

Implementation tasks are those activities that are performed in connection with producing the desired outputs. In a rail transit project this would include such things as guideway construction, station construction, and vehicle manufacture. And since as mentioned before some outputs can only be produced outside of the project definition, some activities will have to take place outside as well. These include, the passing of revised land use or parking regulations, the undertaking of transit oriented development around station areas, and other such actions leading to the production of outputs complementary to achieving project goals.

Inputs

The input is the fuel that allows all components higher up in the hierarchy to take place, the most obvious one being money. There are, however, some less obvious but equally important inputs such as; political support, skillful and conscientious managers, and active cooperation among responsible jurisdictions.

The Project Matrix

The project matrix systematizes the goals, outputs, implementation tasks, and inputs for a given project and further identifies the external factors that will affect each of these components. It then presents a set of indicators or benchmarks against which the progress of each of these components can be measured. Of course, developing a comprehensive matrix for a large complex project is a major challenge.

Table 4-5 Dimensions of a Project Matrix[19]

PROJECT HIERARCHY	INDICATORS	EXTERNAL FACTORS
PROJECT GOALS The highest level benefits that the project is supposed to deliver.	Measures to verify the extent to which goals are met.	External conditions, events or decisions, which are necessary to sustain these goals.
OUTPUTS The things that need to be in place in order to achieve project goals.	Measures to verify the extent to which outputs are being produced.	External conditions, events or decisions, which are necessary for creating outputs.
IMPLEMENTATION TASKS The tasks that have to be undertaken by the project in order to produce the outputs.	Measures to determine the extent to which tasks are being done.	External conditions, events or decisions, which are necessary for conducting these tasks.
INPUTS The resources needed to undertake the work.	Measures to determine availability of resources.	External conditions, events or decisions, which are necessary for obtaining the inputs.

4.3.1.2 Performing the Evaluation Activities

Once the scope is established the next step is to perform those evaluation activities dictated by this scope. In real-time evaluations there would essentially be two classes of activities: monitoring and environmental scanning. Of course, the ability to perform these activities and perform them effectively will depend on such things as the nature of the issues to be evaluated.

Monitoring

Monitoring can be a relatively straightforward task when the indicators are objective and easily identified. For example, in a construction project the level of completion of activities relative to a schedule can be easily monitored. However, in cases where the indicators do not lend themselves to easy identification, monitoring can become a lot more difficult. An example of this is where the level of cooperation between two agencies is the indicator of how likely it is for them to deliver a jointly produced output

[19] Table adopted from: Evaluation Frameworks for Development Programmes and Projects – Dale Reidar

on schedule. Indicators governing such things as quality of construction would also fall into the category of hard to identify and measure. Unfortunately with the relative ease of monitoring issues with quantifiable objective indicators and the difficulty of doing the same for issues with more qualitative and subjective indicators comes a bias towards doing what is easier and neglecting what is harder. Where there are quantifiable measures and subjective ones, the quantifiable ones always dominate (Weinberg, 2000).

Environmental Scanning

Environmental scanning differs from monitoring in the sense that it does not rely solely on a comparison with a plan or standard, but extends to monitor the environment surrounding the project, looking to detect all things of potential concern to the project goals. Douglas Eadie recognizes the importance of environmental scanning by stating that: *in a time of constant, rapid environmental change, environmental scanning and strategy formulation must be ongoing activities if an organization is to respond effectively to both threats and opportunities*[20]. Environmental scanning implies that there is a systematic approach to observing and factoring in the impacts of a dynamic environment. This is of particular importance where a project is being implemented over a long period of time and exposure to the environment is prolonged.

4.3.1.3 Using the Information Stemming from Evaluation

The third step in formative evaluation involves the use of results from the monitoring and environmental scanning activities. In the limited definition of evaluation, the results are reported but not necessarily incorporated into the decision-making process[21]. However, in the more useful definition, the results are inputs into decision-making. Of course, there will be limitations to how the findings will be used as for example, not all the actions that are related to accomplishing a project goal will fall under a single jurisdiction. However,

[20] "Putting a Powerful Tool to Practical Use: The Application of Strategic Planning in the Public Sector," Eadie, Douglas, Public Administration Review, September/October, 1983.
[21] It could be argued that it is when the results of monitoring and environmental scanning are used to make decisions in a strategic sense that it truly becomes evaluation.

on any given project, if all the relevant jurisdictions be engaged, the findings of formative evaluation can be used to: inform decisions about appropriate resource allocation; drive re-engineering; improve or reshape the management of the project; and adjust goals should this be necessary.

Allocation of Resources

Where it is determined that outputs are being under-produced it might be necessary to commit additional resources to the production of such an output. Likewise if it becomes evident that additional outputs might be needed to achieve the project goals decisions can be made to reallocate resources to produce these outputs. In this sense the results from the monitoring and environmental activities can be used to inform decisions on how best to allocate resources.

Drive Reengineering

In situations where it is determined that, for example, the outputs necessary cannot be produced as a result of fundamental deficiencies in design or unexpected developments or if new methods become available to better produce the outputs, changes in the 'production design' can be made. An example where this could happen is where a strait crossing was to be accomplished by a bridge but during implementation unexpected challenges made such a bridge unfeasible while at the same time new tunneling methods made tunneling an attractive alternative.

Improve Organization and Management

Inadequacies in the organization and management of a project may be identified as being detrimental to project goals. In such a case the evaluation could lead to restructuring or improvement in the way the project is organized and managed.

Adjust Goals

Finally, results from the monitoring and environmental scanning activities could be used to adjust the goals of a project. This could be, for example, in cases where it is deemed impossible to achieve the goals as defined at the outset. For example, if a stated (albeit

limited) goal of a transit project is to have 100,000 riders per day by the end of the first month of operations, and the information gathered during implementation suggests that this is no longer a feasible goal then the number could be adjusted downwards. There may also be cases where a more positive adjustment might be made to the stated goals or new goals might be added based on developments in the environment.

4.3.1.4 Summary of the Facets of Formative Evaluations

Formative evaluations can be considered as a continuation of ex-ante evaluations where the ex-ante evaluation introduces the project goals and the hierarchy of outputs, implementation tasks, inputs, and external factors that combine to achieve these goals. These can then be organized in a project matrix where corresponding indicators are identified. From this evaluation activities can be performed to determine the level of progress towards project goals, or to generally identify threats or opportunities related to these goals. The results and recommendations coming out of the performance of evaluation activities can then be used to guide decisions on a real-time basis. This framework for conducting formative evaluation in a generic sense is summarized and shown in figure 4.3.

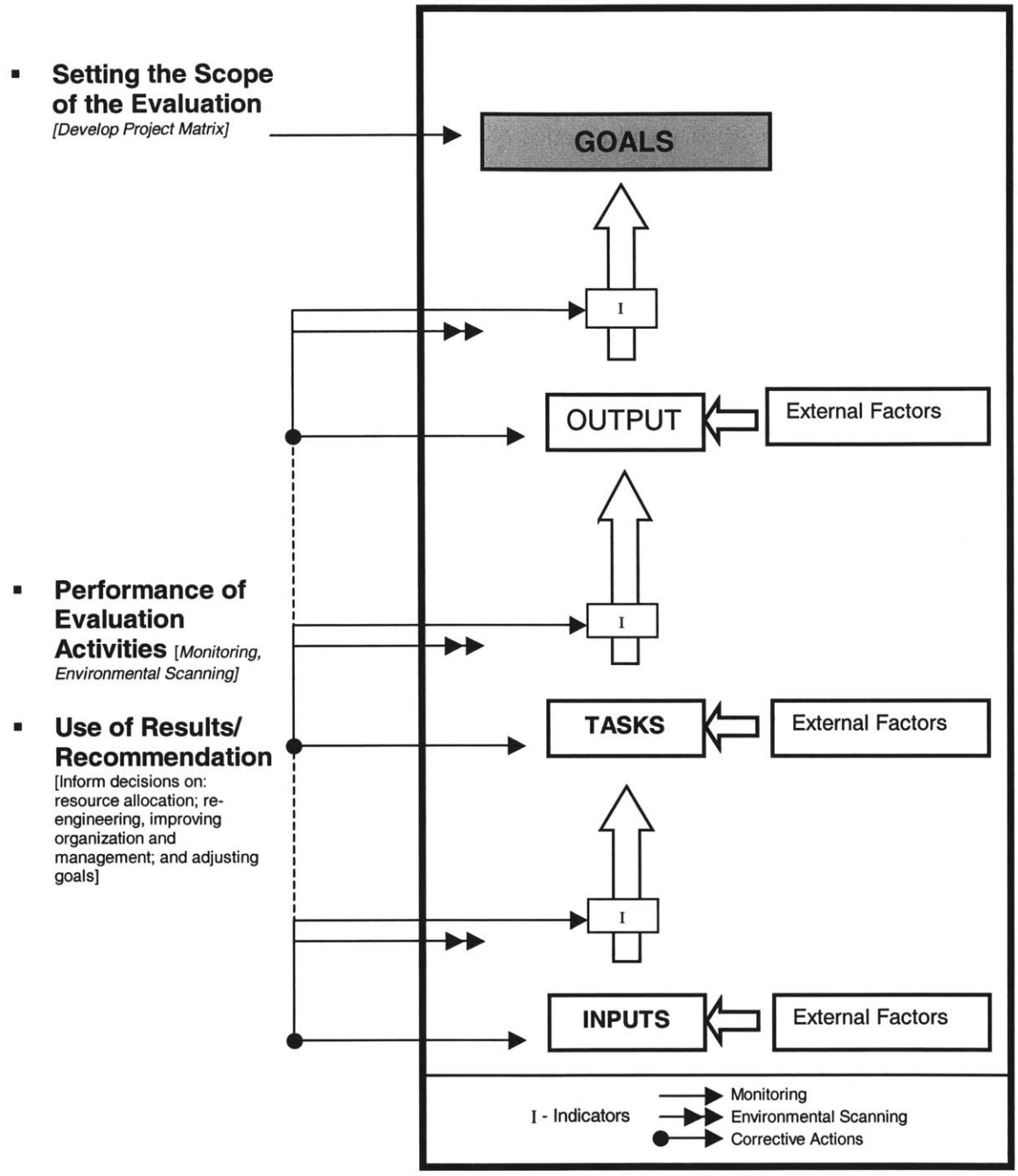


Figure 4:3 A Structural Framework for Performing Formative Evaluation

4.3.2 What Role Can Real-Time (Formative) Evaluation Play in the Success of Projects?

The material concerning the theory and practice of evaluation presented in the preceding sections provides an insight into some of the principles governing evaluations. We identified and focused on formative evaluations as the kind of evaluation that most closely resembles what we propose to do in this thesis --real-time evaluation. The challenge now is to use these principles to guide the development of real-time evaluation specific to the needs of a public infrastructure project. To do this we will further clarify, as a means of giving greater direction to the effort, the role that we believe real-time evaluation can play in helping to ensure success on these projects.

Our argument as to why projects may fail is that *'projects may fail as a result of inadequate long-term/system-wide planning throughout the life of the project'* --with the most significant breakdown occurring during implementation. Our proposition, which forms the basis of this thesis, is that *'real-time evaluation can help to ensure success on a project'*. In essence what we are saying, given this argument and this proposition, is that real-time evaluations can help to facilitate *long-term/system-wide planning* during the implementation stage of a project.

4.3.2.1 Facilitating Long-Term/System-Wide Planning

This, we believe, it can do by: *[keeping in mind the vision of the project laid out at the onset, and the range of issues that need to be addressed for it to be successful in terms of accomplishing this vision] perform real-time evaluations that can determine whether or not the project is on course to accomplish this vision from which applicable corrective actions can be taken.*

In this sense real-time evaluation can provide a systematic approach for relating developments on a project to the likelihood of accomplishing long-term goals, and since many of the issues that determine success are system-wide in nature, it can help to keep the focus system-wide, where the tendency might otherwise be to neglect those issues not

falling under the project definition (those elements not contractually defined as part of the project). Of course, this is what real-time evaluation can do in a theoretical sense, and practical considerations and challenges will inevitably come to bear when attempting to conduct real-time evaluations in the same vein on public infrastructure projects.

Real-Time Evaluations as a Source of Truthful Information

As a by-product, albeit a very important one, real-time evaluations from which truthful and objective information regarding a project can be obtained can fill a void that currently exists on many public infrastructure projects. All projects have, at the very least, some form of public information process, but these evaluation processes do not necessarily present (or at least are often not perceived as presenting) truthful or credible information with regards to the likelihood of meeting project goals. The concern of many project leaders that bad news should be kept a secret often results in a high incidence of "spin", designed to give the impression that everything is going according to plan in place of truthful information. In this regard, the public affairs offices on these projects are often seen as little more than sources of official "spin". There are, of course, exceptions where some project leaders have taken the philosophical position that openness is a desirable trait of good management on public projects (Armstrong, 2000). Such was the case on the Boston Harbor Project, where Doug MacDonald and his management team presented all the important developments to the public[22]. However, more often than not, leaders on these projects take the position that bad news is best dealt with on an internal basis, and resort to "spin" when presenting information to the public.

On the other hand there is the media, whose members in many ways present themselves as independent evaluators --looking into the issues on the project and holding project leaders accountable. Unfortunately, since most of the information lies with the members of the project's leadership team, without a leadership environment amenable to their efforts, getting this information can be a truly difficult task, and if and when received it is hardly ever timely. In this modus operandi, the media has two options: one is to accept

[22] This was additionally brought on by the presence of a court order mandating such...but without a supportive management it would not have been so well accomplished.

spin disseminated by the project leaders and treat it as truthful information; and the other is to become adversarial and aggressively seek to find out the very things that the leaders do not want them to, and quite possibly distort information emanating from unhappy members of the project team.

An objective and open real-time evaluation would represent a middle ground between these two kinds of evaluations --the one by internal managers and political leaders looking to protect the image of their project (and the public view of their stewardship), and the other by the media who may be looking for headline-grabbing news about the project. Such an evaluation could provide benefits to both these 'evaluators'. Project leaders would find the media much more inclined to believe the findings of the evaluation (which would invariably include some negative information) and less likely to become adversarial, intent on unearthing or putting a distinctly negative spin of information. In turn the press would have a place to look for information on the project without being suspicious of that information. In principle this could make for a much more fruitful relationship between the project and the media rather than the adversarial one that seems to emerge during the implementation of many public projects.

In summary, we believe that real-time evaluation can help to achieve success on a project, by facilitating *long-term/system-wide* planning throughout the project life. It can do this by providing a systematic approach to identifying and incorporating threats and opportunities related to accomplishing long-term goals, many of which will be system-wide in nature. It can also provide a middle ground between the standard kinds of 'evaluations' that seem to exist on public works projects --internal and most likely biased evaluation versus external and potentially adversarial evaluation commonly done by the media.

Chapter 5: BEGINNING PRINCIPLES FOR PERFORMING REAL-TIME EVALUATIONS

Given what we have presented thus far --*the proposition that real-time evaluation can help to ensure success on a project; the dynamics surrounding a large public infrastructure project; an argument as to why they may fail; and a discussion on the theory and practice of evaluation*-- we can now present some beginning principles for performing real-time evaluations on public infrastructure projects.

From the theory and practice of evaluation we identified a type of evaluation that had relevance to our efforts. This type of evaluation --*formative evaluation*-- is usually done on a recurring basis during (real-time) the implementation of a project, with the intent to improve. This was viewed as the evaluation from the theory and practice that was most consistent with what we termed *real-time evaluation*, which is evaluation that could be conducted on a real-time basis during the implementation of a project, with the intent to maximize the likelihood of success. Therefore beginning principles will be based in large part on the theoretical discussions on formative evaluations.

In the chapter immediately following this one we will use these principles to guide the presentation and discussion of two cases that approximate real-time evaluation mechanisms in the context of public infrastructure projects. Using these principles to guide a discussion on cases that actually exist on public infrastructure projects provides an opportunity not only to see how they compare to the principles, but also to find out what some of the practical considerations and challenges might be. To facilitate this discussion we will present the principles in a 'framework for analysis' manner.

In presenting the principles in this 'framework for analysis' manner, there would essentially be two levels of analysis in looking at a real-time evaluation mechanism for

the purposes specific to this thesis. First, the principles that determine how well it performs as a generic evaluation mechanism, and secondly, the principles that determine how well it would perform as a mechanism to influence long-term/system wide planning on a project. In the following sections we will discuss these two different levels of analysis and what they might entail.

Dimensions of Real-Time Evaluation: Two Levels of Analysis

In examining the effectiveness of an evaluation mechanism, both in terms of its capacity to identify problems, issues, and other factors that relate to the long-term goals of a project, and its capacity to influence project success by facilitating long-term/system-wide planning, there are two levels of analysis. The first being: an analysis to determine how well the mechanism will perform as a generic evaluation mechanism. In other words, does it have the capacity to identify and analyze all the determinants of success on a project? The second being: an analysis to determine if the mechanism is 'positioned' such that it does in fact help to facilitate long-term/system-wide planning. We will present the principles according to the following two levels.

1. **What Defines a Real-Time Evaluation Mechanism?**
2. **How can a Real-Time Evaluation Mechanism Facilitate Long-Term/System-wide Planning on a Project?**

5.1 What Defines a Real-Time Evaluation Mechanism?

From the theory presented in chapter 4 we can conclude that there are three main facets that define a real-time evaluation mechanism: its scope, its ability to effectively perform the activities related to its scope, and the way the results/recommendations coming out of the performance of those activities are used.

1. **The Scope of the Evaluation**
2. **Performance of Evaluation Activities**
3. **Use of Results/Recommendations**

5.1.1 The Scope of the Evaluation

The scope of a real-time evaluation mechanism is basically the range of activities, processes, and issues that is to be evaluated during the implementation of a project. Typically, this is established at the onset of the evaluation as part of the mandate of the mechanism. Ideally it should be as comprehensive as possible where all areas that relate to accomplishing project goals are covered in the scope of the evaluation. For public infrastructure projects this would necessarily mean that included in the evaluation's scope would not only be those issues that are contractually defined as coming under the project jurisdiction, but all other issues which can either directly or indirectly affect project or program success (this might include looking at such things as the political, economic, or social environment). In this sense the evaluation is not just being done from an internal manager's point of view where the concern is delivering the specific elements for which he/she is responsible, but from the point of view of accomplishing broader project goals. However, while the definition of scope should be as extensive as possible beginning with the primary elements identified in ex-ante evaluation, it is unlikely that all the things that will affect the project can be identified before the project gets underway. In defining the scope then, this should be acknowledged, and while a comprehensive list should be defined to begin with, the scope should also be open.

Two factors that could influence the way the scope of an evaluation is defined are the interest or stake the entity commissioning/conducting the evaluation has with regards to the project and the dominant perspective with which the evaluation is being done. That is the interest or stake of a given entity might determine what it identifies as the evaluation's scope. Likewise the dominant perspective with which this entity is commissioning/conducting the evaluation might influence the way it defines the evaluation's scope.

5.1.2 Performance of Evaluation Activities

After the scope of the evaluation has been defined the next step is performing those activities to address the areas of concern presented by the scope of the evaluation. This involves choosing applicable methods for conducting monitoring and environmental scanning activities. Ideally performance of evaluative activities would be just a matter of giving the directive on what to do based on the scope of the evaluation, however, in reality this is not the case. In fact, the relationship between the performance of evaluative activities and the definition of scope can be considered as a mutually re-enforcing one. Where the constraints on what can be done often dictate what is defined in the scope. In other words, if there are no tools to evaluate a certain area of concern then the dangerous tendency would naturally be to exclude that from the scope of the evaluation.

Some factors that might influence the performance of evaluation activities include the nature of the issues to be evaluated, the amount of resources the evaluating entity has, and the ease of accessing relevant information. That is some issues will undoubtedly be easier to evaluate than others, the amount of resources available to the evaluating entity could be crucial to its ability to effectively perform evaluation activities, and the relative ease with information (data) can be accessed could be a major factor in determining how timely and 'exhaustive' the evaluation can be done.

5.1.3 Use of Results/Recommendations

The final step in the evaluation process is the presentation and/or use of the results/recommendations stemming from the performance of evaluation activities. As noted in Table 4.1, in order for an evaluation from the development perspective (which is the dominant perspective of formative evaluations) to fulfill its purpose it must be used. Ideally all the findings coming out of the evaluation should be directly incorporated on the project, without any 'leftovers' in the form of recommendations confined to documentation. Successful formative evaluation is thus like the state in ideal communism --its content should wither away (Scriven, 1991).

Some factors that might influence the way the results and/or recommendations coming out of the evaluation are used include: credibility, power, and the constraints on actions. That is the amount of credibility the evaluating entity enjoys with those in a position to act on the results and/or recommendations could be critical in determining what gets incorporated on the project. The power that the entity commissioning/conducting the evaluation has over those who would act on the evaluation's findings could reasonably be expected to be a major factor in determining how and if these findings are used. Of course, there may be constraints on what results and/or recommendations can actually be acted on.

5.2 How can a Real-Time Evaluation Mechanism Facilitate Long-Term/System-Wide Planning on a Project?

5.2.1 What does Long-Term/System-Wide Planning Mean?

In getting at what will define a real-time evaluation mechanism as a mechanism that does in fact facilitate long-term/system-wide planning we will first breakdown the concept of long-term/system-wide planning into two parts --long-term planning and system-wide planning.

