

The Delivery of System Wide Elements for Tren Urbano

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Presentation Overview

- **Statement of Thesis**
- **Project Goals**
- **Why Topic is Significant**
- **Research Strategies**
- **Research Progress**

Thesis Statement

- **I propose to examine how the major common physical system elements of Tren Urbano, a transit project consisting of a Design-Build-Operate-Maintain and six civil Design-Build contracts, are managed during the design and construction phases to ensure the functional continuity of the overall project.**

Project Goals

- **Identify the Roles of the Parties Involved**
- **Identify Specific System Wide Physical Elements**
- **Identify Control Methods for these Elements**
- **Identify Systems Design and Integration Control Strategies**
 - **Design and Control Responsibility**
 - **Design and Control Authority**
- **Compare TU Systems Integration Control Strategy with Relevant Case Studies and/or Traditional Design-Bid-Build Procurement**
- **Provide Recommendations for Future Extensions**

Common System Wide Elements for TU

- **System Elements without Public Interface**
 - **Track and Rail Support System**
 - **Back-up Power Distribution System**
- **System Elements with Public Interface**
 - **Fare Collection System**

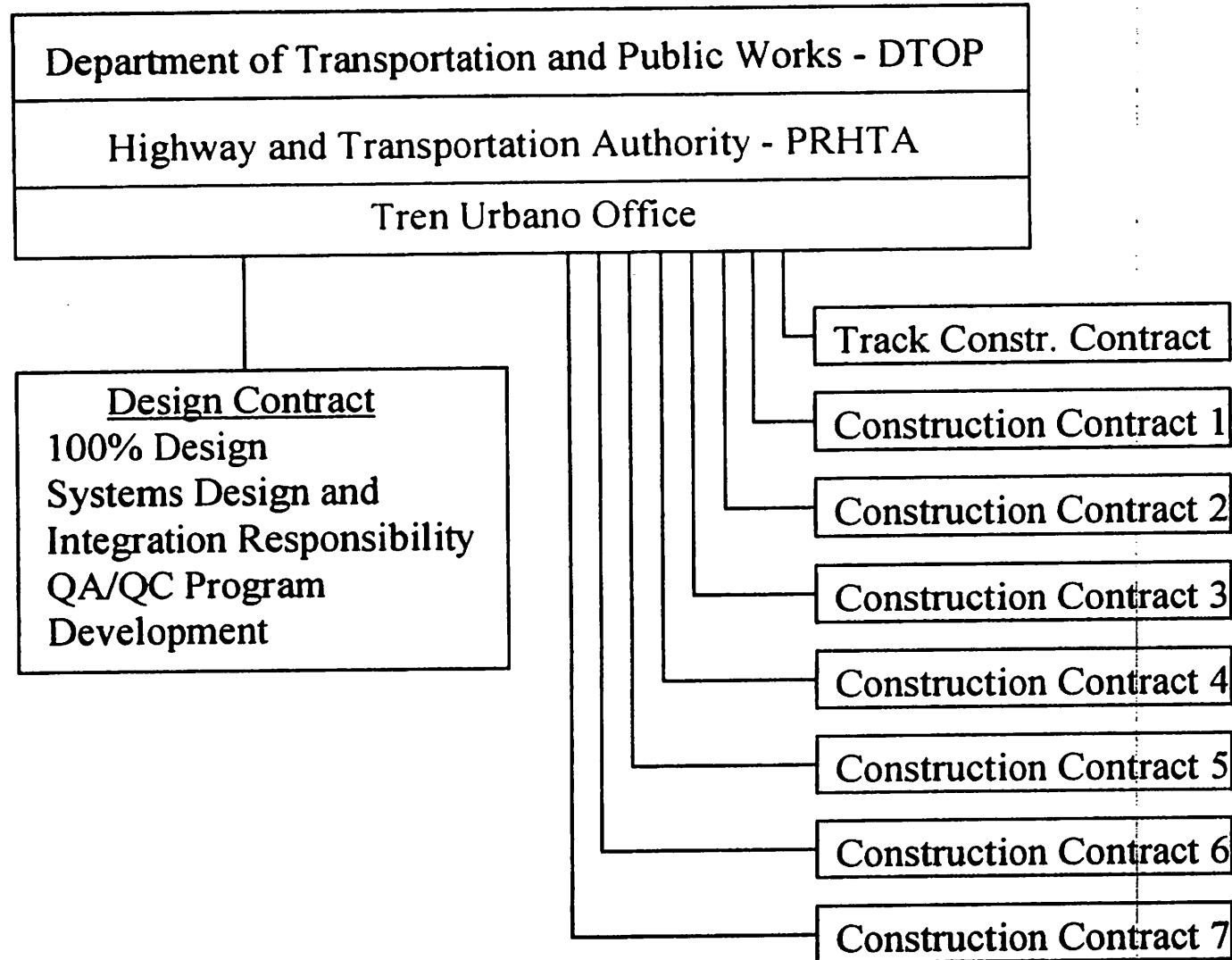
Integration and Control Methods

- **Documentation**
- **Design Specifications**
- **Interface Control Manual**
- **Interface Design Schedule**
- **Submittals**
- **Construction Oversight**
- **Performance Standards**
- **Operational Testing**
- **Reviews and Audits**