Long-Term Planning

Simply put, long-term planning is where all decisions are made and planning is done in the context of accomplishing the long-term goals of a project, rather than just 'in the moment'. This does not necessarily mean that long-term goals are static, but only that the view taken when making decisions is consistently long-term. In fact, it is quite likely that at least minor adjustments to the project goals will be required, given that these goals were initially set and supported by countless assumptions made several years in advance of implementation. *Long-term planning is therefore where all decisions and the planning agenda are driven by the long-term goals (updated as necessary and in a systematic manner) of the project.*

System-Wide Planning

System-wide planning is where all the issues that have the potential to affect the long-term goals of the project are being accounted for on the planning agenda in parallel. In this regard, system-wide planning is concomitant to long-term planning. In other words, *system-wide planning efforts are in support of achieving long-term goals.*

Given this description for long-term/system-wide planning, we can now say what the mechanism should be able to do as it relates to facilitating this kind of planning on a project --*it should be able to help maintain/update long-term goals on a project and concomitantly keep system-wide issues in focus*. This, of course, has some implications

for how the evaluation mechanism, as discussed in the prior section, is designed to begin with --the three facets (scope, performance of evaluation activities and use of results/recommendations) must be designed with this in mind. In other words, the scope of the evaluation should be inclusive of all the issues (system-wide) that affect long-term goals on the project. The evaluation activities (information gathering and related analyses) must be performed in a manner consistent with this objective. And the results/recommendations must be made and used in accordance with this objective.

In terms of functioning as a mechanism to maintain/update long-term goals on a public works project and concomitantly keep system-wide issues in focus, there seems to be two overarching issues at play here. First, does the mechanism or its supporting institution have a good understanding/appreciation for vision (long-term goals) of the project? And secondly, is it empowered to, after having commissioned and/or performed real-time evaluation consistent with this vision, take appropriate actions to achieve this vision? Put in a more succinct way --the mechanism (or a supporting institution) should be a *trustee for the goals of the project*.

Some factors that might influence a trustee's understanding of a project goals include: how knowledgeable this trustee is of the history of the project, how sensitive it is to the many interests that will inevitably exist on the project, and how well insulated the trustee is from short-term political currents. The power of the trustee will likely be a function of the role it plays in the decision-making process on the project (narrowly defined) and the amount of influence it has over the other jurisdictions that will invariable have to be engaged to take 'broader' actions related to accomplish project goals.

A Brief Discussion on Mitigated Barriers

Should the mechanism be viewed as the trustee of the project's goals, having the ability to maintain/update project goals and concomitantly keep system-wide issues in focus, it would have in essence gone a far way in mitigating the barriers to long-term/system-wide planning.

Political: Overcoming the political barrier implies overcoming the tendency for an almost inevitable change in political leadership (within and around the project) to lead to an unsystematic change in vision (goals) on the project. New administrations on a project tend to have their own interpretations of the vision for the project and are additionally not usually fully aware of all the system-wide elements that must be given consideration. This happens where the system-wide issues might have been internalized (no formal institution to organize and prioritize these issues) by a project champion who is no longer around, and the new decision-makers don't necessarily have a full understanding of the issues of relevance to the project (especially those without the benefit of being contractually defined). A formal mechanism or institution that understands the vision that founded the project and has the power to act on behalf of this vision helps to mitigate the negative impacts of the relationship between politics and public projects.

Organizational: In overcoming the organizational barrier, which manifests itself as: an organizational capacity (philosophy, resources, knowledge and experience) potentially inconsistent with the execution of the vision of the project, it could be the mechanism that gives direction to, or helps to set the organization's agenda. For example, in cases where the organization has no experience in running a transit system, and would not be aware of the entire range of issues that have to come together for it to work well, it could at the very least identify this as an area in need of attention.

Jurisdictional: The jurisdictional barrier, which manifests itself where many of the decisions influencing project success lie beyond the direct control of project leaders, could be overcome by multi-jurisdictional buy-in into the trustee institution. Ideally, as a trustee for project goals the mechanism (or institution) should actively engage all the jurisdictions that will play a role in project success.

Technical Complexity: Being a trustee for the vision of the project that appreciates the long-term goals of a project and the many system-wide elements that must come together for the project to achieve these goals, the mechanism (institution) provides a way of

viewing all tasks regardless of complexity or visibility as part of the means in getting to long-term goals and not ends in of themselves.

Chapter 6: CASE STUDIES

In this chapter we will present two cases for discussion as mechanisms that approximate real-time evaluation on a public infrastructure project. We will use the principles presented in the previous chapter to guide the discussion on the cases. The objective here is to 'calibrate' what could be considered as the theoretical model with some evidence from the domain of public infrastructure projects. At the onset it is recognized that there are limitations in the way the mechanisms we are about to present perform formative evaluations, and in order to facilitate the discussion some liberty had to be taken. It is additionally recognized that these cases are somewhat different from each other, hence one to one comparisons are difficult to make. However, by analyzing them against the principles for a formative evaluation mechanism we should be able to extract some useful insights for designing formative evaluation entities in the said context --large public infrastructure projects.

The first case that we will present is the Central Artery Environmental Oversight Committee (EOC), which as the name suggests is concerned with oversight of environmental issues on the Central Artery Third Harbor Tunnel (CA/T) project currently underway (in the implementation stage) in Boston, Massachusetts. This case was chosen from a few other evaluation-like mechanisms surrounding the CA/T project including the Artery Business Committee (ABC), the Conservation Law Foundation (CLF), and the Federal Highway Administration's (FHWA) Project Oversight. It was chosen primarily because of all the mechanisms it is the one that has most aggressively tried to perform ongoing evaluations on the broad range of issues that it identified as important coming out of the ex-ante evaluations on the CA/T project.

The other case that will be presented is the Federal Transit Administration's Project Management Oversight Program, which is a federally mandated program administered across transit projects sponsored by the federal government.

The first case is project specific while the other is administered across projects and while this presents challenges in terms of a consistent comparison of the two it offers opportunities to look at how a mechanism can be designed for a particular project and how a more general mechanism to be used across projects can be designed.

6.1 Central Artery Environmental Oversight Committee (EOC)

6.1.1 Introduction

The Central Artery Environmental Oversight Committee (EOC) was established as an independent committee to monitor progress on environmental commitments made in connection with the Central Artery/Third Harbor Tunnel (CA/T) in Boston. The main component of this project is the replacement of an elevated highway with a below ground expressway in Boston's downtown. However, the project extends to include several other components packaged with the project as part of mitigation measures. Commitments totaling over 1300 were packaged as part of the project and detailed in the various state and federal documents required for approval and permitting.

Local stakeholders, with interest in the environmental commitments and fearful that these commitments would be given low priority once the major engineering tasks and the complexities associated with them began, took steps to form a committee that would serve to keep the project leaders honest with regards to these commitments (Weinberg, 2000). The original idea was to create a consolidated list of all the commitments and their respective deadlines from which progress could be easily monitored. According to one of the project advocates, Robert Weinberg, they were concerned that absent such an effort deadlines would be missed and the coalition of support behind the project would start falling apart. Thus the EOC could serve two objectives: "first, it would restore confidence and unify the stakeholders who would likely take up arms if some commitments were being missed; secondly, it would provide focus for the bureaucracy, especially important with the impending change in administration". These concerns formed the impetus behind the creation of a committee of stakeholders to keep track of the commitments and hold the responsible parties accountable.

Committee Membership

The EOC was established in 1991 through an agreement among the Secretaries of the Executive Office of Environmental Affairs (EOEA) and the Executive Office of

Transportation and Construction (EOTC), and three public interest coalitions: Move Massachusetts, the Boston Greenspace Alliance, and 1000 Friends of Massachusetts[23]. These three groups constituted the original committee, however, its membership has since extended to include representatives from: the Artery Business Committee (ABC), the Spectacle Island Park Advisory Committee, the Massachusetts Bay Transportation Authority (MBTA) Advisory Board, and the Metropolitan Area Planning Council. Ex-officio members represent the EOEA, EOTC, and the Massachusetts Turnpike Authority on the committee. A permanent staff member serving as the Executive Director manages and coordinates the activities of the committee.

6.1.2 The EOC as a Real-Time Evaluation Mechanism

6.1.2.1 The Scope of the Evaluation

The EOC monitors and provides progress reports on the environmental commitments in four major categories:

1. **Air Quality**
2. **Traffic Management**
3. **Transit**
4. **Open Space**

A few of the commitments that fall under these four categories are presented below. The list is just a subset and specific items were chosen to give a flavor for the breadth of issues covered and the multiple responsible and affected parties. Most of the information presented was taken from publications put out by the EOC.

1. Air Quality

Evaluation with regards to air quality commitments covers two stages of the project -- those associated with the actual construction, and those associated with post construction (end-state). The commitments associated with construction include: *pre-set standards for ambient air quality, noise, dust, odors, and truck emissions.* Evaluation for end-state commitments includes such things as: *determining whether the project is modeling traffic*

[23] Annual Report, Central Artery Environmental Oversight Committee, 1999

effects on air quality and is designing the project elements to meet air quality standards; determining whether all reasonable measures are being taken to reduce air quality impacts, including traffic demand reduction strategies; and monitoring efforts by the authorities in Boston and Cambridge to strengthen parking freezes.

2. Traffic Management

Evaluation with regards to traffic management covers commitments made for during construction standards and construction through end state standards. Standards associated with construction include: *maintaining traffic on existing elevated Artery and a minimum acceptable number of lanes on surface; ensuring that construction vehicles follow the project's right of way or designated haul routes; plans to expand and encourage use of high occupancy vehicle lanes (HOVs).* The commitments associated with the end-state of the project include: *a set maximum number of lanes in each direction on future surface artery; improvements to vehicular and pedestrian links between waterfront and downtown Boston; input from public agencies and affected local neighborhoods in final designs; conduct intermodal corridor study of Rutherford Avenue and assign high priority to recommend improvements.*

3. Transit

Transit-related commitments fall into four categories: Feasibility Studies, Capital Improvements, Construction Management, and End State. The feasibility studies commitments have included: *a study of expanding bus service to Logan, a South Station to Logan and a North-South Station rail link, circumferential transit, high-speed rail to New York City and to Portland, Maine; and indexing MBTA fares to automobile costs.* Capital improvement commitments have included: *purchasing new MBTA buses and Red Line and Orange Line cars; making improvements at North and South Stations; building South Station bus terminal; constructing 20,000 new park and ride spaces outside the core area or 15,000 to 40,000 at transit and rail stations; and constructing multimodal center at North Station to connect commuter rail to transit and bus lines.*

Construction management improvements have included: *ensuring continuous operation of major public transportation facilities during CA/T construction; maintaining bus services and coordinate route changes with operators; (pending federal approval) provision of additional bus commuter rail, transit, ride-sharing and park and ride services for the peak construction period.* End state commitments included: *placing greater emphasis on traffic demand and public transportation programs consistent with federal and state legislative, regulatory and policy mandates; expansion of the MBTA's capacity by 96% on its four major transit lines (Red, Orange, Green, and Blue).*

4. Open Space

Open Space commitments are divided into seven areas: Area North of Causeway, East Boston, Central Area, South Boston and Four Point Channel, Spectacle Island, Chinatown and South Bay, and Project-wide.

In the Area North of Causeway commitments were made to: *create a system of linear parks, with continuous pedestrian and bicycle access, along both banks of the Charles River from the existing Esplanade to Boston Harbor; create an additional "Portal Park" or plaza to mark the entrance to the MDC's system at Paul Revere Landing and Lovejoy Wharf.* In East Boston commitments were made to: *build a park between Route 1A and Bremen Street to separate the highway from the community, and expand Memorial Stadium Park into an area now occupied by ramps and airport roadways. These parks were to be designed cooperatively with the community, City of Boston, MBTA and the Massachusetts Port Authority (Massport). Pathways were also to be provided to Airport Station on the MBTA Blue Line.*

In the Central Area, which is the areas that will make up the immediate surroundings of the depressed Artery, commitments include: *75% of the parcels of land above the depressed Central Artery to be open space in the form of parks, plazas, park buildings and sidewalks, including the three surface parcels to be programmed by the Massachusetts Horticultural Society (MHS).* Among the commitments made with regards

to South Boston and Fort Point Channel were commitments that: *plans for these areas, with the appropriate attention given to open space and recreational improvements, would be addressed in an environmental notification form filed with the EOEA; and plans for post construction surface configuration and public amenities, such as a park, would be a cooperative effort involving the community, and all interested parties, and led by the Boston Redevelopment Authority.*

Commitments made with regards to Spectacle Island included commitments that: *the CA/T landfill closure would be graded and revegetated to accommodate passive and active recreational uses and conservation; and within two years of capping, construction of a park with a visitors' center, docking facilities, beaches, and trials would commence.* In Chinatown and South Bay commitments were made to: *remove the Beach Street Ramp and create a small parcel that could be developed to form a visually attractive edge and entrance to Chinatown; and to conduct landscaping that would include seating, special paving, and planting of trees and shrubs.* Project-wide open space commitments included: *establishing Citizens Advisory Committees in all areas concerning park development; and holding regular community meetings during the design phase so as to give the public an opportunity to review and provide comments.*

Factors Affecting the Definition of Scope

Interest/Stake: Although the membership on the committee has since extended to be inclusive of wider interests in the area, the founding membership were mostly people who were interested in environmental issues. This interest coupled with the fact that these members figured that the environmental commitments were the ones most likely to be neglected could have led them to target only these commitments for evaluation.

Dominant Perspective: The impetus behind the formation of the EOC was a fear that the numerous environmental commitments would be forgotten or overlooked when construction on the CA/T got underway. It was recognized that these commitments did not have the benefit of being contractually defined elements of the project and absent a

mechanism to ensure that they were being met it was quite likely that they would be ignored. In this regard the committee was designed to hold the project and responsible parties to the environmental commitments that were made --it was designed with a view for holding responsible parties accountable. In this regard the scope is not as open or extensive as it would have otherwise been if the dominant perspective was development (as is theoretically the case in formative evaluations).

6.1.2.2 Performance of Evaluation Activities

The evaluation activities that the EOC perform fall under both monitoring and environmental scanning. In monitoring they gather information on actions being taken with regards to the commitments and compares this to the schedule for progress. The environmental scanning component is where they stay tuned to the current concerns of affected parties, regardless of whether or not these concerns are related to specified commitments.

Some of the commitments have very physical and visible elements and information on progress presents itself in obvious forms. Others are of a much less physical nature, for example, 'a commitment on the part of the project to promote HOV use', and for these the EOC relies on information presented to it by the project. A formal agreement for transfer of information was signed between the EOC and the project, whereby a report on progress made would be presented to the EOC on a quarterly basis (Fanton, 2000). Working meetings are also held between the EOC the CA/T and other jurisdictions to discuss the state of commitments. Additionally, the Executive Director of the Committee independently researches issues that arise. There is also a community meeting whereby citizens can raise concerns with the EOC who can then follow up on these concerns.

Evaluation activities culminate with an analysis of the progress made by project and other responsible jurisdictions on the commitments. The result of this analysis is the assignment of a letter grade to reflect the level of progress that the EOC feels has been

made with the commitments relative to the established 'deadlines'. The grades range from an A to D, with:

A = exceptional progress

B = good progress

C = some concern

D = serious concern

Factors Affecting the Performance of Evaluation Activities

Nature of Issues: The progress made on some of the commitments is easier to evaluate than others. For example, evaluating the progress in *"creating a system of linear parks"* is easier than evaluating the *"level of effort by the authorities in Boston and Cambridge to strengthen parking freeze"*.

Availability of Resources: Although some funding is provided by the EOTC and the EOEA, with the exception of one permanent staff member, the committee is made up of people working entirely on a volunteer basis. The size of the project makes it difficult for such a small almost entirely volunteer staff to monitor the progress on commitments (Fanton, 2000).

Ease of Access to Information: The ease of accessing information becomes doubly important given the limited resources that the committee has to work with. However, getting access to some of the relevant information can be difficult, especially with regards to the commitments that have low visibility. For example, information on commitments by the project to perform studies, or promote programs requires a willingness on the part of project leaders to divulge such information.

6.1.2.3 Use of Results/Recommendations

The EOC reports its findings to the project leaders as well as to the other parties who are responsible for fulfilling commitments made as part of the mitigation. Additionally, it prepares reports for dissemination to interested parties and the public at large. A public

meeting is held every other month, where they also report their findings, and members of the public can voice their concerns. The table below was taken from one of the reports on progress published by the EOC, and is but a small sampling of many commitments that the EOC monitors progress on.

Table 6-1 EOC Sample Progress Report

Phase	Commitment	Grade/Comment
Feasibility Studies	Study feasibility of expanding bus service to Logan, a South Station to Logan and a North-South Station rail link, circumferential transit, high-speed rail to New York City and to Portland, Maine; and indexing MBTA fares to automobile costs.	**B:** All studies are either complete or underway. Most of them are useful tools for planning. Two seemed predisposed to a finding of infeasibility, namely additional Logan express bus services and MBTA fare indexing to automobile costs (which could mean small, incremental fare increases rather than large ones that impact ridership)
Capital Improvements	Build two new docking facilities, and expand inner harbor water transit services to connect points downtown with Charlestown, Logan Airport, and South Boston.	**B (up from a D last year):** All are up and running except the dock at Russia Wharf in Fort Point Channel that is delayed by CA/T construction. Services are operating from the new dock at Lovejoy Wharf (North Station) to Charlestown and South Boston.
Construction Management	Ensure continuous operation of major public transportation facilities during CA/T construction	**A:** MBTA/CA/T construction coordination is a high priority, e.g. at North Station, Aquarium Station and CA/T construction near red line.
End State	Greater emphasis on traffic demand management and public transportation programs consistent with federal and state legislative, regulatory and policy mandates.	**C:** The project's primary focus is on maintaining traffic flow during and after construction, rather than on encouraging shifts to other modes.

Factors Affecting the Use of Results/Recommendations

Credibility: Although at the onset the founding members of the committee wanted to have a partnership relationship with the project, over time an adversarial relationship has developed, where the project leaders now see the EOC as "just a big critic" (Fanton, 2000). In this sense the EOC does not enjoy credibility from the project leaders, but rather are viewed as a group with narrowly defined interests mostly unappreciative of the concerns facing the project.

Power: The EOC has no statutory power to force the project or responsible parties to act on its findings. Without the credibility to convince these parties to act on their findings

and without the power to force them to do so, the parties tend to be very unresponsive to the findings of the EOC, except to the degree media attention can force action.

Constraints: The CA/T project and its leadership have come under intense criticism and scrutiny for being over budget and behind schedule. In this environment the leadership on the project seem to be primarily concerned with getting the project done as quickly as possible and are reluctant to take on any process that might undermine this. In this sense, the project's leadership is constrained in their unwillingness to stop and address the concerns that the EOC's evaluations raise.

6.1.3 The EOC as a Mechanism to Facilitate Long-Term/System-Wide Planning

6.1.3.1 A Trustee for Project Goals

As an evaluation mechanism the EOC was designed to help preserve the goals that are environmental in nature, and although these are an important set of goals they do not represent all the goals of the project --hence as a trustee for the entire goals of the project the EOC is limited. However, by espousing the environmental goals, it acts as a trustee for the most vulnerable subset of the project's goals, and in so doing provides an appropriate counter balance to the traditional evaluations based on monitoring budgets and schedules.

The Dimensions of a Trustee for Project Goals

1. Understanding/Appreciation for Project Goals

In terms of its understanding/appreciation for the vision for the project, the EOC was founded by advocates of the project; meaning they understood and were supportive of the vision for the project. It is also very well insulated from the political process given that its members are not elected officials and do not report to elected officials. This insulation from the political process means that the goals won't be interpreted solely through political lenses. The EOC could therefore function fairly well as a trustee for the entire goals of the project, in terms of its understanding/appreciation for these goals.

2. Power to Act on Behalf of Project Goals

On the issue of having power to act on behalf of the project goals, the EOC has some obvious limitations. First, it has no formal power over the project and as a result cannot force decision-makers to take any action that it might see as relevant to accomplishing the project goals. Secondly, it has very limited active buy-in from the other jurisdictions surrounding the project. The EOC's power was undermined in part by FHWA's failure to include all of the commitments agreed to by the state government in its Record of Decision (Salvucci, 2001). Since the FHWA did not include all the commitments in the

Record of Decision the avenues for recourse should the commitments not be met are limited. Moreover the FHWA has been unwilling to enforce elements included in the Record of Decision, and has actually hampered the project in its efforts to fulfill commitments.

6.1.4 Summary

Being predominantly concerned with keeping the project to its environmental commitments --identifying these as the goals they would target-- the scope of the evaluation is somewhat limited. This is not to say that having key stakeholders target specific goals for evaluation is a bad thing, but as a stand-alone mechanism its scope is not reflective of all the goals on the project. Of course, on any given project should all the goals be actively (and equally) represented by stakeholder groups and their efforts consolidated the ideal mechanism would have been formed.

With the absence of any authority or power over the project the ease of performing evaluation and the way recommendations are used is very dependent on the project leaders' acceptance of such a program, and over time this acceptance has dwindled, and as Executive Director Ann Fanton puts it "...the project just sees us [the EOC] as a big critic". It is difficult enough to evaluate their performance and hold them to the obvious commitments, such as building parks, but to evaluate their progress on promoting programs and conducting studies (without predisposition) is much more difficult.

With regards to being a mechanism to directly influence long-term/system-wide planning by being a trustee for the project goals, the EOC is somewhat limited. Not necessarily in terms of its understanding of the vision, since although it only chose to represent a subset of the goals, its founding members obviously had a good understanding/appreciation for the original project goals. However, in terms of its power to act on behalf of the project the EOC is very limited; having neither the power to force decision-makers to take actions nor the necessary cooperation to have other responsible parties take actions. It is interesting to note that the FHWA, which had responsibility to oversee the environmental

permitting processes, not only did not include all of the commitments but also failed to follow up on any of the environmental commitments in its Record of Decision once it was accepted. And with the power that the FHWA has as a major source of funding there was a genuine opportunity for it to be the EOC's supporting institution. Similarly the State environmental agencies have tended to be passive, acting in many cases only where outside legal intervention has been threatened. In some ways the sheer size and economic importance of the project, bringing over $5 billion in net federal transportation funds into the area may be a cause of reluctance to appear critical of the project.

6.2 The Project Management Oversight Program (PMO)

6.2.1 Introduction

Project Management Oversight (PMO) is a concept employed by federal agencies and some private owners to monitor the effective implementation of their projects (Goode, 1991). As this definition suggests, the PMO concept came about as a result of an owner's desire to ensure that their projects were being implemented in accordance with their expectations. This concept is not new or original to any single entity, and PMO programs of some sort may have existed for as long as professionals have provided specialized services for owners, or investors have funded projects.

In recent times Project Management Oversight has been used extensively in industries requiring high technical sophistication such as the nuclear power industry. During the 1960's, several nuclear investor-owned utilities used design and construction firms in conjunction with nuclear power vendors to build plants under a turnkey agreement. The utility companies took on the role of oversight to assure that specific requirements of operation and maintenance were considered as the project progressed[24]. In this case the owners assumed the responsibility of performing oversight tasks. Since then a variety of independent firms have been used to safeguard owner or investor interests on a project and to meet regulatory requirements.

The Origin of PMO in the FTA

While the concept of PMO is by no means new, it was the Urban Mass Transportation Authority (UMTA)[25] that put the concept on the map for large public projects and advanced its application, when it adopted it for use on its projects. PMO within the FTA in its present state originated in the early 1980s when UMTA [FTA] and the U.S. Congress became concerned over alleged problems of poor quality in construction on the

[24] "Project Management Oversight: a Partnership in Mass Transit Projects", Christiansen and Sherry, 1992
[25] UMTA has since become the Federal Transit Administration (FTA)

projects it was funding in Miami and Detroit[26]. In part, these problems were attributed to the general process followed by grantees in pursuing a new start, where the focus would be on attention to planning and sales activities, with little effort spent in developing a viable plan for effectively implementing the project once funding was granted (McCarron, 1993). The Project Management Oversight Program as it now exists within the FTA emerged from these concerns.

The Project Management Oversight Consultant (PMOC)

Partly due to the budget reductions imposed by the Reagan Administration, the agency lacked the in-house capacity to adequately carry out oversight on its projects and private consulting engineering firms were retained to provide project oversight expertise. Project Management Oversight Consultants (PMOC), as they are called, have since been retained on FTA-funded projects that warrant such. PMOC are assigned to projects based on the complexity and size of the project (usually on all projects costing over $100 million), and the experience of the grantee implementing the project. Their services are generally initiated during the preliminary engineering phase of a project. The federal share of PMO cost is 100%, as long as the operating agency prepares and submits a Project Management Plan (PMP)[27] to UMTA [FTA][28]. The Program is financed by setting aside 0.75% of the funds available under 49 U.S.C., Section 5309, Capital Program and 0.5% of funds available from Sections 5307 and 5311 programs[29].

Some Contrasting Views of the PMO Program

We will present some contrasting views of the PMO program; this is intended to give a better appreciation of the effectiveness of such a program in practical terms. As can be expected the use of PMO is viewed differently depending on who you talk to. The FTA,

---

[26] "Project Management Oversight –Good Tool For Program Managers", Michael Goode, Journal of Management in Engineering, Vol. 8, No.3, July 1992.

[27] PMP means a written document prepared by a recipient that explicitly defines all tasks necessary to implement a major capital project.

[28] "Project Management Oversight: What it is and How it works", Susan C. Anastasi, Mass Transit Magazine, July/August, 1987.

[29] PMO Quarterly, Issue 24, A Project Management Oversight Publication, April 2000

the grantee, the PMO consultant, and contractors all have a different take on both its appropriateness and effectiveness.

From FTA's Viewpoint

While they have admitted that it is "not 100% foolproof", the FTA at the very least views the PMOC as being useful. To a certain extent it lessens the pressure from Congress on the FTA, concerning lack of accountability on the expenditure of federal dollars. As Alfred DelliBovi, deputy administrator at the time UMTA was starting the program put it (Anastasi, 1987):

> *"We are not owners and we are not operators. We are charged by Congress with providing financial assistance and not interference, but we do have a responsibility to make sure the funds we spend for projects are properly used."*

FTA has also argued that its merits extend to include compensating for the different levels of sophistication among the operating authorities. In this regard the high level of expertise that the PMO contractors have is a tremendous benefit, especially to "novice" grantees. It acts as a safeguard against what former UMTA Administrator Ralph Stanley calls "people going to school on your money."

From the Standpoint of the Grantee

For obvious reasons most grantee agencies resented the idea of an oversight authority designed to look over their shoulders, especially one having the power to report problems directly to a major sponsor. Some view it as an unnecessary entity, arguing that projects usually have a wealth of internal oversight authorities monitoring various aspects of the project. This view of PMO as being unnecessary is often accompanied by the claim that the PMO siphons off about 1 percent of FTA grant funds, which is money that grantees believe could be better spent elsewhere. However, since the PMO is a fact of life if FTA funds are to be used to finance a project, most grantees have begun to accept or even support the concept. One project having a grantee that seemed to have been among the converted was the St. Louis Metrolink. Below are some comments made by the program

director for the grantee, Douglas Campion, on the use of a PMOC, Parsons Brinckerhoff, on its project. [30]

> *"UMTA had an additional step up on understanding the project. PMO helps balance the pure press type of reports of the problem and reduces some of the suspicion between UMTA and the grantee. From the local perspective, it gives everyone an alleged unbiased assessment of what's happening --it's unasked for value engineering. It also allows the grantee to know that someone else knows what is happening –it offers another confirmation to UMTA."*

Another grantee, Southeastern Pennsylvania Transportation Authority (SEPTA) also seems to have accepted it as being useful, but this acceptance was tempered with reservations about the problems that it can trigger. Thomas Margo, assistant general manger at SEPTA, at a time when they were implementing an FTA funded project points to some of its merits and faults[31].

> *"It has proven to be worthwhile especially in the technical areas. Sometimes you need UMTA approval before you can go down the road, and having their immediate involvement can lead to more timely decisions."*

> *"I can't think of anyone who enjoys having his organization, staff and projects subject to detailed scrutiny...and reported in detail monthly to UMTA."*

> *"At various times we felt that the reports were self-serving, blowing issues out of proportion or creating issues where there were none. One of the things the PMO has not been sensitive to is that these reports can become public; in our case some did. As a public agency we must bear the scrutiny of the press --and good news does not make good press."*

---

[30] "Project Management Oversight: What it is and How it works", Susan C. Anastasi, Mass Transit Magazine, July/August, 1987.
[31] "On-Site Oversight Still Unpopular", Greg Borzo, Modern Railroads, December, 1988.

The Viewpoint of the PMO consultants

As can be expected the PMO consultants all seem to be in agreement that this is a very useful program in helping to improve project implementation. They, however, point out that its usefulness comes at a cost to them since firms providing oversight services on a project are prohibited from working on the project for the life of the project. Below is a collection of comments made by participating consultants, as found in Susan Anastasi's paper on the Project Management Oversight Program.[32]

Hill International Group, Vice President Frederic Samelian:

> *"PMO is an early warning system which alerts the government to problems so that corrective measures can be implemented. It ensures compliance to pre-established safety and quality requirements and makes sure that all performance standards are met."*

Flour Transportation and Infrastructure Inc., Project Manager Kent Olsen commenting on his experience on the Detroit Peoplemover project:

> *"I think it [PMO] works very well. There were serious problems on guideway beams that needed to be fixed. Whether they would have been done without Flour being here I don't know. They say it would have been."*

Another consultant <u>not</u> part of the PMO pool:

> *"Overall it's a good program. One problem with it --the primary emphasis is on reporting to UMTA. That's good for the rookie owner...but it is important for the owner to have someone else looking out for the owner's interest. There is an element of big brother watching."*

[32] "Project Management Oversight: What it is and How it works", Susan C. Anastasi, Mass Transit Magazine, July/August, 1987.

6.2.2 The PMO as a Real-Time Evaluation Mechanism

6.2.2.1 The Scope of the Evaluation

The PMO activities typically begin with an evaluation of the grantee's technical capacity and capability to undertake the project as proposed and approved. This is done by reviewing the Project Management Plan or other equivalent documents prepared by the grantee agency. The review includes such things as, the grantee's organization, policies, procedures and line of authority, including grantee's consultants and contractors. The objective here being to evaluate the applicability and effectiveness of grantee's Project Management Plan in effecting a quality project in a timely and cost-effective manner, as well as the plan's conformance with applicable requirements[33].

During the construction period (the implementation stage) the scope of the work shifts to ensuring that the approved PMP is being followed (the PMP is a dynamic document that the grantee updates and submits to the FTA as changes dictate). Some of the project management functions that are covered here include the grantee's processes for: timely management decisions, schedule analysis, cost analysis, and delivery of a quality product. The table below shows a list that defines the areas that the PMO can cover as its scope.

Table 6-2 Scope of the PMO's Evaluation[34]

Pre-Construction - *Evaluation of Grantee's Technical Capacity and Capability*	- Organization. - Policies. - Procedures and line of authority. - Consultants and contractors.
Construction to Start-Up - *Monitoring of Project Development and Implementation.*	- Contract packaging and sequencing - Constructability reviews. - Schedule, cost and reporting. - Quality control. - Quality assurance. - System safety. - Risk management. - Change orders. - Staffing and training. - Claim avoidance/management - Value engineering. - System start up. - Financial capacity. - Environmental monitoring.

[33] "Project Management Oversight Program Guidance #3: Description/Specifications/Work Statement, FTA
[34] Project Management Oversight Program Operating Guidance, FTA

Factors Affecting the Scope of the Evaluation

Interest/Stake: As a major source of funding the FTA has an interest in how its money is spent and the results it produces, although this interest is not the same as it would be for private sector investors. Evidence to this effect is provided by the view that the PMO "lessens the pressure from Congress". In other words, it seems as though the interest exists only in the sense that the FTA needs to demonstrate that there are processes in place to account for the use of funds, and not necessarily in terms of a return on investment. It is probably in light of this that they have focused mostly on the issues that could potentially be embarrassing to them such as cost and schedule, rather than on all the issues that might determine project success.

Dominant Perspective: The scope of evaluation under the Project Management Oversight program is established in large part by the definition of Project Management Oversight as recorded in the final rule that initiated the PMO program as a responsibility of the Federal Transit Administration (FTA), which states that[35]:

> *Project Management Oversight means the monitoring of a major capital project's progress to determine whether a project is on time, within budget, in conformance with design criteria, constructed to approved plans and is efficiently and effectively implemented.*

From this definition it would appear as though accountability is the dominant perspective from which this program was designed. There is, however, at least in theory, some developmental motivation behind the program --where 'effective' implementation could imply that improvements (wherever necessary) to a project are a desired outcome of the program.

[35] U.S. Department of Transportation. Federal Register, Rules and Regulations, Vol. 54, No. 169, 1989.

6.2.2.2 Performance of Evaluation Activities

The PMO consultants' evaluation activities usually include interviews, document reviews, observations, examination of records, analysis of information, and reporting findings to the FTA. The review and monitoring done by PMO consultants is process oriented, and detailed investigations are done only on a discretionary basis, or as concerns dictate. This is in keeping with the FTA's mission and method of operation, where the hands on responsibility ultimately lie with the grantee. This approach is driven in part by the fact that the FTA, unlike the Federal Highway, is not charged with inspection and acceptance of construction work (McCarron, 1993).

During the construction, the PMO consultant will look to the Project Management Plan (PMP), and monitor the grantee's use of it and its effect on project implementation. For example, the PMO consultant will review a grantee's PMP to determine whether or not the grantee has defined a proper Quality Assurance/Quality Control program. It can then conduct spot checks to determine whether the program is being followed. This might include doing such things as reviewing a Resident Engineer's log to see if testing of concrete is being performed in accordance with the QA/QC program, but would not extend to the PMO contractor doing the actual testing.

Authority to gather the information needed to perform the evaluation is provided under the federal guidelines that implemented the Project Management Oversight Program. Under the guidelines "a recipient of UMTA [FTA] funds for a major capital project shall provide the Administrator [FTA Administrator] and the PMO consultant chosen under this part access to its records and construction sites, as reasonably may be required."[36]

[36] U.S. Department of Transportation. Federal Register, Rules and Regulations, Vol. 54, No. 169, 1989.

Factors Affecting the Performance of Evaluation Activities

Nature of Issues: Some of the issues are easier to evaluate than others and without the right discipline the issues that are easiest to be evaluated will be the only ones evaluated. Looking at issues such as budget and schedule is fairly straightforward while others such as quality will be harder to get at.

Ability of the Evaluator: Typically only very experienced consultants are hired to perform the evaluations. However, since the local context and players involved could be unique the ability of the evaluator to understand and relate to the players and context could be critical.

Ease of Access to Information: As part of the federal guidelines, the grantee agency has to provide the PMO consultant's with access to the materials it needs to carry out its evaluation functions. However, given the size of the project, the opportunities to withhold information without violating this requirement are numerous, and absent full acceptance of the PMO consultant's efforts by the management team many problems could go undetected.

6.2.2.3 Use of Results/Recommendations

Wherever deficiencies are identified, the PMO contractor reports this to the grantee through informal communications with the management team, and may advise them on a remedial course of action that could be taken. There is, in the ideal, an open and honest line of communication between the PMO consultant and the leaders on the project.

In many ways the PMO consultant acts as an extension of FTA and as a representative of FTA. The PMOC is FTA's "man on site" and relays information from FTA to the project team and vice-versa. The PMO consultant informs the management team of their observations through informal communications, and informs FTA via more formal

reports. The PMO consultant reports its findings to the FTA on a monthly basis, or may prepare spot reports as conditions dictate.

The PMO consultant also participates in the quarterly review meetings held between the grantees and FTA. They are typically required to brief the FTA's staff on major issues before this review meeting.

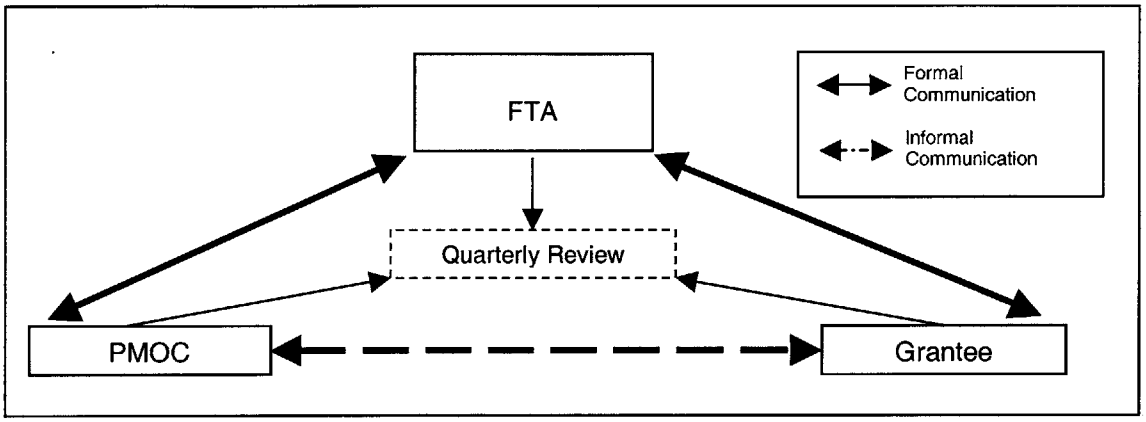


Figure 6:1 Interaction among the FTA, the PMOC and the Grantee

Factors Affecting the use of Results/Recommendation

Credibility: Over time, and depending on how accepting the leaders are of the PMO consultant, the relationship between the grantee and the contractor can go beyond one of a coerced existence, to one where the grantee looks to the PMO consultant as a "critical" friend in advising them where more attention needs to be focused. This is in recognition of the fact that the PMO consultant being somewhat removed from the day-day activities of the project is able to get an independent perspective on: how well the project is progressing, what are some of the dangers to look out for, and how well the management team is handling problems. The PMO consultant group is usually staffed with highly experienced project managers, and project leaders could look to them as a valuable source of advice, acting on their suggestions without the usual level of reservation for 'oversight' programs. However, there is no guarantee that they will be viewed in this manner, and their input on the project may have to be via the FTA.

Power: Although the relationship to the FTA does confer some real power to the PMO, its power is constrained by FTA policy to provide information and discuss issues with the grantee, attempting to leave final accountability with grantee. This tends to mean that on clear issues such as budget and schedule, where the FTA might be politically embarrassed, power is exercised more aggressively, but on less clear issues such as quality and effectiveness there is a stronger tendency to defer to the grantee.

Constraint on Actions: Constraint on actions in this sense would be where the grantee is unable (or unwilling) to take certain actions even though it might agree with the findings of the PMO. For example, where the PMO finds that a contractor is continually doing poor quality work and probably should be replaced, the grantee might find it difficult to do this even though it agrees with the PMO's findings.

6.2.3 The PMO as a Mechanism to Facilitate Long-Term/System-Wide Planning

6.2.3.1 A Trustee for Project Goals

In this dynamic the FTA is the entity that resembles the trustee for project goals with the PMO being the mechanism designed to support the FTA as a trustee for project goals. The FTA initiated the Project Management Oversight Program to ensure that a project was implemented in accordance with an approved Project Management Plan, this plan presumably being the plan that would accomplish the goals of the project. This makes them trustees for goals as represented by a PMP (and other supporting documents) proposed by the grantee and approved by the FTA. However, although the Project Management Plan is supposed to be the guidelines by which the tasks associated with the vision will be implemented, it does not necessarily, in truth, speak to the entire vision for the project. In other words, not all aspects of the vision may be documented and stated explicitly. Therefore, in relying on official documentation submitted by the grantee, the FTA may not be in a position to represent the entire vision for the project. Additionally, since the FTA has absolved itself of ultimate responsibility for the success of the project it does not readily act to exercise its power over decisions on the project.

The FTA/PMO as a Trustee for Project Goals

1. Understanding/Appreciation for Project Goals

The vision as articulated to the FTA in terms of project goals may not speak to the true or entire vision that a grantee has for a project. The fact that the FTA receives the vision well after the project idea was conceived and the grantee staff had figured out how to articulate the vision to the FTA in order to maximize its chance of being awarded funding means that the FTA is not in an ideal position to know what the real motivation behind the project is. However, over time and through interaction with members of the grantee staff and other from the local context they might be able to develop a greater understanding of the history of the project and the motivations behind its implementation.

The FTA is also somewhat insulated from short-term political currents and in this regard as trustees they would be able to provide some continuity for the vision of the project.

2. Power to Act on Behalf of Project Goals

As a major source of funding on the project the FTA has considerable power to influence decisions by the grantee in pursuit of the project goals as it sees them. However, since not all of the goals can be met by actions taken solely by the grantee and the FTA has no power over the other relevant jurisdictions its power to act on behalf of all goals may be constrained. Additionally, the FTA's power is diluted by its position that the guarantee has the ultimate responsible for project success.

6.2.4 Summary

The FTA looks at a wide range of factors in its ex-ante evaluation to determine what are the chances of a project being "successful". It then engages in 'real-time evaluations' through its PMO program, only the scope of its formative evaluation process is not consistent with the wide range of factors that it used to determine how successful a project could be. This is likely a reflection of the FTA relationship to the Congress, within which on clear issues such as schedule or budget, FTA is likely to be criticized for inadequate stewardship, but on issues affecting effectiveness, quality, and environmental compliance the congressional members from the jurisdiction are likely to defend the grantee.

The experience overwhelmingly suggests that the focus of the PMO consultants' efforts is on monitoring cost, schedule, and quality. This narrowing of the scope from ex-ante evaluation to formative evaluation is probably attributable to the fact that the FTA believes ultimate responsibility for the project lies with the grantee agency, and "they are not charged with interference".

The evaluation activities are driven by the scope of the evaluation, and PMO consultants have experienced varying levels of success in these efforts. As part of federal guidelines,

the grantee agency has to provide the PMO consultants with access to the materials it needs to carry out its monitoring function. However, given the size of the project the opportunities to withhold information without violating this requirement are numerous and absent full acceptance of the PMO consultants' effort by the management team, many problems could go undetected.

The FTA/PMO's performance as a mechanism to facilitate long-term/system-wide planning in terms of being a trustee for project goals is affected by the fact that it does not necessarily have a solid appreciation for the vision of the project, and the FTA generally does not take the position that it is ultimately responsible for accomplishing this vision. However, the FTA acting on the findings from the PMO process can require the grantee to give priority to rectifying a problem.