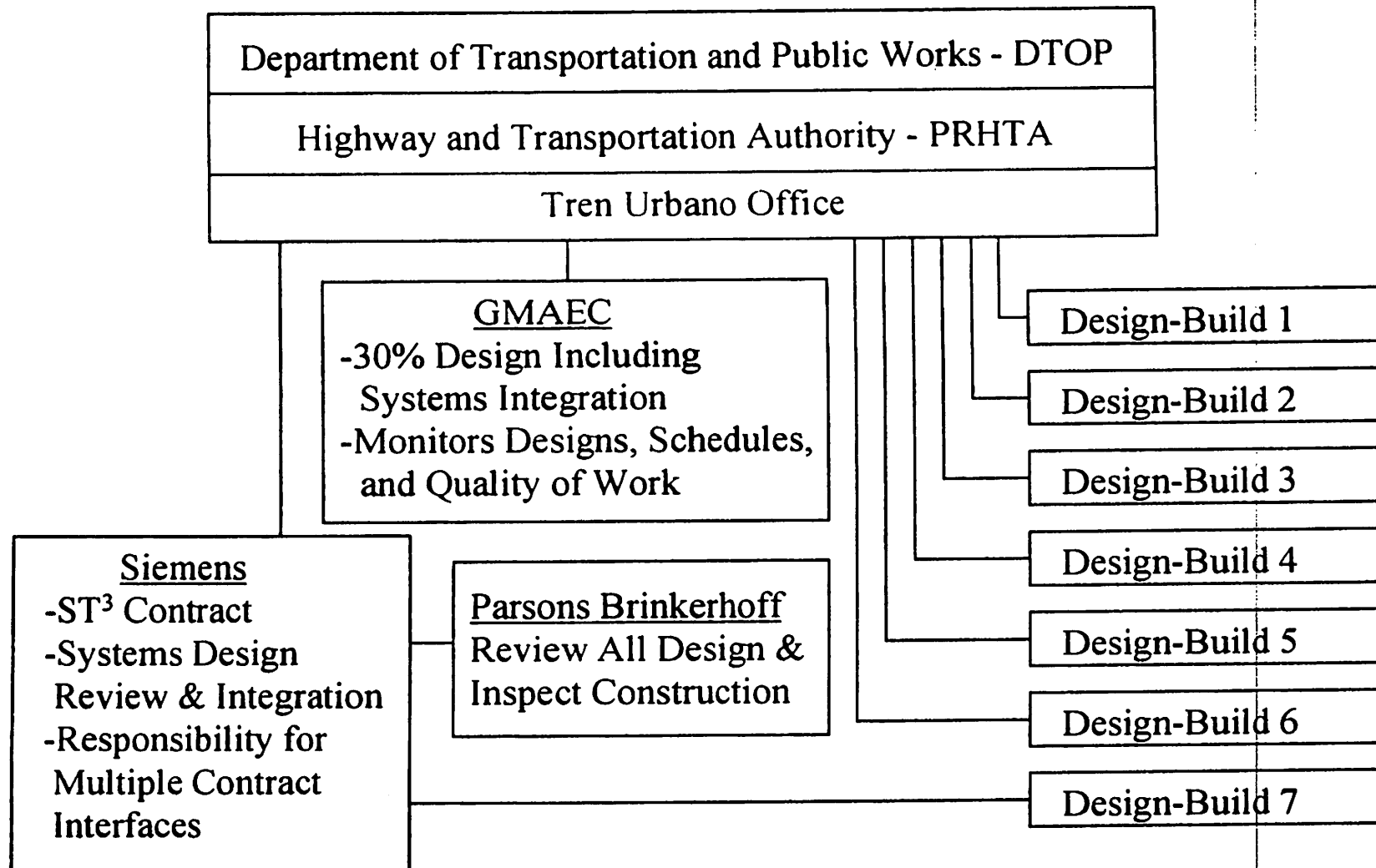
Why Topic is Significant

- **Unique Procurement Structure**
 - Design-Build-Operate-Maintain
 - Design-Build
 - Multiple Primes
- **Challenges for TU Success**
 - Design Responsibility/Authority
 - Contract Interfaces
 - Dependence on the Quality of Work by Different Contractors
 - TU Financing - discretionary Federal money
 - Future Extensions
- **TU Procurement vs. Trad. Design-Bid-Build Procurement**

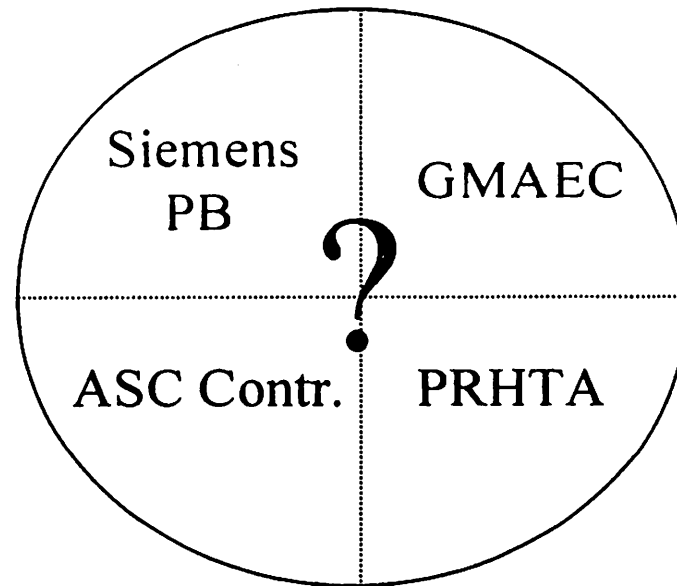
Traditional Design-Bid-Build



Tren Urbano Turnkey Structure



Distribution of Design Responsibility & Authority



- How is the responsibility and authority for producing an integrated design for common physical system elements distributed?
- What are the relationships and potential conflicts among the parties involved?

Research Strategies

- Review Contract Documents
- Review QA/QC Documents
- Establish Contacts
- Review Literature on Available Control Methods
- For Each Selected System
 - Siemens Parsons B Design-Build PRHTA
 - Design
 - Schedule
- Examine Relationships Between Parties Concerning Contract Interfaces
 - Systems Design Integration
 - Schedule Integration
- Examine Relationships Between Parties Concerning Design Approval and Design Changes during Construction
- Analyze Phase I and Provide Recommendations for Future Extensions

Research Progress

- **Reading Contract Documents**
- **Reading QA/QC Program Information**
- **Determining Tren Urbano's Organizational Structure**
- **Gathering Information on Available Systems Integration and Control Methods**
- **Creating a Contact List**

Tren Urbano Thesis Proposal

By

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Project Background

Puerto Rico, though only 160 kilometers long by 56 kilometers wide, has a population of about 3.8 million. One third of the island's residents live in the San Juan Metropolitan Area (SJMA). The region on the northeast coast encompasses 13 municipalities covering 400 square miles. An estimated 4,200 vehicles per square mile and approximately 3.2 million trips to the central SJMA per day, creates one of the most congested urban road networks in the world.

The Turnkey, or Design-Build-Operate, contract of Tren Urbano, an urban rapid transit turnkey project to be developed for the SJMA, was awarded to the Siemens Transit Team (STT), a group led by Siemens Transportation Systems (STS). The turnkey strategy developed for Tren Urbano attempts to maximize quality, value, and local control by dividing the project into six Design-Build contracts and a Design-Build-Operate contract, the Systems and Test Track Turnkey contract.