Chapter 7: LESSONS LEARNED/TOWARDS THE DESIGN OF A CONCEPTUAL REAL-TIME EVALUATION FRAMEWORK

The previous chapter examined two cases as mechanisms that provide some degree of real-time evaluation on public infrastructure projects. Before entering into the discussion of the cases we acknowledged that there were obvious limitations to the way these entities perform as evaluation mechanisms, and in fact, some liberty was taken with the use of the term 'evaluation'. However, they were viewed at least as being a platform from which an ideal mechanism could be expanded.

In this chapter we will identify the lessons from the two cases and 'refine' the initial framework by integrating the practical observations made from the cases with the beginning principles that were put forward in Chapter 5. Based on these lessons we will present some factors that would appear to define how effective an evaluation mechanism would be on infrastructure projects. Following the presentation of these factors we will conduct a combined analysis of the cases studies. Finally, we will present what we consider a model conceptual real-time evaluation framework for maximizing the likelihood of success on public infrastructure projects.

7.1 What makes for an Effective Real-Time Evaluation Mechanism

Referring to the principles presented in Chapter 5 as two levels of analysis for examining the effectiveness of a real-time evaluation mechanism --there are two different levels of criteria that an evaluation mechanism should meet in order to be effective in the sense that we propose to use it. The first level of analysis asks the question: how does the mechanism perform as a stand-alone evaluation mechanism? The second level asks: how does it actively influence long-term/system-wide planning?

7.1.1 The Defining Characteristics of an Evaluation Mechanism

The theory, which we view as having universal applicability, clearly suggests that there are three facets that define an evaluation mechanism --its scope, the performance of evaluation activities, and the use of the results stemming from such activities. These three facets seem to be universal across the definitions for evaluation, and regardless of the kind of evaluation they can be analyzed along these facets. We further presented, as a guide for the discussion on the case studies, some of the factors that we thought might influence these three facets. After looking at the cases according to these initial principles and factors, we can now better speak to the factors and conditions that would define an evaluation mechanism on a public infrastructure project.

Factors that Affect the Scope of an Evaluation

Interest/Stake: The scope of an evaluation is determined in large part by the interest/stake that the entity conducting the evaluation has in the project. This is demonstrated, for example, by the EOC's choice of environmental commitments as the scope of its evaluation, which is reflective of the interests of the founding members most of whom were environmental advocates who probably had valid concerns that the environmental commitments were most vulnerable.

Dominant Perspective: It is clear from both the theory of evaluation and the evidence drawn from the cases, that the scope of an evaluation is dictated in large part by the dominant perspective from which it is being done. Although the dominant perspective in performing formative (real-time) evaluations is development, the EOC and the PMO, which were looked at as approximate to real-time evaluation mechanisms, seemed to have greater emphasis on accountability. For example, the PMO has focused on making evaluations to point out deviations from such things as cost, schedule, and quality.

Factors that Affect the Performance of Evaluation Activities

Nature of Issues: Given that for some issues robust tools and methodologies exist to perform evaluation, while for others the tools and methods are much less developed, the nature of the issues will have an effect on how well the evaluation can in fact be performed.

Availability of Resources: The availability of resources is fundamental to being able to perform the activities related to an evaluation.

Ability of the Evaluator: The ability of the evaluator is of general importance when conducting evaluation activities, but this takes on added significance in large complex projects that will have many idiosyncratic elements contributing to project success.

Access to Information: The ease with which evaluators are able to access information is of particular importance on public infrastructure projects, this in light of the fact that the politics surrounding these projects can make accessing truthful information in a timely manner very difficult.

Factors Affecting the Use of Results/Recommendations

Credibility: Credibility can play an important role in determining how the results of an evaluation are used, especially in cases where the evaluation is being done by an external agent who does not necessarily identify itself as an advocate of the project or where the findings can be controversial.

Power: The power of the evaluator or its supporting institution can be a major influence on how responsive leaders on a project are to the results of an evaluation. If one considers the press as evaluators then it is obvious that on public projects leaders are often very responsive to issues brought up by the press because of the influence they have on public opinion.

Constraint on Actions: In making the distinction between projects and programs Dale (1998) alludes to the significance of 'constraint on actions' in stating that 'the scope for changes on a project may be limited to fairly modest adjustments, unless one concludes that the project has to be re-planned --in full or in part' while 'for many programs, the scope for evaluations to induce changes of design and implementation may be substantial, due to the framework nature of programs.' There is also an institutional element to the constraints-on-actions on a project. For example, on the Boston Harbor project, the MWRA had no choice but to satisfy the requirements mandated by court order, so any shortcoming identified would have to be fixed, in this sense there was a constraint on inaction.

The table below summarizes the facets of a real-time evaluation mechanism and the factors that influence them.

Table 7-1 The Facets of a Real-Time Evaluation Mechanism

Facet	Factors
The Scope of the Evaluation	- Interest/Stake of the Evaluating Entity. - Dominant Perspective of the Evaluation.
Performance of Evaluation Activities	- Nature of the Issues to be Evaluated (Subjective versus Objective and Amenableness to Measurement). - The Availability of Resources. - The Ability of the Evaluator. - Ease of Access to Information.
Use of Results/Recommendations	- The Credibility of the Evaluating Entity. - The Power of the Evaluating Entity. - The Constraints on Actions.

7.1.2 The Defining Characteristics of a Mechanism to Facilitate Long-Term/System-Wide Planning

Trustee for Project Goals

As a mechanism to facilitate long-term/system-wide planning we have suggested that the evaluation mechanism or its supporting institution must in essence serve as a trustee for the project goals. As a trustee for the project goals it must: (a) have a good understanding

and appreciation for the goals of the project; and (b) be empowered to act on behalf of these goals.

1. Understanding and Appreciation for the Goals of the Project

In order for this trustee to have a good understanding and appreciation for the project goals it should be: knowledgeable about the history of the project, sensitive to the many interests on the project, and be insulated from short-term political currents.

2. Empowered to Act on Behalf of the Project Goals

Having the power to act on behalf of project goals requires that the mechanism or its supporting institution have: the statutory or tacit political power in the decision-making process on the project, and the ability to convince other responsible parties to take actions to help achieve the project goals.

The table shown below summarizes the dimensions of a mechanism or institution that acts as a trustee for project goals.

Table 7-2 The Characteristics of a Trustee for Project Goals

Dimension	Factors
Understanding/Appreciation for Project Goals	- Knowledge of the History of the Project. - Sensitivity to the Many Interests on the Project (have a strong local perspective). - Insulation from Short-Term Political Currents.
Empowered to Act on behalf of Project Goals	- Power over the Decisions on the Project. - Multi-Jurisdictional Involvement (Buy-In).

7.1.3 Analysis of the Case Studies

7.1.3.1 As Effective Evaluation Mechanisms

The Scope of the Evaluation

Neither the PMO program nor the EOC has identified what could be considered as an extensive scope for evaluation given the breadth of issues that will determine success on the projects they are concerned with. According to some of the literature on the mandate of the PMO, the scope of evaluation for a PMO would appear to be unbounded (covering those things that relate to 'effective implementation'), this is, however, not the case in practice and often only a few areas are 'evaluated'. These areas usually tend to be the ones that fall under the control of the grantee agency. On the other hand, while the EOC's scope is fairly well bounded (Air Quality, Traffic Management, Transit, Open Space), many of the issues it focuses on lie outside of the project leaders' jurisdiction.

The Factors Affecting Scope

Interest/Stake: The FTA who, as major source of finance on rail transit projects, has a financial stake in the project, commissions the PMO's evaluation. Additionally, and as the federal agency responsible for transit development it does have a stake in the overall success of the project. This implies that the scope of its evaluation as a function of its interest/stake in the project should be defined by the desire to ensure responsible use of funds and overall success of the project. However, in reality of the two areas of interest to the FTA, the driver behind the scope appears to be the position with regard to responsible use of funds, especially in light of FTA's accountability to the Congress for the way its funds are spent. Environmental interests groups founded the EOC and as such its scope as a function of the interest/stake of its members was limited to the environmental commitments on the CA/T project. Of course, this was probably due to a recognition on their part that these were the 'goals' of the project that would most likely be neglected and hence decided to focus their energies on trying to secure these goals.

Dominant Perspective: The scope for the PMO's 'evaluation' appears to be defined by the perspective that the FTA has on its use. Although its charter does, if only vaguely, imply that it is concerned with performing evaluation from the development perspective "...effective implementation", the dominant perspective seems to be accountability "...monitor progress..." and making sure that "...no one goes to school on the FTA's money". The dominant perspective on the EOC appears to be accountability '...monitor progress made on the commitments'. The view taken is that this body exists to keep the project and other jurisdictions 'honest' with regards to the commitments that were made during the permitting and coalition building processes on the project (project development stage).

Performance of Evaluation Activities

PMO consultants have been able to perform evaluation activities with some degree of success, although there are some factors that limit their effectiveness. The EOC, on the other hand, has had a much more difficult time performing its evaluation activities.

Factors Affecting the Performance of Evaluation Activities

The Nature of the Issues: Given the somewhat open scope of evaluation the nature of issues to be evaluated as part of the PMO consultant's activities vary greatly. The issues that have tangible indicators such as cost and budget are easier to get at, while issues such as quality are harder to get at, and still other issues such as improvement in organizational capacity are hardest to evaluate. The more well-defined scope of the EOC's evaluation means that the nature of the issues to be evaluated, are at least clearly documented, however, some of these are easier to evaluate than others. For example, where a commitment is to build a park by a certain date, the schedule of progress can be easily monitored. On the other hand, where a commitment relates to 'effort' on the part of project leaders to undertake an initiative, for example making an 'effort to promote the use of HOV lanes', this can be harder to evaluate.

Availability of Resources: The PMO program is funded by setting aside approximately 1% of the funds awarded to the grantee agency sponsoring the project. In this regard the amount of money allocated for the performance of PMO related activities could be substantial and is not really a limiting factor. Additionally, with the support of the FTA more money could be allocated should they feel that more money is required to perform evaluation. In contrast, the EOC is almost an entirely volunteer organization with only one permanent staff member, who serves as Executive Director of the Committee --this constrains the 'investigative' reach of the EOC.

The Ability of the Evaluator: Typically the FTA chooses a PMO consultant based on the level of experience and knowledge they have with respect to the particular project to which they will be assigned. In this sense, the PMO consultants are usually very knowledgeable people having the capacity to detect incipient problems on transit projects. Of course, this is within certain confines, as local context matters and while the evaluator may be fully capable of performing evaluations of items that appear across projects, items specific to the local context might be difficult for them to understand. The types of activities that are performed as part of the EOC's efforts is so well defined that the ability of the evaluator takes on less significance, than it would otherwise have been had the scope of evaluation been more open. The EOC is mostly concerned with 'monitoring progress made on commitments', and these commitments were all documented well in advance, the task of identifying them is somewhat straightforward. Of course, some progress is hard to detect and the Executive Director has to use judgment and some investigative skills to determine what actual progress has been made.

Ease of Access to Information: Provision for access to information by the PMO consultant is made and stipulated as part of the agreement between the grantee and the FTA. The PMO has guaranteed access as "...each grantee should provide access to the PMO as reasonably required". This guarantee does, however, have limitations as a certain degree of cooperation is required on the part of the grantee and its contractors since a lot of important information will lie with them and although not necessarily hiding this information they may not be entirely forthcoming with it either. The EOC does not have

any guaranteed access to information, and most of its information is supposed to be provided by the project via quarterly reports. Cooperation on the part of project leaders becomes an extremely important factor in determining how successful efforts to perform evaluation activities.

Use of Results/Recommendations

Neither the PMO nor the EOC has had the results of their findings used as effectively as they could have been.

Factors Affecting the Use of Results

Credibility: As 'knowledgeable and experienced' consultants the PMO consultants who perform evaluations command a certain degree of professional credibility from both the grantee and the FTA. However, since they are working for the FTA and not the grantee, credibility can become an issue where the grantee does not see them as being fair and sensitive to their concerns. Their sensitivity to the grantee's concerns can greatly affect the way the grantee views them, in terms of willingness to respond to their findings. They are not necessarily viewed as a 'critical friend' of the project. And as a PMO consultant put it *"someone needs to be looking out for the interest of the grantee"*. With the EOC credibility is an important determinant as to how the project (or other responsible jurisdictions) will use the results of the EOC's findings. Initially the intention was to have the EOC function as a partner with the project, reminding them of the commitments and helping them to keep up to date, however, over time the project has come to see the EOC as 'big critic' and is much less responsive to its findings.

The Power of the Evaluator: Through the FTA the PMO consultant has some real power, at least in theory, as the FTA can pull the plug on financing or in other ways put pressure on the grantee to respond to the findings of the PMO consultant. This power is, however, limited by the FTA's position that the 'ultimate responsibility for the success of the project lies with the grantee'. And furthermore by its position that, Congress charges it with 'assistance not interference'. The EOC has no formal power or authority to force

the project to address the shortfalls that it has detected. And while most of the commitments were part of the environmental documents signed during project development without any real support from the powerful institutions such as the FHWA or the EOEA it has no power to intervene and force the project or other responsible parties to take action. It does, however, have some power to put pressure on the responsible parties by informing the public via its meetings or press releases about the failure to honor commitments.

Constraint on Actions: The use of results is directly related to the options that are available to the project in responding to the findings of an evaluation --in other words, its ability (or willingness) to carry out corrective actions. Where the PMO might suggest that the project is behind schedule and can't realistically be completed by the expected date, and recommends that the schedule be updated to reflect this, the leaders in the grantee agency might find this unacceptable from a political standpoint. With the Central Artery being openly criticized for being over budget and behind schedule the project is constrained at least in its willingness to take actions that would slow down the implementation of what they consider the most important aspects of the project.

Table 7-3 Summary of the Analysis of the PMO and EOC as Real-Time Evaluation Mechanisms

FACET	EOC	PMO
The Scope of the Evaluation	*Interest/Stake* Environmental interest groups founded the EOC and the scope is so reflective. *Dominant Perspective* The scope of the evaluation very specifically targets the environmental commitments, with the dominant view being to hold responsible parties accountable for these commitments.	*Interest/Stake* The 'evaluators' are protecting the interest of the FTA, who as providers of financial support is 'accountable' for the responsible use of funds *Dominant Perspective* The perspective of the evaluation seems to be predominantly accountability although in theory the evaluation is partly intended for development purposes.
Performance of Evaluation Activities	*Nature of Issues* Some issues are quite difficult to evaluate. For example, evaluating the level of effort by a responsible party to pursue an action might prove very difficult. *Availability of Resources* Mostly volunteer group, with only one permanent staff member. *Access to Information* With the 'secrecy' on the part of project leaders, information can be difficult to get at.	*Nature of Issues* Some issues such as cost and schedule are easier to evaluate than others such as quality. *Availability of Resources* Guaranteed funding from the FTA, therefore money as a resource is not a constraint. *Access to Information* Under federal guidelines grantees accepting federal funding must allow access to relevant information, however, there are numerous opportunities to indirectly withhold information.
Use of Results/ Recommendations	*Credibility* CA/T project leaders mostly see the EOC as a 'big critic'. *Power* The EOC has no real power over the project or other responsible parties. *Constraints on Action* The project leaders are now mostly focused on getting the project completed as quickly as possible.	*Credibility* The credibility of the evaluator is dependent on how the grantee's staff views them i.e. as a 'critical friend' or as FTA's 'watchdog'. *Power* Through the powers of the FTA the PMO has some power but the FTA chooses to use this power sparingly. *Constraints on Action* With the nature of politics surrounding these projects the grantee is often constrained from taking certain actions even if it agrees with the PMO's findings.

7.1.3.2 As Mechanisms to Facilitate Long-Term/System-Wide Planning

Trustee for Project Goals

Neither the FTA/PMO nor the EOC is ideally positioned to behave as trustee for the entire project goals, although the both have some positive elements in terms of understanding/appreciation for project goals and the power to act on behalf of these goals.

1. Understanding and Appreciation for Project Goals

In the case of the PMO, the consultant comes on board fairly late in the game, after the decision has been made by the FTA to fund the project. It interprets the goals of the project through the documentation presented to the FTA, which does not necessarily speak fully to the vision the grantee has for the project. Although over time and from working in the local context they could eventually gain a better understanding and appreciation for the 'true' goals that the local citizens and the grantee has for the project. The EOC was founded by citizens and groups from the locale in which the project is being implemented; in this regard its members have a good appreciation and understanding of the vision for the project.

2. Empowered to Act on Behalf of Project Goals

With the view that the grantee is the one with ultimate responsibility for the success of the project, the PMO and FTA, does not overstep the grantee in protection of project goals. The EOC has no formal power to act on the behalf of the environmental goals (commitments), let alone project goals.

Table 7-4 Summary of the Analysis of the EOC and the PMO (FTA) as Trustees for Project Goals

Dimension	EOC	PMO
Understanding/ Appreciation for Project Goals	*Knowledge of the History of the Project.* The founding members of the EOC were local citizens who had knowledge of the history of the project. *Sensitivity to the Many Interests on the Project.* Sensitive mostly to the 'environmental' interests on the project but does have a strong local perspective. *Insulation from short-term political currents.* The EOC seems to be fairly well insulated from short-term political currents.	*Knowledge of the History of the Project.* The FTA gets the vision well after it was founded and only after the grantee has articulated it in a manner to maximize its chances of being awarded funding. *Sensitivity to the Many Interests on the Project.* The FTA is not necessarily sensitive to all the interests on the project and it might be difficult for them to identify and understand all the local interests on the project. *Insulated from short-term political currents.* FTA's interpretation of the vision for the project is somewhat insulated from changes in the political environment and has a fair degree of insulation from local politics.
Empowered to Act on Behalf of Project Goals	*Power over the decisions on the project.* The EOC has no real power over the decisions on the project. *Multi-Jurisdictional Buy-in* The EOC has very limited multi-jurisdictional buy-in.	*Power over the decisions on the project.* As a major financer the FTA has some real power over the grantee, although it uses it only sparingly. *Multi-Jurisdictional Buy-in* The FTA does not directly reach out to other jurisdictions.

7.1.4 Presenting a Conceptual Real-Time Evaluation Framework

In concluding this chapter, which is also the conclusion of what could be considered the first section of this thesis, we will present a conceptual framework for real-time evaluation in the context of public infrastructure projects.

To recapitulate, we began by presenting the six stages in the life of a major public infrastructure project as a means of establishing why they may not live up to initial expectations. From this presentation we concluded that there is often inadequate continuous long-term/system-wide planning on the project, which contributes to this failure to live up to original expectations. We further drew attention to some barriers that make it difficult to sustain this long-term/system-wide approach to planning. The proposition that a real-time evaluation mechanism, appropriately designed, could help to overcome these barriers and help promote the sustained long-term/system-wide approach was then presented. The next step was to delve into some theory of evaluation and its use to gain a frame of reference for how evaluations can be done.

Out of this theory and our proposition, we presented some guiding principles (a first model) for a real-time evaluation mechanism that could facilitate long-term/system-wide planning. Next we 'calibrated' the initial model by using it to guide the discussion on some mechanisms that approximate real-time evaluation on infrastructure projects. We then took the lessons learned from the discussion on these case studies and refined the model --presenting it as it might apply to infrastructure projects. As iteration, we then reviewed the cases using this refined model. And now will present a conceptual framework for real-time evaluation to maximize the likelihood of success on a public infrastructure project.

7.1.4.1 The Conceptual Framework

From the work done thus far we can conclude that:

> *A mechanism appropriately designed*[37] *and deployed during the implementation of a project can facilitate real-time evaluations that determine whether or not the project is on course to accomplish its vision, and make applicable recommendations in pursuit of this vision.*

We can further conclude that this ability to perform real-time evaluation can be used to facilitate long-term/system-wide planning --this however, implies that the mechanism be positioned to act in this regard. This we suggest it can best do if it is housed or supported by an institution that serves as the trustee for project goals. In order to be the trustee for project's goals the institution should:

> *(1) Have a good understanding and appreciation for the vision for the project, and*
> *(2) Have the power to act on behalf of this vision (which may include modifications to the vision itself).*

This relationship where the real-time evaluation mechanism is housed within or acts in a supporting capacity to a trustee for the project goals is demonstrated in the figure below (figure 7:1).

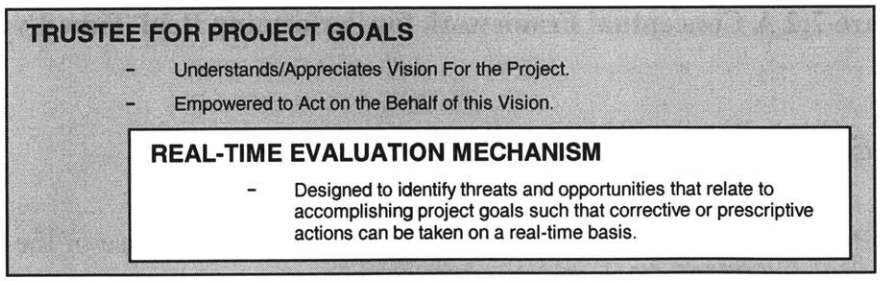


Figure 7:1 Real-Time Evaluation under a Trustee for Project Goals

[37] The lessons from the analysis of the cases that were presented as 'approximate' real-time evaluation mechanisms can be used to guide the design of an appropriate real-time evaluation mechanism in the context of public infrastructure projects. Issues to consider would include the need to balance advocacy with credibility so that project leaders are receptive to the evaluation, while at the same external parties can look to the mechanism as a truthful and objective source of information.

A conceptual framework that 'locates' this relationship in the context of a public infrastructure project is presented in the figure below (figure 7:2).

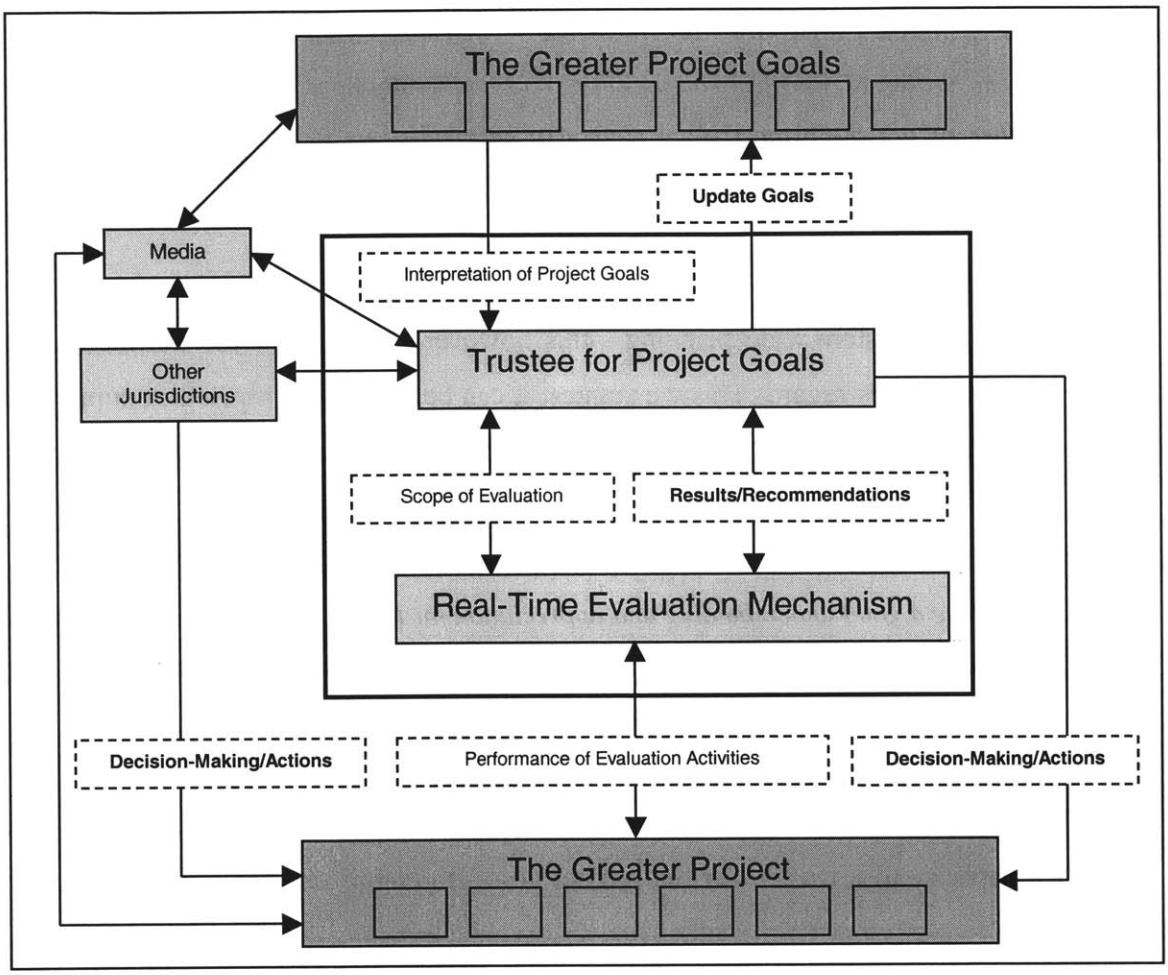


Figure 7:2 A Conceptual Framework for Performing Real-Time Evaluation

7.1.4.2 Explaining the Framework

Greater Project Goals: In the above conceptual framework, the use of the term 'greater project goals' is deliberate in trying to capture the entire vision that stakeholders might have for any given public infrastructure project. This does not necessarily mean that there is consensus on every single goal but rather that this is the collection of goals that the 'owners' have for the project. These greater goals are often not captured in the narrowed definition of the project (as contractually defined elements) once implementation begins.

Trustee and Real-Time Evaluation: In the evaluation framework, a trustee usually related to a government entity (or acting in some elected capacity) would be responsible for representing the vision that the citizenry has for the project and acting to implement this vision on behalf of the citizenry. The framework suggests that this trustee based on its interpretation of the project's goals should, in consultation with an evaluation entity, determine the relevant scope in performing real-time evaluation relative to these goals. The evaluation entity then proceeds to perform real-time evaluation on the project consistent with this scope and presents its results and recommendations to the trustee. It is then the responsibility of the trustee to make decisions based on the findings of the evaluation mechanism. This might mean adding resources, improving the organization and managerial structure of the project, prioritizing critical actions, or updating the project goals and articulating what the new goals are, given what was discovered from the evaluation.

Other Jurisdictions: And since accomplishing the 'greater goals' of the project imply that extra-jurisdictional decisions and actions have to be taken the trustee should engage all the relevant jurisdictions in an attempt to have them address the extra-jurisdictional components of the 'greater project'.

The Greater Project: In defining the 'project' this framework suggests that a project is more than its traditionally narrow definition as the collection of contractually defined elements (with numerous complementary assumptions), but is inclusive of all the elements that relate to accomplishing the 'greater project goals'. In a transit project the 'greater project' would include such things as transit oriented development initiatives, transit supportive parking policies, coordinated feeder services, and so on.

The Media: The role of the media in this framework is to communicate to the public, in an independent manner, the developments on the project with regards to: the goals of the project; the actions of the trustee and the other jurisdictions; and the progress being made on the project relative to its goals.

Chapter 8: THE TREN URBANO CONTEXT

In keeping with our second objective, this chapter will attempt to apply the conceptual framework developed in the Tren Urbano context. It begins with some background information on Puerto Rico and the Tren Urbano project and then proceeds to a discussion and analysis of the stages in the project thus far. It then attempts to identify the elements of real-time evaluation that exist in the Tren Urbano context and concludes with a discussion on what might be done in moving to perform real-time evaluation consistent with the conceptual framework.

8.1 The Commonwealth of Puerto Rico and the Tren Urbano Project

Puerto Rico is one of the islands that form the Greater Antilles of the West Indies. As shown in figure 8.1, it lies to the east of the island of Hispaniola (Haiti and The Dominican Republic) and is approximately 1,000 miles south east of Florida. The island is roughly rectangular in shape and has an area of 8,406 square kilometers and a population of 3.7 million, according to the 1990 U.S. Census.

Puerto Rico is a commonwealth in free association with the United States; its residents are US citizens. Its association with the U.S. began in 1898 when it was first occupied by American troops during the Spanish American War, it was established as a commonwealth by the U.S. Congress in 1952[38]. The government of the commonwealth mirrors that of a typical U.S state, with the chief executive being a governor elected for four-year terms, and a bicameral legislature consisting of a 27 member Senate and a House of Representatives of 51 members; both branches having members that are elected for four year terms. The two major political parties are the Partido Nuevo Progresista (PNP) and the Partido Popular Democratico (PDP).

[38] Puerto Rico is not a State and therefore does not elect voting Congressmen or Senators, but does elect a "Resident Commissioner" who can communicate on behalf of Puerto Rico to the U.S. Congress.

San Juan is the capital of Puerto Rico and is located on the north coast of the island. The San Juan Metropolitan Area (SJMA) covers an area of 1,036 square miles and contains 13 municipalities. The proposed Tren Urbano system will serve this metropolitan area with the first phase now under construction designed to connect the Municipality of Bayamón in the west to Santurce, a community of the Municipality of San Juan in the north. As shown in Figure 8.2, the project corridor for this first phase of the Tren Urbano system is L-shaped with one segment lying in a north-south orientation and the other lying in an east-west orientation. The corridor contains six major employment and population centers, including: Bayamón, the regions second largest municipality; a dense area west of Centro Médico; Centro Médico, the region's most important area for health services; Río Piedras, home of the University of Puerto Rico, the island's largest education institution; Hato Rey, Puerto Rico's business and financial center; and Santurce, a neighborhood and commercial area within the Municipality of San Juan.[39]

8.2 The Stages of the Tren Urbano Project

The Tren Urbano project is now in its fifth year of implementation --implementation activities having begun in 1997. According to the six-stage model, the stages that the project had to traverse to get to this point were: pre-history, project development, and procurement. In this section we will discuss the players, activities, and events, associated with these stages that ultimately led to the project being where it is now. The discussion builds mostly on work by Ardila (2000), who did extensive work on these three stages in conducting research to answer the question --why did Tren Urbano get built?

8.2.1 Pre-History

In his paper, Ardila (2000) brings to light some of players, events, and activities that represented the pre-history stage of the Tren Urbano project. He identifies a period of over 25 years as the pre-history stage, with the first idea for a mass transit system emerging in the 1960s and appearing in different forms for much of the next three decades. He concludes that the project could not get out of this stage until the idea made

[39] Final Environmental Impact Statement, Tren Urbano Transit Project, 1995.

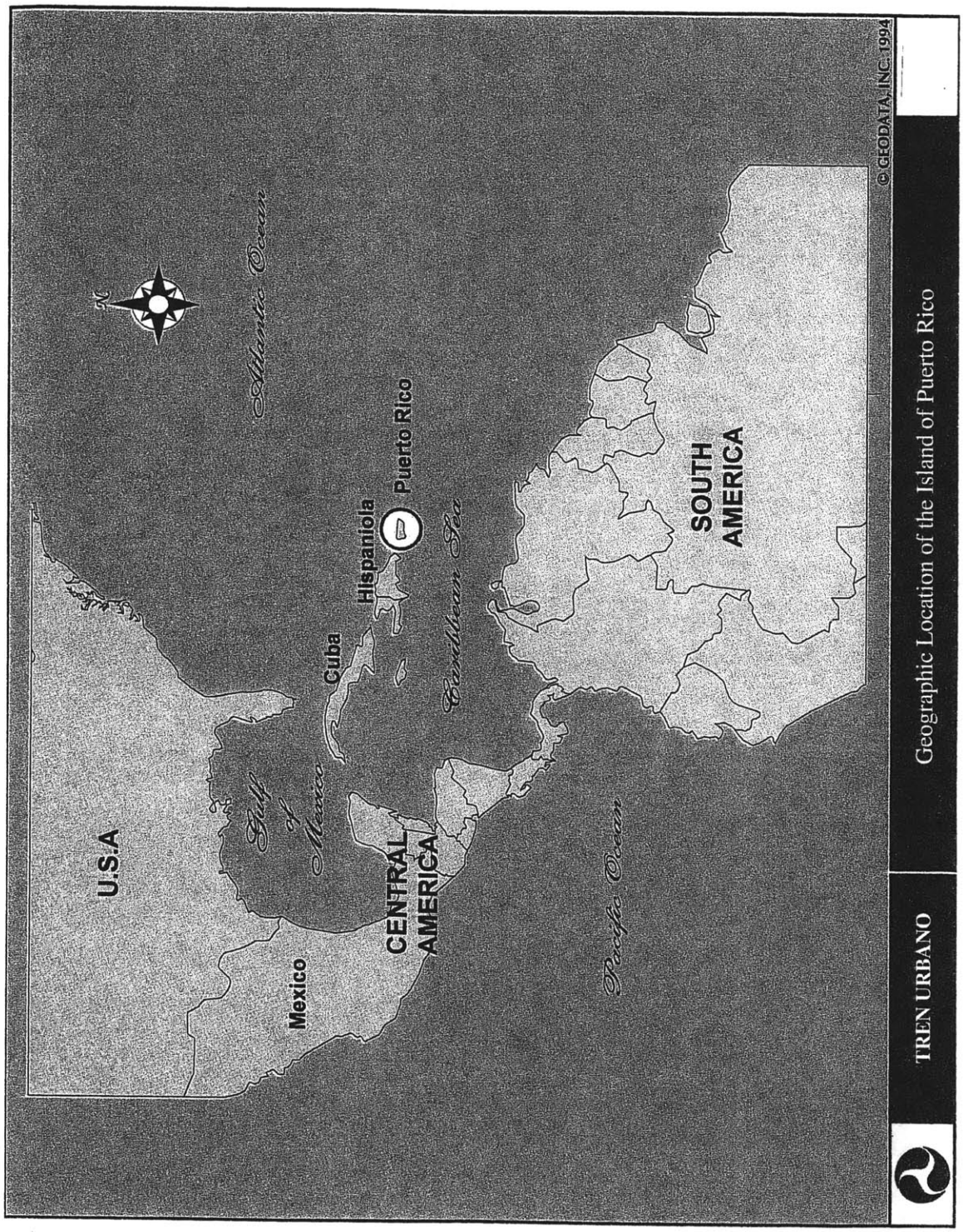


Figure 8:1 Geographic Location of the Island of Puerto Rico

Figure 8:2 Phase I of the Tren Urbano Project

sense from a "political, financial, and planning" perspective --these things eventually coming together in the early 1990s. Embedded in the discussion is the emergence of a vision for the project, in terms of the changes and improvements it was expected to bring to the citizens of the San Juan Metropolitan area.

The Origins of an Idea for Mass Transit

In the 1960s the Puerto Rico Planning Board in planning for future development in the San Juan Metropolitan Area (SJMA) evaluated a scenario to promote a multi-centered pattern of growth around the area's five major urban centers. Complementary to this planning effort they commissioned a transportation study by the consulting firms Wilbur Smith and Associates and Padilla y Asociados. The study concluded that a system of highways, expressways, and mass transit would be needed to meet the transportation needs of the SJMA under this development pattern. The argument given in favor of mass transit was that, highways and expressways by themselves would not be able to accommodate the projected demand across the centers.

The Board adopted this pattern of development and the supporting transportation system as part of its plan for the future development of the SJMA. It projected that the plan, with the mass transit component, would be fully implemented by 1985. However, this was not to be, and instead residential and commercial projects went ahead without the parallel implementation of the entire proposed transportation system, and specifically without the mass transit component.

Throughout the 1970s several other studies proposed a mass transit system, as relevant to the future of the San Juan Metropolitan area. These included for example, the "Study for the Transportation and Urban Settlements Combined Action Project", and the " Status del Poyecto de Transportacion Colectiva Rapida (metro) para el Area Metropoltana de San Juan". During this same period the government in recognition of uncontrolled sprawl and congestion adopted a policy to increase the density in urban areas, contain urban sprawl and promote mass transportation (Rodriquez 2000). Reform of the Executive branch of

the government also saw the creation of the Department of Transportation and Public Works --which was created as the umbrella agency for the transport sector.

The idea for mass transit was first taken to the federal level, for funding assistance, in 1979 following the study "Metro for San Juan: A Study of Transit Alternatives for the Metropolitan Area of San Juan." Unfortunately, and although the federal government committed $500 million towards funding the project, the project would never get underway, as the local commitment necessary to fund the remaining portion was not present. This, as Ardila puts it, "marked the first death" of Tren Urbano.

A Second Coming

The second, and ultimately sustaining series of events that took place during the pre-history stage of the project began towards the end of the 1980s, only this time, unlike before, members of the private sector took the lead. This re-birth was orchestrated by the business sector who ostensibly worried that the economic well-being of the metropolitan area was being threatened by growing congestion, organized to find a solution to the congestion problem. This coalition of business interests, the Committee for the Economic Development of Puerto Rico, had members with significant economic and political influence.

Out of what appears to have been their concern for the economic well being of Metropolitan San Juan, they hired a consulting firm to conduct a study of the transportation options for the Metropolitan area. The study identified the four separate areas where business activities were concentrated as: Old San Juan, Santurce, Hato Rey, and Rio Piedras. It concluded that the number of cars in the San Juan area was inconsistent with expected levels, based on the average income of the population. It further concluded that the combination of attention on building highways, car-friendly parking policies, and lack of high quality transit service would only contribute to the trend of increased reliance on the automobile. To counter this it made three recommendations, one of which included the development of a mass transit system. It proposed that a light rail system would be the best option for mass transit given the needs of the area (it is noteworthy that the consortium had interest in the development of light rail --as they were involved in the manufacture of such technology).

The Committee, convinced that rapid transit was now essential to preserve and promote the economic vitality of the metropolitan area and armed with this study, began the process of gaining across the board political support for the project, both at the Commonwealth level and at the municipal level. The Committee was successful in gaining the support of local mayors and other political players at the Commonwealth level. Armed with the support of political players, the Committee was able to hold a press conference demanding that the government of Puerto Rico build a rail transit system for San Juan as a matter of urgency.

A Friendlier Government Environment

During this time other events that would prove favorable to the idea of a mass transit system began to take place. One of these events was the appointment of a Secretary of Transportation in 1989, Hermenegildo Ortiz, who was friendly to mass transit and who had been trained in Regional Planning. Up to this point the tradition had been to appoint persons trained as Highway Engineers to this post. Ortiz's belief in the need for a viable mass transit system led him to promote changes in that would be more favorable to mass transit. One such change was, the renaming of the Highway Authority to the Highway and Transportation Authority with responsibilities for promoting and administering public policies regarding mass transit.

With the renewed attention to a mass transit option for the San Juan Metropolitan Area brought on by the Committee for Economic Development of Puerto Rico and the changes in the Department of Transportation and Public Works (DTPW) that would make it more receptive to mass transit, the idea was gaining what was to be sustaining momentum. From here on the newly structured and directed DTPW would take on the issue of mass transit as its own. Out of this renewed momentum and interest on their part, the DTPW commissioned a transportation study that one could argue was somewhat predisposed to a recommendation for a rail transit system.

Barton Aschman and Associates and Parsons De Leuw, Inc. performed the study, *A Regional Transportation Master Plan for the San Juan Metropolitan Area.* The study

would take three years to be completed and using projections for population growth, employment, and land use patterns suggested three transportation options that might be feasible and practical for the metropolitan area. The options included: a plan for highways, a public transportation plan, and a congestion management plan. The study cited that public transportation would become increasingly important to the metropolitan area. It suggested that conditions in the area were generally favorable to the public transportation given that there were: high population densities, concentrated employment, relatively low auto ownership, relatively low household incomes, and low transit fares. The study recognized that according to projections at least three corridors would not be adequately served by the use of buses and publicós, but rather a light rail transit system would be needed.

The study recommended a 19.6-mile (31.6 km) light rail system linking Santurce and Bayomón, via Hato Rey and Rio Piedras --The Tren Urbano. They also recommended that improvements be made in the existing bus and publicó service both to serve as feeders to the Tren Urbano and to serve areas that the train would not. It found that the money to undertake the projects could be obtained by marginally increasing toll rates, gas tax, and motor vehicle registration fees. The study was completed in late 1992, just when the Hernandez Colon administration was about to give way to a new administration. According to Ardila (2000) the planners, wary that the new administration might not take on a project proposed by the prior administration, decided to delay the study and instead deliver it to the members of the new administration. It was then up to the new administration to decide whether or not this project would get out of the pre-history and into the project development stage.

8.2.2 Project Development

By the time Rosello was sworn in as Governor of Puerto Rico in 1993, much of the groundwork had been laid for the administration to aggressively pursue the project, and the press made sure to keep this momentum going by questioning the new administration about its plans for Tren Urbano. The light rail concept had been developed as far as conceptual plans for an 11 mile, 14 station alignment, and work had begun on a

preliminary DEIS (TUO, 1998). Additionally, a strong consciousness regarding the project and its need was in place.

Signaling their interest in the project the members of the new administration, specifically the new Secretary of Transportation, Carlos Pesquera, and the Executive Director of the Puerto Rico Highway and Transportation Authority (PRHTA), Sergio Gonzalez, sought to gain an independent assessment of the findings made by the prior study. To do this they approached Multisystems (a consulting firm based in Boston), and the Massachusetts Institute of Technology, both of which independently found that the project was a sound one. With this independent verification on the soundness of the project they began the work of further conceptualizing and defining the project as a major step towards eventually implementing it.

In recognition of the limited experience in implementing such projects in Puerto Rico, a strategy of seeking input from planners from the mainland with such experience and experience in gaining federal funding for projects was adopted. Out of this strategy came the involvement of a group of Boston planners, who would bring their experience in planning and implementing large public works projects to bear on the effort to do such in Puerto Rico --the project development stage was now underway.

As a constraint, the members of the planning team recognized the importance of getting the project out of the project development stage before the next gubernatorial elections -- i.e. have the major procurement contract signed. To help with the acceleration of this stage, that would include doing environmental impact studies and analyses of different alignments, a General Managerial Architectural and Engineering Consultant (GMAEC) team would have to be assembled as soon as possible. A temporary GMAEC that included Parsons DeLeuw (part of the groups that prepared the study) was retained to start work on these, until a permanent one could be selected.

The GMAEC along with the Boston based planners would form the Tren Urbano Office, which was to have overall responsibility for the planning and implementation of the project. It was to be headed by an executive team from the government consisting of the

Secretary of Transportation, the Executive Director of the PRHTA, and the Deputy Executive Director of the PRHTA.

With the assembly of the Tren Urbano office the detailed work of conceptualizing and refining the project to the point where it could be procured, began in earnest. Using the Barton Aschman (Barton Aschman was the lead firm in the study) study as a base several modifications were made that would make the project more feasible. One consideration during this process was to ensure that mitigation measures be an integral part of the project, or to as much as possible ensure that the project is defined to minimize the need for mitigation. This led them to make several adjustments in the previously recommended design --one such change was to move the alignment to avoid a parkland (which could have faced substantial objection under Section 4F federal regulation). Another consideration was to ensure that all the major demand centers would be covered as part of the first phase of the project. This led them to bring the alignment close to the University and through the downtown of Rio Piedras. This they proposed to do with a tunnel built using cut and cover technique. This would face strong opposition from the members of the Rio Piedras community, and a decision was ultimately made to use a deep tunneling technique rather than cut and cover. A further alignment adjustment used a tunnel to achieve a convenient station to serve the medical center.

Another recommendation that was made was to extend the first phase to Minillas rather than have it stop at Sagrado Corazón. This it was argued made sense since Minillas is an important economic center having many important government facilities. This would have to be considered as phase 1A of the project however since the work done by Parsons DeLeuw with regards to the environmental process did not include the Minillas extension and making this part of phase 1 could be detrimental to the strategy of starting implementation before the next gubernatorial elections.

A parallel strategy of looking for funding opportunities was also engaged, and a transportation lobbyist hired to do just that. With the project already selected to participate in the turnkey demonstration program and being further defined and having studies to substantiate its merit, the project was thought to have a reasonable likelihood of

securing federal support, notwithstanding the lack of a Puerto Rican Congressional voting delegation.

The culmination of the project development stage was essentially marked by two events. First, the Record of Decision (ROD) by the FTA indicating that the environmental impact statement was completed in February 1996. And secondly, by the issue of a Full Funding Grant Agreement (FFGA) committing the FTA to providing the project with $307.5 million in federal aid over a period of five years. To fund the local share the PRHTA would issue project bonds and prioritize Tren Urbano over highway projects (eventually, the government of Puerto Rico would earmark a tax on oil for funding transportation projects to replenish the funding capacity to maintain an aggressive program of highway projects). Additionally a federal "TIFIA" loan would be secured for Tren Urbano to ease cash flow problems.

8.2.3 Procurement

In deciding on a procurement strategy the DTPW and the PRHTA had four overriding objectives: top quality, local control, technology transfer, and accelerated start up (TUO, 1998). The procurement stage is where the necessary arrangements to procure and build the system are made. This involves choosing a project delivery method (Design-Bid-Build, Design-Build, Design-Build-Operate-Maintain, etc.) putting the project out to bid, and awarding contracts to the producers of the system.

The kickoff off of the procurement process began in 1995[40] with an Industry Outreach Seminar, and the first contract of a modified hybrid turnkey procurement was signed in May 1996. Below is a discussion of some of the rationale behind this choice of delivery method, and some of the details of the choice of contractors and scope of work.

There were several considerations that led to the choice of project delivery method. First, the Tren Urbano project had been selected to participate in FTA's Transit Turnkey

[40] Please note that the procurement stage actually began before the completion of the project development, to "fast track" the project. Since much of the thought into how procurement is done actually takes place in this stage this worked reasonably well.

Demonstration Project, and as such the planners did not want to lose the opportunity to maintain favorable attention from FTA. Secondly, the planners wanted to ensure that the project could award its first contract before the next gubernatorial election to be held in November 1996. Thirdly, it had to choose a strategy with the recognition that there was no local experience in building such systems.

Project Delivery Methods

The term turnkey is used to refer to procurements where at least the design and construction function is packaged together as a single contract --i.e. Design-Build (DB). Other strategies that fall under the definition of turnkey (with the term super turnkey often used to describe contracts that package additional elements into the single contract) include: Design-Build-Operate (DBO), and Design-Build-Operate-Maintain (DBOM). The traditional approach to procuring government infrastructure projects is Design-Bid-Build (DBB). This is a segmented delivery strategy in which the design function is fully separated from the construction function, both of which are, in turn, separated from operations and maintenance of the facility (Miller, 2000).

Turnkey procurements have been lauded as presenting several advantages over the traditional DBB method. Some of the cited advantages include: expedited schedule, control cost, better allocation and management of implementation risks, effective cash flow management, project control, partnering of small, medium, and large-sized firms, attraction of new sources for funding, and fostering the use of innovative technology (FTA, 1997). Another notable feature of turnkey is the elimination of "hand off" between project stages and the emphasis on teaming (TRB, 1998).

The practical advantages for Tren Urbano to using a turnkey approach over a traditional DBB, was the fact that it allowed for a construction bid before 100% of design was completed which meant it could get a construction contract earlier than would otherwise have been possible. Additionally, by going with a turnkey procurement the project could keep its status as one of the FTA's transit turnkey demonstration projects. Finally, DBOM was viewed as superior to DBB and DB in the sense that it secures greater

accountability on the part of the contractor for delivery of a functional system given that their obligations extend to include operations and maintenance of the system.
The Tren Urbano Office ultimately decided on what they termed a modified hybrid turnkey procurement strategy --using this approach they would issue one DBOM system and vehicle contract and six civil DB contracts. They would separate the fixed construction projects from the transit system components in a way that still involved the system contractor in design and construction of all the stations and civil structures (TUO, 1998). This 'hybrid' approach allowed the project to maintain its turnkey label, it allowed them to issue a contract within the electoral cycle, and it allowed for the involvement of local firms (which could do the civil works if not the systems works).

The DBOM contract, which would form the centerpiece of the procurement package, was referred to as the Systems and Test Track Turnkey (STTT). It would be contracted to a single entity to provide vehicles, track, power and signals, and to operate and maintain the system for five years (with an option for five more years). Because of the lack of experience on the part of local firms they would be precluded from participating in this contract or from being the main partner in a joint venture. The other six contracts, alignment section contracts (ASCs), would be to build the rest of the alignment and stations, and would allow for the involvement of local firms. Additionally, by breaking up the contract into seven pieces, the objective of issuing the first contract by the end of the electoral term was practicable, since it was feasible to get to 10% design[41] of one of the contracts. Another perceived advantage to using a DBOM as the centerpiece of the procurement over DB, was that it would tie the contractor's success to operational success, where with a DB the contractor's obligation (beyond certain warranty agreements) ends once the system is built.

Once it was determined that this strategy would yield the desirable results it was presented to the industry, and further refined to take into account input from industry members, without any change in the fundamental strategy. The bidding process was

[41] As a rule of thumb, turnkey contracts should be at least 10% complete prior to been put out to bid, although the Tren Urbano planners decided to continue the design up to 30% while the FTA was reviewing the EIS.

designed as a two envelope, best value process. This allowed the decision-makers to first choose a bidder based on technical and management merit and secondly on price.

On May 3rd, 1996 the DBOM contract was awarded to the Siemens Transit Team (STT), a consortium consisting of, Siemens Transportation Systems, Juan Requena, and Alternate Concepts. Siemens Transportation System, which serves as lead partner, is a German based company with expertise in vehicle manufacturing. Juan Requena is a Puerto Rican firm, and Alternate Concepts a Boston based firm with expertise in operating and managing transit systems. The table below lists contractors, facilities, section length, and the estimated cost of each contract (1998 numbers).

Table 8-1 The STTT and Alignment Section Contracts[42]

Contract	Stations/Facilities	Guideway Length (km)	Contractor	Contract Value ($millions)
STTT	Torrimar, Martinez Nadal, Maintenance Facility, Operations Control Center	2.6	Siemens Transit Team	612.5
Bayamón	Bayamón, Deportivo	2.9	Grupo Metro San Juan	71.5
Rio Bayamón	Jardines	1.7	Redondo-Entracanales	37.9
Centro Medico	Las Lomas, San Francisco, Centro Medico	2.5	Redondo-Entracanales	74.1
Villa Nevárez	Cupey	1.9	Redondo-Entracanales	71.8
Rio Piedras	Rio Piedras, Universidad	1.8	Grupo Kiewit (KKZ/CMA)	245.3
Hato Rey	Pinero, Domenech Roosevelt, Hato Rey, Sagrado Corazón	3.6	Redondo-Entracanales	125.8

8.2.4 Implementation

By mid 1997 all contracts been awarded for phase I of Tren Urbano and construction activities were underway. The initial schedule called for completion with full operations and maintenance by November of 2001. However, because of mobilization problems, the schedule slipped to a new baseline schedule predicting completion of all implementation activities by March 2002 with Operations slated to begin in August of that same year.

[42] TUO, 1998

As of the end of November 2000, the Project Management Oversight report forecasted schedule delays from zero to twenty-six months on the individual section contracts for the Guideway construction and Stations. This forecasted slippage would delay the start-up and revenue operations date to September 2003 at the earliest.

Table 8-2 Status of Alignment Section Contracts as of November 2000[43]

Number	Description	%Complete Actual	% Complete Planned
ASC-1	Bayamón Section	86.0%	89.5%
ASC-2	Río Bayamón Section	77.4%	95.0%
ASC-3	System Turnkey and Test Track and Maintenance Facility	69.4%	83.0%
ASC-4&5	Centro Medico Section	71.9%	89.2%
ASC-6	Villa Nevárez Section	74.5%	82.2%
ASC-7	Río Piedras Section	74.2%	99.6%
ASC-8&9	Hato Rey Section	57.4%	97.0%
ALL	**TOTAL**	**75.7%**	**89.2%**

[43] Project Management Report, December 2000

8.3 Evolution of Planning on the Tren Urbano Project

Planning on the Tren Urbano project has evolved in much the same way as planning on most public infrastructure projects have. It has moved from a very long-term/system-wide approach where the project idea originated from a long-range metropolitan planning process, to one where dealing with the day-to-day challenges of implementation activities dominates the agenda.

8.3.1 Planning from Prehistory to Implementation

Prehistory

Although the model suggests that the entire prehistory stage is one where long-term/system-wide planning dominates it can be seen that even during this period there is some narrowing of focus. The first mention of mass transit came out of a Regional Transportation Planning study commissioned by the Puerto Rico Planning Board and intended at informing their policy decisions for the future development pattern of the metropolitan area. Perception of competition for funds, or perhaps lack of institutional capacity led to the project not moving forward even though federal funding of $500 million had been secured, whereas a major highway project to link the island together more closely was initiated.

The second life of the project began with a study performed on behalf of members of the business community who saw mass transit as necessary to the continued economic vitality of the metropolitan area. The study that eventually accompanied the project out of the pre-history stage was a study commissioned by the DTPW on mass transportation, and one that seemed pre-disposed to a finding in favor of a rapid transit system. This narrowing of definition is somewhat logical as once the need is identified in a broader context it has to be defined in smaller components.

Project Development

At the start of the project development stage, long-term and system wide planning still tends to dominate as the environmental process, coalition building, and other activities

related to this stage dictate. However, over time and as final decisions regarding alignment were made and the environmental process neared completion, the emphasis began to narrow further to one of project planning where strategies for procuring the project began to dominate the agenda.

Procurement Stage

The procurement stage was governed mostly by a project planning approach, where the focus was on how to design and put to bid the contractual elements of the project, within a politically defined timetable. In addition, it is fair to say that the choice of a DBOM strategy intended to extend the contractor's financial responsibility and interest beyond implementation had some long-term/system-wide thinking behind it.

Implementation Stage

The implementation stage has further narrowed the approach to planning, where:

> *"Now that the Tren Urbano Phase I has reached the full construction stage the TUO's overriding mission is to make sure that the exigent technical and management criteria in the contract are implemented. The DTPW/PRHTA executive team and the TUO Project Director closely monitor this mission, which is carried out by the TUO Implementation Department (TUO, 1998)".*

This overriding attention to the 'exigent technical and management criteria' is important, but allowing it to dominate the activities of the planning office can only undermine long-term/system-wide planning. At the same time, an upgrading of the performance of the AMA[44] bus system, carried out in December 1999, and planning for further restructuring of the bus feeder system, and the publicó (jitney) system has received some attention. Planning for transit oriented joint development, planning for a new transportation building at a transit station, and securing legislation[45] to facilitate a major PRHTA role in joint development have all demonstrated some ongoing attention to system-wide and long-term planning. Nonetheless, it is fair to say that implementation staffing, attention to

[44] AMA is the Spanish acronym for the Metropolitan Bus Authority.
[45] "Resolution Creating Interagency Committees and Adopting Guidelines for Evaluation of Private and Public Project Proposals in the Tren Urbano Corridor." Junta de Planificación, Office of the Governor, Government of Puerto Rico. April 18, 2000.

schedule, budget and quality problems with construction has resulted in distraction of PRHTA attention away from effective long-term/system-wide planning.

Summary of the Evolution of Planning on the Tren Urbano Project

In summary, the planning or implied planning on Tren Urbano has consistently narrowed with the passage of time and as the project moved from stage to stage. This is due in part to the increased level of detail involved as the project moves from just an idea to one that can actually be implemented. It could additionally, however, be due to the fact that there is no mechanism to constantly remind decision-makers of the vision for the project and all the requirements to get to this vision. The figure below summarizes the way planning has evolved on the Tren Urbano project from the pre-history stage to where it is now, the implementation stage.

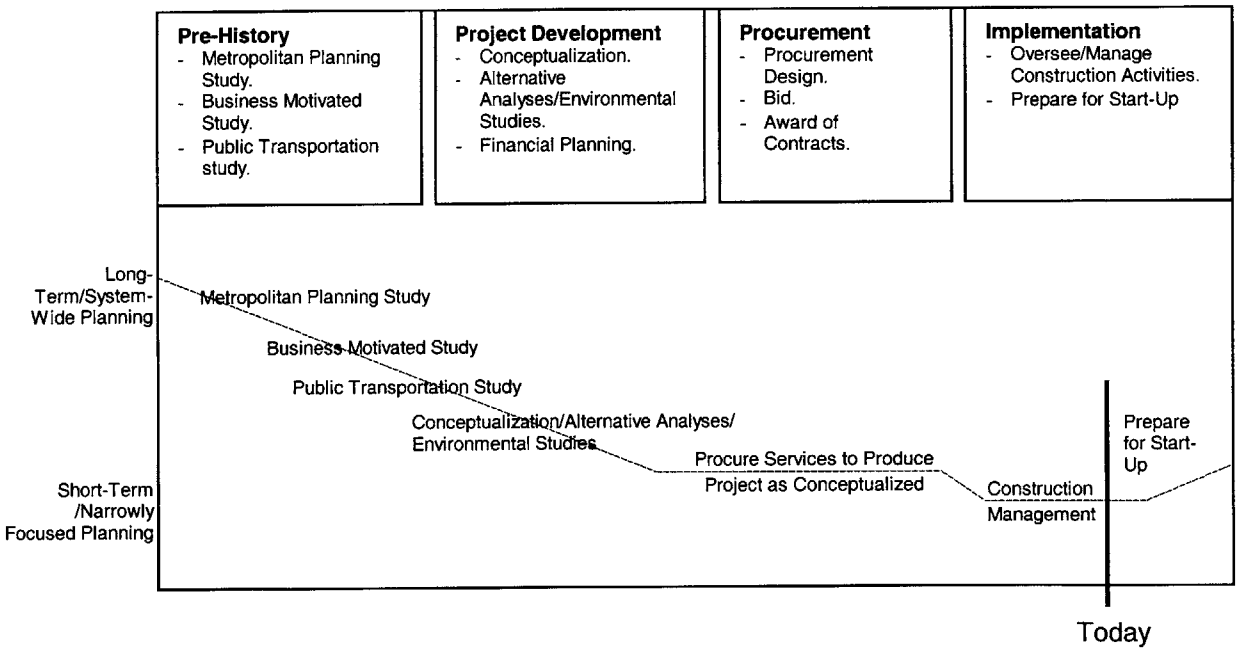


Figure 8:3 The Evolution of Planning on the Tren Urbano Project

8.3.2 The Barriers to Long-Term/System-Wide Planning

The progressive narrowing of planning on Tren Urbano from the pre-history stage to the implementation stage as illustrated in the preceding section is a result of several factors, some having greater legitimacy than others. As mentioned earlier, in order to get the project idea to a point where it can actually be implemented, efforts had to be concentrated around defining the project in terms of very specific components, and this necessarily meant some narrowing of focus. In this section we will revisit the barriers that we have suggested retard long-term/system-wide planning on a project and see how these have or might manifest themselves on the Tren Urbano project.

Political

The chief executive on the project, responsible for setting the policy and direction of the project is the Secretary of the Department of Transportation and Public Works (DTPW); in essence this person is the one entrusted with the vision of the project.

The Colon administration under the leadership of Secretary Ortiz began to move the concept of Tren Urbano out of the prehistory stage, with a fairly broad land use and planning philosophy. It can be argued that he had a broad vision of the role Tren Urbano could play in the San Juan Metropolitan Area and his efforts in the prehistory stage were consistent with this broad vision. The Rosello administration under the leadership of then Secretary Carlos Pesquera focused on project development, and then proceeded into the procurement stage, and started the implementation stage of the project. It is safe to say that Secretary Pesquera possibly using Secretary Ortiz's vision as a starting point had his own vision of the role that Tren Urbano could play and set out to design, procure and build a system consistent with this vision. During the second Rosello term Sergio Gonzalez, the Executive Director of the Highway and Transportation Authority took over as Secretary. One might again say that Gonzalez had his own interpretation of what the project meant and could at a macro level influence the direction of the project. This interpretation was much more focused on implementation issues of cost and schedule, and much of the slippage in attention to feeder system and extensions can be interpreted

as resulting from a combination of the new pressures of implementation coinciding with a change in policy leadership. In the gubernatorial election of 2000, the incumbent party with candidate Carlos Pesquera (former Secretary of the DTPW), lost the election and a new administration under Sila Calderón took office in January 2001. José Miguel Izquierdo was appointed as Secretary of the DTPW by Governor Calderón.

This discontinuity, where the chief visionary and director of the project has already changed four times since the latter parts of the prehistory stage and three times since the implementation stage began certainly adds complexity to the challenge to sustain long-term/system-wide planning, complexity which our six stages model recognized as almost inevitable in large projects.

Organizational

The responsibility for implementing and operating the train system belongs to the Highway and Transportation Authority (PRHTA). Until 1989 this was the Highway Authority concerned with the development and maintenance of the Commonwealth's highway infrastructure. As such they have very limited experience in public transportation let alone in one that will soon include a rail transit system, and in contrast to an existing rail transit organization building an additional line, the PRHTA will have much greater difficulty in managing for the success of the system.

Jurisdictional

Maintaining a system-wide approach to planning would necessarily require multi-jurisdictional cooperation, in order to implement, in parallel, parking policy, land use policies, joint development initiatives, among other system-wide components that have the potential to affect long-term success. Even more narrowly within public transportation systems, a wide variety of issues under different jurisdictions have to be addressed. For example, the feeder systems essential to success are a combination of contracted bus services by PRHTA, buses operated by AMA (an independent agency that reports to Secretary), and the publicós, which are totally outside the jurisdiction of the Secretary.

Technical Complexity

As is typical, the implementation of these projects involves significant technical complexity. Using the narrow definition of the project, the major components of the project are the guideways, stations, vehicles and systems work. These all involve great complexity and require assiduous attention to detail in order for the rail system to function effectively and efficiently once implementation is complete. Most of the work thus far has been on implementing the guideway and this has involved great complexity.

About 40% of the guideway is at grade while the rest is elevated or underground. The underground segments entailed the greatest amount of complexity, with the high groundwater table in some areas, and the need to carefully navigate under historic buildings in the Río Piedras community presenting special challenges. These complexities have resulted in "quite a few change orders", as Río Piedras contract manager Vinton Garbesi noted[46]. In addition uncertainties such as hurricanes (Hurricane Georges hitting the island in fall 1998) and even smaller ones such as unanticipated buried utilities have disproved any assumption that effective and timely implementation is automatic.

Currently most of the guideway is near completion, however, additional and probably more significant complexity lies ahead with stations, system and vehicle testing where greater focus on quality is needed. With these complexities and the reality that delivery of quality[47] 'products' on time, within schedule and budget is not a given, a lot of focus has to remain on addressing these issues rather than doing longer-term/system-wide planning which at this stage should include implementing plans for creating an integrated transit system with feeder services appropriately designed and coordinated.

[46] Cho, Aileen, "Twisting and Turning through San Juan", Engineering News Record, January 2000

[47] With the threat of federal fund holds if quality criteria are not met, much attention has to be paid to these issues. Even more fundamental, if quality construction is not secured, quality operations will be at risk.

8.4 Towards Performing Real-Time Evaluation consistent with the Conceptual Framework in the Tren Urbano Context

To conclude this chapter we will present a discussion on moving towards performing real-time evaluation, consistent with the conceptual framework developed, in the Tren Urbano context. To do this we will look at elements that resemble the trustee function and some of the actions they have taken that approximate real-time evaluation. Following this we will present a beginning option for performing real-time evaluation in the Tren Urbano context by building on what currently exists.

VISIONS FOR TREN URBANO AND EFFORTS TO ENSURE THEM

Coming out of the prehistory stage a fairly well defined vision for the Tren Urbano project existed. The local citizenry, political figures, businesses, and other affected parties were more or less convinced of what they expected from the project. This is not to say that everyone's vision of the project was in perfect alignment, but for the most part they all had some notion as to what benefits the project would deliver.

As part of the project development stage project leaders had to articulate a vision for the project in terms of 'project goals'. This they had to do, for example, in response to federal requirements such as the EIS. Additionally they had to develop strategies and put in place mechanisms that would ensure that the project as delivered did in fact yield this vision several years down the line, within available resources and constraints. Similarly other stakeholders on the project moved to safeguard their interests adopting strategies and putting in place mechanisms geared at helping to ensure that the project was being delivered consistent with their expectations. In this sense different parties took efforts to ensure that the project would be delivered consistent with their own interpretation of the vision of the project. In other words, different parties acting as trustees for at least a subset of goals established programs or other initiatives that would help them to determine whether or not the project was on course to accomplish these goals, with a view for having corrective actions taken on a real-time basis. In keeping with the conceptual framework developed where we suggested that real-time evaluation be

commissioned/conducted by a trustee, we will look at the different interested parties as trustees (each with their own interpretation of the project goals) and some of their efforts that approximated real-time evaluation. Doing so with a view to: identify the elements of real-time evaluation that exist on the project, make observations on their limitations in relation to the conceptual framework and finally move to suggest what might be done going forward.

IDENTIFYING A TRUSTEE FOR PROJECT GOALS

Given our conclusion that there are two major requirements that have to be fulfilled in order for an institution or individual to function effectively as a trustee for project goals we will look to identify a trustee in terms of these two requirements. These two requirements being an understanding/appreciation for the goals of the project and the power to act on behalf of these goals. On the Tren Urbano project there are various institutions and individuals who would satisfy at least parts of these requirements. For example, local planning organizations that participated in the prehistory and project development stage, business groups who advocated for the implementation of the project, members of the media who covered the project over the years, members of the community who were active participants during the project development stage, and many others from the local context would boast some level of understanding/appreciation for the goals of the project. In addition there are the many institutions and individuals such as local government entities, funding and regulatory entities, private developers, community groups, and others who would have the power to act on behalf of different goals depending on the jurisdiction(s) under which a certain goal would fall. Of course, the two requirements are not (and quite possibly cannot be) met in their entirety by any single institution or individual.

The discussion on who would represent trustees for Tren Urbano project goals will focus on three classes of entities: the Commonwealth Government entity responsible for Tren Urbano as a public infrastructure project, the Federal Government entity responsible for Tren Urbano as a federally sponsored transit project, and the Communities as the people

who will be affected by the project and for whom it is being built. These three classes of entities all have characteristics that provide them with an understanding/appreciation for the project goals and some amount of power to act on behalf of certain project goals.

The Commonwealth Government Entity

In the U.S. most public infrastructure projects are sponsored and managed by a State agency (or in the case of Puerto Rico an agency under the government of the Commonwealth). This agency usually falls under the executive branch of the government of the State or Commonwealth and is typically headed by a political appointee. Generally this agency would have within it several departments with different functions and responsibilities, with the head of the agency being the individual charged with setting the agenda and giving directions to their functions and responsibilities.

The Department of Transportation and Public Works (DTPW) is the entity charged with transportation planning and policy making on behalf of the government of the Commonwealth of Puerto Rico. The departments within the DTPW that have responsibility for promoting and administering the public transportation policies established by the Secretary of the DTPW are the Puerto Rico Highway and Transportation Authority (PRHTA) and the Metropolitan Bus Authority (AMA).

As the transportation planning and policy-making agency of the Government of Puerto Rico, the DTPW shoulders the responsibility for quality, cost efficiency, and ultimate success of Tren Urbano (TUO, 1998). In this sense one can point to the DTPW as a trustee institution for the project goals and the Secretary serving as the chief executive of this department being the individual trustee. However, it is important to note that there are many divisions and individuals within the DTPW, such as the PRHTA, the planning group, and long standing bureaucrats who have played different aspects of the trustee role. In fact while the DTPW as the umbrella organization is ultimately responsible for

the success of Tren Urbano the PRHTA is the primary financial supporter of Tren Urbano, and is the grantee agency[48].

The Federal Government Entity

The federal agency with responsibility for transit development is the Federal Transit Administration (FTA). This is the agency through which the federal funds for transit projects are appropriated. Decisions to fund a project are usually made on a competitive basis after an extensive ex-ante evaluation process. This process includes determining whether or not the requirements for environmental permitting have been met and making a judgment on how competitive a project is versus other competing projects. The two most important milestones in the ex-ante evaluation process, as mandated by federal guidelines, are the Record of Decision (ROD) that marks the acceptance of the Environmental Impact Statement (EIS) and the Full Funding Grant Agreement (FFGA), which commits the federal government to a certain level of discretionary funding. Following these two milestones and when the implementation stage gets underway the FTA is charged with providing assistance to the grantee agency.

The Tren Urbano project is funded in part by the FTA and given the FTA's mandated role to assist the grantee agency in its implementation of the project, the FTA can be viewed as a trustee for project goals or at the very least as an assistant to the grantee agency in its role as the central trustee on the Tren Urbano project.

Communities

In theory and according to democratic principles both the government of the Commonwealth and the Federal government are acting to represent the interests of the communities affected by the project. However, in reality not all communities will concede this trustee role and most will invariably have reservations about the ability or willingness of government entities to effectively represent their concerns. These

[48] Grantee Agency is the term used by the Federal Transit Administration to define the agency that has direct responsibility for implementing the project.

communities often take the position that their concerns are not necessarily well understood or well represented on the project and they subsequently move to position themselves as trustees for their own goals.

In the case of Tren Urbano one community that has been very effective in taking steps to have its interests represented on the project is the Río Piedras Community Group. This group was very active during the environmental permitting process of the project and has managed to have the Secretary attend their monthly meetings where issues of concern to them can be raised. Along with the other affected communities, they also have the Tren Urbano Community Relations Office (CRO) through which issues of concern can be raised.

REAL-TIME EVALUATION EFFORTS BY THE TRUSTEES

The parties discussed above as parties that act in some form as trustees for project goals have each engaged in efforts to, on an ongoing basis, determine where the project is relative to the goals they serve as trustees for. While it is recognized that these efforts may not amount to evaluation in the broad sense of the word, they all undertook efforts aimed at relating issues on or around the project to the likelihood of accomplishing the goals of the project (the ones they see themselves as trustees for). In this regard these efforts can be considered as at least starting points for conducting real-time evaluations in the Tren Urbano context and will be discussed as such.

The DTPW and the Just in Time Research Mechanism

In addition to the standard oversight mechanisms put in place to ensure that, for example, construction progresses on schedule, within budget, and according to quality specifications, the DTPW contracts for a program which in principle has some attributes of a real-time evaluation mechanism[49]. This program is the 'just in time' research component of the Tren Urbano MIT/UPR Professional Development Program.

[49] The contracting authority is actually the PRHTA, which falls under the DTPW.

This program was initiated with the view that: the long-range success of Tren Urbano will depend on Puerto Rican professionals and technicians trained in all aspects of planning, designing, building, operating, and maintaining rail transit systems (TUO, 1998). This was in recognition of the fact that at the time of project development the institutions and expert capacity required to operate and manage the rail system did not exist on the island. One of the objectives of this program was to provide 'just in time' research for the project (Salvucci, 2000). This by establishing cross-disciplinary cooperation among the faculty in engineering, architecture, and planning, working together with experts from government and industry to apply an integrated systems approach to the development of a major urban infrastructure project (TUO, 1998).

As part of the program students under the supervision of faculty and with input from people within the DTPW and/or TUO staff develop research projects of relevance to the goals of Tren Urbano. The students then set out to conduct research on the topics approved by the DTPW through the Tren Urbano Steering Committee[50] and prepare a report on their findings. These reports are submitted to the Tren Urbano Steering Committee with the intent of incorporating applicable findings. Topics have ranged from, strategies for successful phasing, construction management, integration of buses and publicós, transit oriented development, location efficient mortgages, and marketing transit use, among others --highlighting the system-wide issues that relate to long-term goals.

The FTA and the Project Management Oversight Program

A Project Management Oversight Consultant (PMOC) was deployed by the FTA on the Tren Urbano project as part of the funding agreement. As was discussed in earlier chapters the role of the PMOC is to monitor the project's progress to determine whether it is on time, within budget, in conformance with design criteria, constructed to approved plans and is being efficiently and effectively implemented. The project management oversight services are provided by MK Centennial Engineering, Inc, of Hamden Connecticut.

[50] The Tren Urbano Steering Committee is chaired by the Secretary's Press Secretary.

The PMOC has been playing its role as a real-time evaluation mechanism reasonably effectively. Its relationship to the FTA and the power to withhold funds is significant. It has forcefully insisted on improved quality in construction, and its December 2000 report indicating a need to revise schedule and cost estimates, and prepare for more exacting station quality, system installation and service commencement issues ahead has assisted the transition by providing a credible source of expert advice independent of the prior administration.

The Communities (The Río Piedras Community Group)

Río Piedras is one of the communities through which the Tren Urbano alignment passes as it goes from Bayamón to Santurce. In bringing the alignment through Río Piedras two options were considered --one an elevated guideway, the other a cut and cover tunnel. Members of the community who had a history of being well organized opposed both these options, and eventually through effective leveraging of their organizational skills and an understanding of how to get decision-makers' attention, they were able to convince then Secretary of the DTPW, Carlos Pesquera, that a deep tunnel would represent the only acceptable option for bringing the alignment through their community. Since then they have remained active in trying to identify issues on or around the project that relate to the community's interests, particularly in terms of enhancing the long run viability of Río Piedras by renewing all underground sewer and water utilities, maintaining the short-term survival of the commercial establishments through careful mitigation of construction impacts, modifications of station design, and maintaining constant open communication channels. This process works through the Tren Urbano Community Relations Office (CRO), which reports to the Press Secretary of the Secretary of the DTPW, in addition to direct regular contact between the Secretary of the DTPW and the Community at a monthly meeting.

ANALYSIS OF THE EXISTING ELEMENTS

The Trustee Function

According to the conceptual framework presented at the end of Chapter 7, there are two primary requirements of a trustee for project goals: (1) understanding/appreciation for the goals of the project, and (2) having the power to act on behalf of these goals. Given these two requirements and the realities that now exist in the Tren Urbano context there are some logical steps that can be taken to improve the performance of the trustee function on the project. To avoid the obviously less feasible option of creating a so-called ideal trustee entity with all the desirable attributes, we will adopt an approach that takes advantage of the existing entities that have some of the attributes of a trustee entity.

It is evident that the entity serving as the central trustee on the project is the DTPW with the Secretary as the head of this entity being the individual who serves as central trustee for the goals of the Tren Urbano project. Given this we will identify the Secretary of the DTPW as central trustee and suggest ways for improving his performance as trustee for the project goals, keeping in mind that other parties have acted and will continue to act as trustees based on their interests.

1. UNDERSTANDING/APPRECIATION FOR PROJECT GOALS

The conceptual framework suggests that in order to have a good understanding/ appreciation for project goals a trustee should: be knowledgeable of the history of the project, be sensitive to the many interests on the project, and be insulated from short-term political currents. Below we will discuss the understanding/appreciation for project goals that the position of the Secretary of the DTPW has as a function of these three factors.

Knowledgeable of the History of the Project

At an institutional level, the DTPW is the entity that has being 'on board' from the onset of the project. This was the entity from within which the efforts to get the project out of the prehistory stage and pursued were coordinated. In this sense there is some institutional memory within the DTPW as to why the project is being implemented to

begin with. However, DTPW and PRHTA are overwhelmingly highway organizations, with little understanding of or support for public transportation, other than the planning department, and AMA, the bus organization. Most of the efforts during the project development stage, where the goals were being discussed and articulated along with strategies for accomplishing them, were confined to a select team and the institutional memory of the DTPW (with regards to Tren Urbano) is undoubtedly very much a function of this fact. Most of the planning, although led by the Secretary of the DTPW and the Executive Director of the PRHTA, was done by a team of consultants in an office physically removed from the DTPW[51]. And in addition to the barriers to creating institutional memory caused by the physical separation of the planning and contract management team for Tren Urbano from the DTPW is the reality that the key members of the DTPW (Secretary and the Executive Director) are subject to change and in fact many changes in these two positions have occurred since the latter part of the prehistory stage.

In compensating for the limitations discussed above, there are a few steps that the current Secretary can take. First, he can take advantage of those elements over which he exercises some jurisdiction. These include some of the people within the DTPW (the bureaucrats) who have remained actively involved with the project over the years[52], and the experts within the GMAEC and the contracted capacity of the TUO, and the continuing participants of the 'just in time' research mechanism. In addition, he can take advantage of the other two entities that were discussed as trustees and that have been on board from early on in the project: the Communities, and the FTA. In most cases the communities that took part in the environmental process have a greater understanding/appreciation for what the original goals of the project are than members of the implementation team. The FTA in and of itself or through the PMO can also help to overcome this limitation as their involvement dates back to the project development stage. In this sense both the communities and the FTA, as entities that have been on board from project development stage can serve a role in 'reminding' the Secretary of the

[51] Although, perhaps in light of this, the new Secretary has announced plans to retain most of the members of the implementation team from the prior administration consisting of a combination of Puerto Rican and U.S. mainland consultants (Salvucci 2001).

[52] One such person is Gabriel Rodriguez who was part of Ortiz's team that began planning for Tren Urbano and has remained involved with project since then.

original goals of Tren Urbano. Of course, each Secretary and new administration will bring their own interpretations to the goals but taking advantage of the elements over which he has some jurisdiction and that have institutional memory of the original goals of the project and having the involvement of the FTA and the Communities can only be helpful in identifying the range of goals on the project.

Sensitive to the Many Interests on the Project

In order to be an effective trustee an institution's or individual's understanding/ appreciation for the project goals must be based on sensitivity to the many interests on the project (with a strong local perspective). As in any large public project the interests on the Tren Urbano project are many and complex. They include, among others, the communities that will be affected by the project, the people who use or will potentially use public transportation, businesses and institutions, and the municipalities in the San Juan Metropolitan Area.

In serving as trustee the Secretary has to find a way to determine what all the interests are and balance them. In so doing an understanding for the collection of goals that interested parties have for the project can be gained.

Insulated from short-term political currents

The need for a trustee to be insulated from short-term political currents was identified as necessary in the sense that the project goals should not be interpreted purely on the basis of short-term political priorities. And given that the Secretary of the DTPW is subject to political appointment and it is possible that prevailing political priorities might overly influence the interpretation of the project goals, a move to involve more diverse political interests would be desirable. More than just token involvement by other political figures would reduce the tendency for each new administration to feel the need to adopt goals based significantly on their political inclinations. But without question there is tension between the effectiveness of location of the trustee function with the Secretary, who is best positioned to act effectively on advice, and the desire for insulation from short-term political currents which is unlikely in this location.

2. POWER TO ACT ON BEHALF OF PROJECT GOALS

According to the conceptual framework, the second requirement of a trustee for project goals is the power to act on behalf of these project goals. On a public infrastructure project this requirement will be defined in large part by two factors: the power the trustee has over the decisions to be taken on the project, and the buy-in or cooperation of jurisdictions that lie beyond the traditional project definition.

Power over the Decisions on the Project

On the issue of having the power to act on behalf of the project goals, the Secretary of the DTPW does have power to make decisions within the project definition. Of course, this is constrained since, for example, many contracts have already being signed and options for changing them are limited. However, for the most part the Secretary of the DTPW is the chief power broker on decisions regarding the narrow definition of the project (guideways, stations, systems, etc). Additionally with control over some of the feeder services (AMA, and Metrobus) it has some power to make decisions regarding such things as bus feeder services.

Multi-Jurisdictional Buy-In

On the issue of multi-jurisdictional buy-in, there are decisions that have to be made outside the jurisdiction of the DTPW and although as a powerful government entity the Secretary has some leverage in eliciting cooperation from other jurisdictions such as the municipalities in the SJMA some formal steps can be taken to make this more effective. The Secretary also serves as the chairman of the Metropolitan Planning Organization and can use this as a forum to elicit greater cooperation on taking actions that are outside his jurisdiction. Additionally, the Junta de Planificación, which is the Executive Government agency responsible for planning can be engaged in trying to have actions taken in support of the greater project goals and that lie beyond the DTPW's jurisdiction. Since some actions have to taken by members of the private sector, a way to formally get them involved would also be beneficial. Authority over surface transportation is functionally and structurally fragmented among public and private sector organizations (Mallet, Horan, Gifford, Stough, 1992). But the combination of the newly legislated station area

development powers of the PRHTA and the planning department's statutory role and relationship with the Junta de Planificación, and as Chairman of the MPO, the Secretary is well positioned to facilitate multi-jurisdictional "buy-in".

THE REAL-TIME EVALUATION COMPONENT

In addressing the real-time evaluation component of the framework, a fairly straightforward step can be taken to begin with. Given that we have identified several mechanisms that display some aspects of real-time evaluation, a move by the Secretary to consolidate these efforts is a logical first step. This is also consistent with our suggestion that the Secretary look to these mechanisms for information that will support his understanding/appreciation for the project goals of a broad range of constituents. These mechanisms currently perform 'evaluations' on a particular range of issues and the recommendations or findings that emerge can be formally examined and incorporated at the Secretary's discretion.

The "just in time" research component of the MIT/UPR Professional Development Program can be strengthened by placing greater emphasis on explicit consideration of the results of the university based research, and recruiting the best graduates of the program. The 'evaluation' role of the Community can be incorporated through the Community Relations Office, where all the community issues can be systematically brought to the Secretary's attention. The PMO consultants can be looked to as a 'critical friend' rather than in an adversarial manner. The role of the media as an independent evaluator and as source of information for the public could also be embraced to the point where the relationship between the media and the project can become more mutually beneficial.

All of these currently somewhat disparate components, along with the responsibility of managing the TUO and GMAEC contracts, and the Tren Urbano implementation contracts can be organized into a more coherent public transportation unit, which includes an explicit real-time evaluation component.

A BEGINNING OPTION FOR TREN URBANO: *Consolidation of the Disparate Elements of Real-Time Evaluation*

The above discussion has presented the Secretary of the DTPW as the central trustee for the goals of the Tren Urbano project, with the FTA and the Communities also serving as trustees for a certain subset of goals, and has additionally presented the "just in time" research program (JIT), the Project Management Oversight program (PMO), and the Communities through the Tren Urbano Community Relations Office (CRO) as mechanisms that engage in real-time evaluation. The discussion highlighted some of the limitations of the Secretary of the DTPW in terms of its ability to function as trustee for the 'greater' project goals. It also alluded to some of the shortfalls of the JIT, the PMO, and the CRO in terms of their effectiveness in performing real-time evaluations pursuant to the 'greater' project goals.

The ability of the Secretary to perform as a trustee for project goals can be enhanced along both dimensions that the conceptual framework suggests define an institution's or individual's ability to function as a trustee for project goals: its understanding/ appreciation of project goals, and its ability to take actions on behalf of these goals. The Secretary in his position as central trustee can take advantage of the existing mechanisms that perform 'real-time evaluations' and concomitantly the effectiveness of these mechanisms can be enhanced with greater integration into the decision-making process.

An option for doing this is to essentially consolidate all the entities that embody an understanding/appreciation for the project goals and all those that have the power to make decisions on behalf of the project. Furthermore the existing mechanisms that are, on behalf of the somewhat disparate trustees, currently engaged in identifying issues that relate to project goals can be part of this consolidation move. In other words, consolidate the disparate elements of real-time evaluation that currently exist in the Tren Urbano context. The Secretary in the role as central trustee can do this by creating, for example, a public transportation group as a first step to formalizing the involvement of all the entities that have some understanding of the goals of the project and/or have the power to make decisions or take actions on behalf of the some of these goals. That is the communities,

the FTA and jurisdictions such as: the municipalities, planning organizations, the private sector, and others. And formalize and actively look to the three mechanisms for concerns or recommendations related to accomplishing project goals. Doing this as a first step helps to enhance the ability of the trustee and the effectiveness of the existing mechanisms. As shown in figure 8.4, this public transportation group would be answerable to the Secretary of the DTPW and would be a point of consolidation for the entities that display trustee-like characteristics and the existing 'real-time evaluation' mechanisms. This group could also be a source of information for the members of the media who could in turn play a role in recognizing the different jurisdictions that have responsibility over various aspects of the 'greater' project.

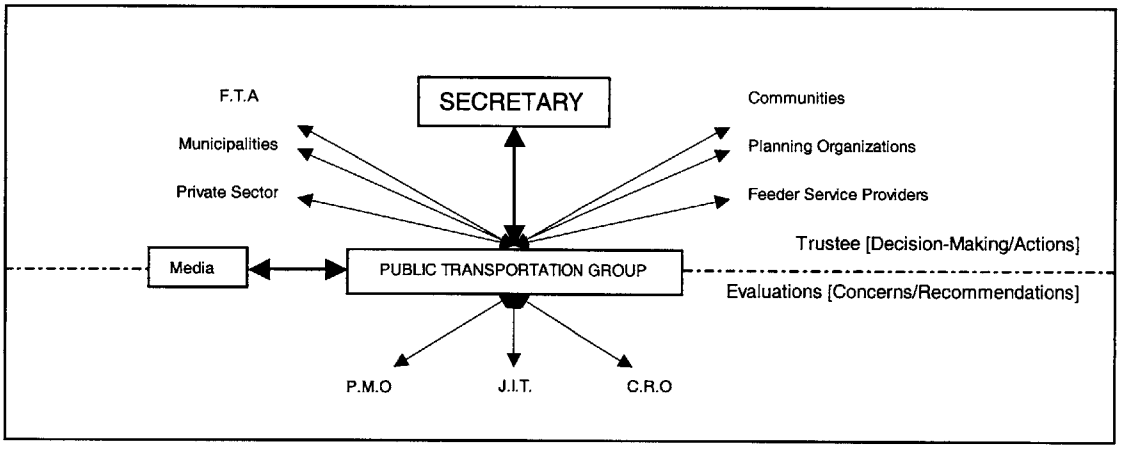


Figure 8:4 Consolidating the Disparate Elements of Real-Time Evaluation on the Tren Urbano Project

The Public Transportation Group: A useful approach to initiating the public transportation group would be to recruit a public transportation deputy who enjoys the total confidence of the Secretary, to begin to build public transportation capacity, with the power to manage the Tren Urbano contracts, coordinate feeder service and station area development issues, and act as convener of and coordinator of the entities that have trustee-like characteristics and the existing real-time evaluation efforts on the project. Graduates of the MIT/UPR professional development program might be a good place look in staffing the public transportation group who could help to build the Puerto Rican expertise to manage a growing public transportation initiative into the future.

Looking further ahead it may be desirable to develop enough institutional stability in this group to sustain continuity across future electoral cycles, by introducing a "board of directors" with longer terms (indeed it is odd that the Systems and Test Track Turnkey (STTT) contract will give the Siemens Transit Team (STT) more longevity than its public sector contract monitors). However, given the priority need to instill confidence in the institution so that the Secretary will be confident taking action based upon the real-time evaluation, creating a group that is answerable to the Secretary is a good place to start and this can be implemented in a relatively short timeframe.

8.5 Summary

In summary, similar to most major public infrastructure projects Tren Urbano can be conceptualized as having different stages in its life. It is currently at the implementation stage (for Phase I) having already passed through the prehistory, project development, and procurement stages. As in other projects there have been barriers to long-term/system-wide planning, and similar to many other projects no formal organization was initiated to perform real-time evaluation related to these long-term/system-wide goals, although like most projects the extensive ex-ante evaluation process would have suggested the need for such an organization. Nonetheless disparate elements of a real-time evaluation framework do exist on the project.

A beginning option for consolidating the trustee-like entities and the existing real-time evaluation efforts through the creation of a public transportation group under the Secretary of the DTPW was presented. There are limitations to this option but given the short timeframe within which this would have to be implemented in order for it to be effective in helping to address and resolve the outstanding issues it is the option that makes the most sense for Tren Urbano at this time. Within the next three years implementation of Phase I must be complete and while the contractors have legal responsibility to complete, the most challenging work lies ahead and ensuring quality will certainly take renewed emphasis, and could require added resources. High quality feeder systems must be organized without pirating resources from existing public transportation services and a station area development process should be initiated. A real-time evaluation process coordinated through a public transportation group acting in direct support of the Secretary as central trustee can help facilitate the effective completion of these essential tasks to achieve the full expectation of Tren Urbano. Given the short timeframe to resolve these outstanding issues that are critical to the success of Tren Urbano, it is prudent to err on the side of an entity whose loyalty the Secretary can trust, and accept some continuity risks from the electoral cycle, rather than attempt a more neutral trustee, which might have more credibility but might not inspire adequate trust from the Secretary in the immediate period.

Chapter 9: CONCLUSIONS

While motivated by the broad objective of helping to maximize success on large public infrastructure projects, this thesis was very deliberate in staying away from a set definition for success excepting to allude to success as being a measure of how closely the outcome of a project mirrors the vision behind its implementation. This 'project-vision' tends to originate in the local environment in which the project is to be implemented and is often based on a range of benefits that the project is perceived as facilitating. These expected benefits are not necessarily identical to any standard for similar projects and are more likely grounded in multiple complex and idiosyncratic motivations. Notwithstanding the many and varied motivations that might have led locales to pursue a particular project, in the end all these projects espouse goals that will only be realized several years in the future and which require actions outside of the jurisdiction of those charged with implementing the project (narrowly defined). There is always an optimistic assumption that somehow the project (narrowly defined) will be implemented effectively and the broader actions will take place such that the outcome of the project is consistent with the vision that founded it. In reality this is not necessarily so.

9.1 Goals of the Thesis

This thesis was motivated by the broad objective of helping to maximize the likelihood of success on large public infrastructure projects in terms of helping to accomplish the long-term goals of the project. This it proposed to do by developing a framework for conducting real-time evaluation such that threats and opportunities related to these goals occurring during the implementation stage can be identified and corrective actions taken on a real-time basis. If one views an ex-ante evaluation as an evaluation to *"assess*

potential merit or worth", and an ex-post evaluation as one to *"determine whether or not merit or worth was attained"*, then an evaluation to "*ensure merit or worth*" is just as critical as the former and definitely more useful to a project than the latter. This is the end towards which this thesis was geared --the development of a real-time evaluation framework for *"ensuring merit or worth"* during the implementation of a public infrastructure project.

9.2 Defining an Effective Real-Time Evaluation Framework

Early on in the thesis we established that there was a dangerous if not unnatural tendency to move from the long-term/system-wide approach to planning that is evident at the stage when the vision for a project originates to a narrower outlook as the project progresses through implementation. We presented the argument that this is the reason why a project may fail --*failure to maintain a long-term/system-wide approach to planning throughout the project*. An effective real-time evaluation framework would therefore have to be one that could facilitate an approach to planning and project management based on accomplishing the long-term/system-wide goals of the project.

9.3 Lessons For Undertaking Large Public Infrastructure Projects

Left to their own devices large public infrastructure projects will not proceed along a linear path from vision to actual outcome, but will instead take on a life of their own -- a victim of their own complexity and the ever-changing currents that shape them. The most assiduous effort to plot a successful path for the project by judiciously writing contracts, hand picking project leaders, and building strong support coalitions will fall short of guaranteeing that a project stays on course for accomplishing its founding vision. In navigating the stages in the life of a project various factors will emerge that retard a sustained effort to accomplishing the founding vision for the project. The barriers that manifest themselves during the different stages and most especially during the

implementation stage can be identified and classified as: political, organizational, jurisdictional, and technical complexity barriers.

The political barrier is associated with the fact that politics and public projects are inextricably linked, and decisions on the project are often reflective of the prevailing political priorities rather than of an attempt to accomplish the founding vision of the project. The organizational barrier is associated with the challenge in creating an entity that can effectively preside over the vision of the project, which could have very unique requirements. The jurisdictional barrier relates to the fact that all these projects espouse goals that can only be fully accomplished by actions external to the decision-makers on the project and absent effective coordination and cooperation many of the goals will not be accomplished. The technical complexity barrier is cause by the potentially overwhelming nature of the tasks that must be completed in order for the project to be functional, which has the tendency to narrowly focus resources around such to the detriment of long-term/system-wide planning. These barriers make it difficult to get results that are consistent with the founding vision for the project.

The lesson, therefore, in undertaking large public infrastructure projects is to first and foremost acknowledge that these and other barriers will manifest themselves as threats to accomplishing the longer-term/system-wide goals of the project and to subsequently put a safeguard in place to mitigate these barriers in the pursuit of project goals. The safeguard we have explored in this thesis is a real-time evaluation mechanism, which would be designed as a mechanism to *"ensure project goals"*. To be able to do this in the context of a large public infrastructure project the mechanism would have to be supported by or housed within an institution serving as a trustee for the project's goals. In the framework, the trustee would be an institution having an understanding and appreciation for the founding vision of the project and furthermore having the power to make decisions and take actions in pursuit of these goals. The trustee would then employ, as a support tool, a real-time evaluation mechanism that can identify and relate threats and opportunities occurring during the implementation of the project to the likelihood of accomplishing project goals.

9.4 Suggestions for Further Research

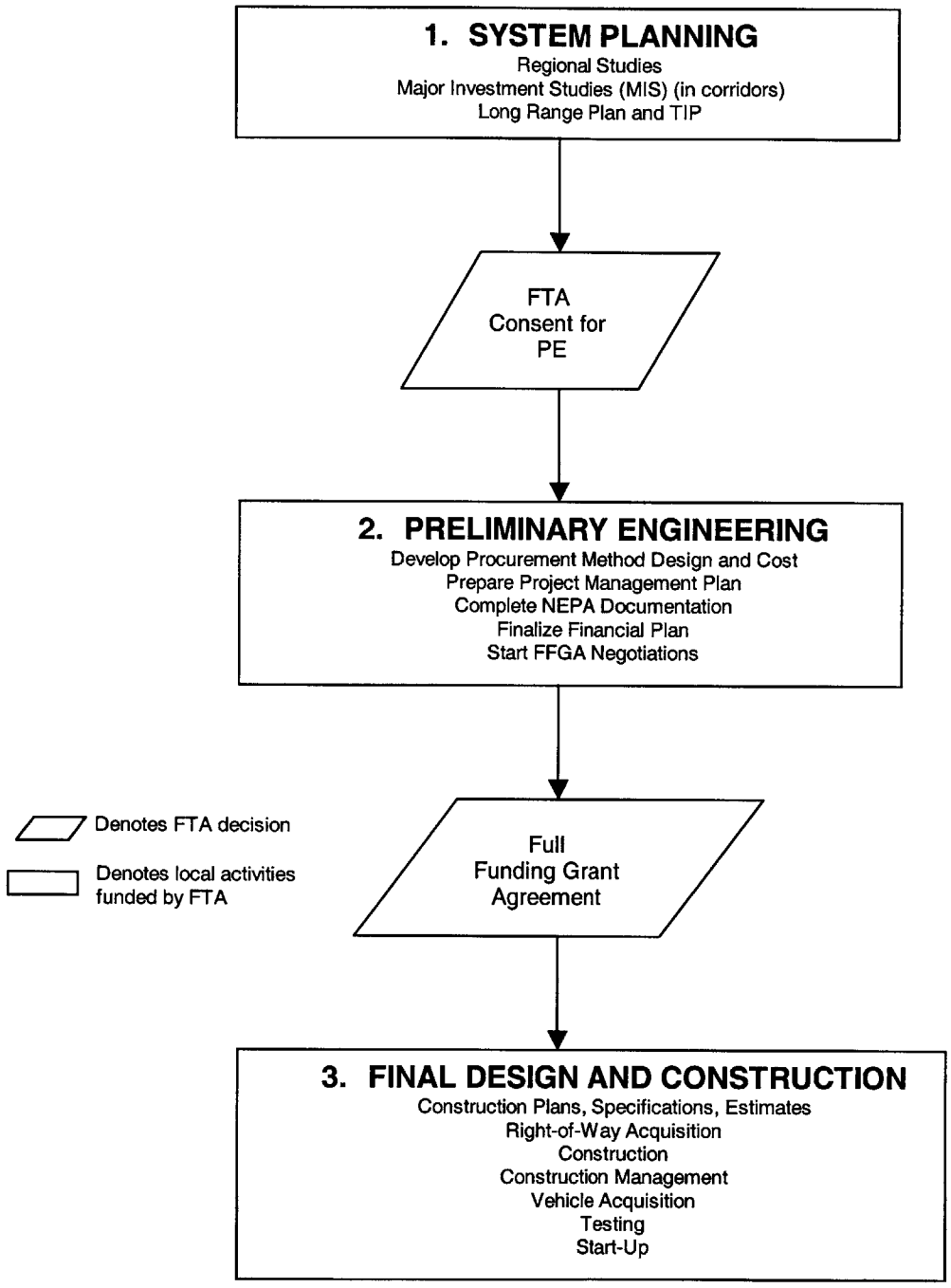
This thesis tried to address a complex topic on which much prior work had not been done and as such took a very general approach leaving many details unattended to. It has presented in very broad terms a conceptual framework for performing real-time evaluations on a public infrastructure project and there are many potential areas for further investigation.

The evaluation framework that was presented suggested that a trustee for the project goals should be created and that this trustee should then employ, as a support tool, a mechanism to perform real-time evaluation related to accomplishing these goals. Of course, more work needs to be done to ascertain what practical and institutional challenges might exist in trying to create such a trustee in the context of a public project, and this is an area for further research.

The thesis also mentioned the detailed ex-ante evaluations dictated by funding agencies such as the FTA, or the World Bank prior to the implementation of a project. These ex-ante evaluations must be carried out to great level of detail and must include a documentation of the long-term/system-wide goals and the strategies that will be used to accomplish these goals. But the funding entities then fail to follow up with a mechanism to ensure that the project progresses in accordance with the exhaustive long-term/system-wide outlook it dictated at the front end. Further research could focus primarily on the role funding agencies could play in emphasizing the need for such a mechanism. And since at a practical level, the most likely conflicts which require resolution are from cost increases and schedule slippage, which require either added resources or revised goals, some capacity to partially fund such contingencies could strongly encourage these kinds of real-time evaluation processes. However, this opens major process questions to be considered, and would be a valuable area for further research.

APPENDICES

Appendix I: FTA New Start Planning and Project Development Process



Appendix II: A Model Ordinance for Integrating Land Use and Public Transportation Planning

A Model Ordinance that can be used to achieve an integration of land use and public transportation planning as proposed in: A Guide to Land Use and Public Transportation, USDOT, 1989.

1. Encourage land uses that:
    A. Are located in an urban area or an activity center.
    B. Are located in an area served by transit.
    C. Contribute to a mix of residential, office, and commercial land uses within walking distance of one another
    D. Are developed at the highest possible density.
2. Encouraging site features that improve access such as:
    A. A site location within 1320 feet of a bus stop or transit center, or
    B. A bus stop or transit center on site.
    C. Reserved parking for carpools or vanpools.
    D. Carpool/vanpool parking near building entrances.
    E. Paved walkway along all streets adjacent to the site and through the site to promote pedestrian travel through the site and between the site and adjacent uses.
    F. Marked routes, racks, lockers, and showers for bicyclists.
    G. All features needed to meet handicapped access standards.
3. Encourage site designs that:
    A. Have buildings clustered near transit facilities (bus stops, park-and-ride, ride sharing, rideshare parking, etc) if present.
    B. Have any large parking areas located at the rear or side of the site.
    C. Have building entrances oriented toward transit routes and facilities.
    D. Have marked routes to available transit facilities or services.
    E. Have buildings located within 1320 feet of a bus stop, rideshare lot, or other public transportation facility.

F. Have building entrances, parking areas, transit facilities, and other site activity centers connected by paved and covered walkways.

G. Are free of barriers to safe and convenient pedestrian travel (walls, ditches, roads, landscaping, etc. without safe crossings).

H. Include shelters, benches, and lighting for pedestrian and transit users.

4. Encouraging developers to use parking management techniques such as:

A. Limiting parking spaces to the lowest possible number.

B. Charging a fee for on-site parking.

C. Providing free or reduced-rate parking for carpools and van pools.

5. Encourage developers to provide ridership incentives such as:

A. Distributing information on public transportation options to site tenants.

B. Providing transit passes or carpool/vanpool subsidies to site employees and residents.

C. Providing shuttle service between the site and transit centers or park-and-ride lots.

D. Employing a permanent rideshare coordinator.

BIBLIOGRAPHY

Allison, G., and **Zelikow, P.** *Essence of Decision.* New York: Longman Press, 1999.

Anastasi, S. "Project Management Oversight: What it is and How it Works?" *Mass Transit Magazine,* July/August, 1987.

Ardila, A., "The Planning Process for the Tren Urbano project." Draft Paper M.I.T., July 2000.

Armstrong, Walter. Former Director Program Management Division, Massachusetts Water Resources Authority. Personal Interview, October 2000.

Boone, E. *Developing Programs in Adult Education.* Englewood Cliffs, NJ: Prentice-Hall, Inc., 1985.

Borzo, G. "On-Site Oversight Still Unpopular." *Modern Railroads*, December 1988.

Central Artery Environmental Oversight Committee. *The Environmental Commitments: A Progress Report.* March 1998.

------- *Central Artery/Tunnel Project Environmental Commitments: A Progress Report.* March 1999.

------- *Annual Report 1999.* March 2000.

Chelimsky, E. "The Coming Transformations in Evaluation." In E. Chelimsky and W. Shadish (eds.), *Evaluation for the 21st Century*. Sage, 1997.

Christiansen, J., and Sherry, C. "Project Management Oversight: a Partnership in Mass Transit Projects." *AACE Transactions.* 1992.

Cho, A. "Twisting and Turning Through San Juan: Tren Urbano brings transportation expertise to island and relief to its congested capital." *Engineering New Record,* January 2000.

Cobb, W., and Coughlin, J. "When is a Solution Politically Feasible? Maglev Rail and Intercity Traffic Congestion." *Public Works Management and Policy,* Vol. 1 No. 4, April 1997.

Cook, T. "Lessons Learned in Evaluation over the Past 25 Years." In E. Chelimsky and W. Shadish (eds.), *Evaluation for the 21st Century*. Sage, 1997.

Eadie, D. "Putting a Powerful Tool to Practical Use: The Application of Strategic Planning in the Public Sector." *Public Administration Review,* September/October, 1983.

Fanton, Anne. Executive Director, Central Artery Environmental Oversight Committee. Personal Interview, September 2000.

González-Quevedo, *et. al.* "The Tren Urbano UPR/MIT Professional Development Program." *Journal of Engineering Education,* April 2000.

Goode, M. "Project Management Oversight: Good Tool for Program Managers." *Journal of Management in Engineering*, Vol. 8, No.3, July 1992.

Government of Puerto Rico, Office of the Governor, Junta de Planificación, "Resolution Creating Interagency Committees and Adopting Guidelines for Evaluation of Private and Public Project Proposals in the Tren Urbano Corridor." April 18, 2000.

Hughes, T., *Rescuing Prometheus;* New York: Pantheon Books, 1998.

Kain, J. "Cost-Effective Alternatives to Atlanta's Rail Rapid Transit System." *Journal of Transportation and Economic Policy*, January 1997.

Kiepper, A. and R. Golembiewski. "MARTA: Toward An Effective, Open Giant." *Public Administration Review,* January/February 1976.

------- "Perspectives on a Fast-Paced Public Project: Personal Reactions of MARTA Executives." *Public Administration Review,* May 1983.

------- "Lessons From a Fast-Paced Public Project: Perspectives on Doing Better the Next Time Around", *Public Administration Review*, November 1983.

Levy, Paul. Executive Director (1987-1992), Massachusetts Water Resources Authority. Personal Interview, November 2000.

Linhart, J. J., and Kennedy, M.G. "Project Management and UMTA." In G. V. Marks and B. Lall (eds.), *Organization and Management of Public Transport Projects.* American Society of Civil Engineers, 1985.

Luberoff, D., and Altshuler, A. "Mega-project - A political History of Boston's Multibillion dollar Artery/Tunnel Project", Harvard University, 1996.

Mallet, W., Horan, T., Gifford, J. and **Stough, R.** "Edge City Governance: Implications of Federal Surface Transportation Legislation." Paper presented at the FHWA workshop on Edge Cities and ISTEA, Washington, DC. August 1992.

McCarron, F. "Project Management Oversight Program Operating Guidance #28." November 1993.

McDonald, Douglas. General Manager, Massachusetts Water Resources Authority. Personal Interview, October 2000.

Miller, J. "Construction Project Delivery Systems: Public/Private Infrastructure." M.I.T. 2000.

Pickrell, D. "Urban Rail Transit Projects: Forecasts Versus Actual Ridership and Cost." October 1990.

------- "A Desire Named Streetcar: Fantasy and Fact in Rail Transit Planning." *Journal of American Planning Association,* Vol. 58, No. 2, Spring 1992.

Ridge, C. "A Study of Rail Transit System Phasing and Expansion Decisions," M.I.T., Master's Thesis, May 1996.

Rodriguez, Gabriel. Special Assistant to the Secretary, DTPW. Personal Interview, January 2000.

Rossi, P., and Freeman, H. *Evaluation: A Systematic Approach* (5th ed.); Newbury Park, California: Sage. 1993.

Scriven, M. *Evaluation Thesaurus* (4th ed.); Newbury Park, California: Sage. 1991.

Shiels, R., Moshofsky, S., Lall, B. "The Coordination Effort: Getting Through the Levels." In G. V. Marks and B. Lall (eds.), *Organization and Management of Public Transport Projects.* American Society of Civil Engineers, 1985.

Sipress, A. Washington Post Staff Writer, Thursday, October 5, 2000; Page B01.

The World Bank Group, Operations Evaluation Department. "Designing Project Monitoring and Evaluation." *Lessons and Practices*, Number 8., June 1996.

Transportation Research Board. "Proceedings of the Workshop on International Turnkey and Joint Development." *Transportation Research Circular*, No. 483 March 1998.

Tren Urbano Office. "An Organizational Portrait of the Tren Urbano Office." December 1998.

U.S. Department of Transportation. "Project Management Oversight." *Federal Register* Vol. 54, No. 169. September 1989.

------- "A Guide to Land Use and Public Transportation." 1989.

------- "Proceedings of the UMTA/APTA Workshop on Fixed Guideway Planning." June 1991.

------- "Lessons Learned: Turnkey Applications in the Transit Industry." October 1997.

U.S. Department of Transportation/FTA and **DTPW/PRHTA**. "Final Environmental Impact Statement Tren Urbano Transit Project Puerto Rico." October 1995.

Weinberg, Robert. President, MarketPlace Development. Personal Interview, September 2000.