The Puerto Rico Highways and Transportation Authority (PRHTA) and the Puerto Rico Department of Transportation and Public Works (DTPW) made the decision to construct Tren Urbano in phases. The first phase will extend over 17 kilometers and will provide service for an estimated daily ridership of 115,000 passengers. The trains will operate 20 hours a day and run every four minutes during the morning and afternoon peak hours. Tren Urbano will be fully automated with a double track, fixed-guideway system and 15 stations. The system will start at Bayamon and run to Santurce with stops at the major centers of Rio Piedras and Hato Rey. Approximately forty percent of the system is at grade level while the remainder is elevated above street and highway rights-of-way, except for an underground section at Rio Piedras. The first phase is projected to be operational by the fall of 2001. Future extensions of the system to Carolina, Old San Juan, and the Luis Munoz Marin International Airport are in the planning stages.

Tren Urbano's design-build-operate strategy has currently reduced potential project costs by an estimated 30 percent and shortened the length of the project schedule by about 2 years.

Thesis Objectives

I propose to examine how the major systems of a portfolio of design-build-operate and design-build projects are managed during the design and construction phases to ensure functional and aesthetic continuity of the overall project through construction, start-up, turnover, and initial operations.

To accomplish this task I propose to:

- 1) Identify common systems throughout Tren Urbano
- 2) Identify system control methods used for Tren Urbano
- 3) Identify alternative project control methods based on relevant case studies
- 4) Apply the information from Tren Urbano and the case studies to develop a project systems control strategy

Important Considerations

In the context of a rail transit system the Turnkey, or Design-Build-Operate, contractor provides a system to move people from one place to another that satisfies the performance requirements outlined by the owner.

The Design-Build-Operate contract integrates the processes of design, construction, and operations and maintenance under the responsibility of one entity, Siemens. This integration increases the motivation and ability of Siemens to develop a design taking into consideration the short-term goals of construction and the long-term goals during operations and maintenance.

The customer is primarily concerned with two things, service quality and the cost of service. Siemens is concerned with performance and low construction, maintenance, and operations costs. In order to attain these objectives, Siemens must achieve successful integration of the major systems. It is important to identify the motivating factors involved, particularly the risks, to enhance system control methods. One risk associated with systems integration is the possibility that a subsystem operates but is not compatible with the entire system. Another risk includes the possibility of the failure of one subsystem causing the entire system to fail.

The large scale and complexity of the project requires detailed and innovative methods of control. Before the analysis of the methods to be implemented for systems control can begin, a clear definition of a system must be established.

System – A group of elements that work together to perform a specific function with respect to an objective or goal

Methods of systems control may include design specifications, construction oversight, scheduling, performance standards, or operational testing.

Significance to Tren Urbano

Turnkey, or Design-Build-Operate, procurement allows the focus of the public agency, the PRHTA and DTPW, to shift from construction management and oversight to strategic planning and the determination of the overall project goals and needs. The flexibility of the turnkey construction contract allows risk to be distributed to the party that is most capable of mitigating that risk. The risk of systems integration is therefore transferred from the owner, the PRHTA and DTPW, to the Turnkey contractor, Siemens.

The Systems and Test Track Turnkey Contract (ST³ Contract) designates Siemens' responsibility throughout the life of the project:

- 1) the design, procurement, construction, test and start-up of the Project system components and the test track and two stations (Alignment Section 3)
- 2) the coordination with, and the interface, of the Work under this Proposal with the design and construction for the stations and alignment sections to be performed by other contractors
- 3) the maintenance of all project facilities between acceptance and the start of revenue service
- 4) the operation and maintenance of the completed Project for five years, with an option for an additional five years

The contract includes 64 heavy rail vehicles and requires the design, manufacture, and construction of 17.2 kilometers of track and 2.5 kilometers of rail guideway. Siemens will be responsible for the construction of two stations, Las Lomas and Torrimar, the yard and maintenance facilities, and an operations control center. The STT will coordinate and help monitor the construction of the remainder of the alignment sections by the Design-Build contractors. Siemens' assurance of a genuine effort to produce an integrated, safe, and efficient system is guaranteed by the fact Siemens will operate and maintain the system for at least five years.

Research

The first task will be to develop criteria to facilitate the determination of which systems will be analyzed. The criteria must designate and include the systems that are of importance to Siemens.

A careful examination of the contract documents, particularly the systems sections of the ST³ contract, will establish the distribution of responsibility, outline the project control structure, and provide a detailed description of the systems involved.

Contact and dialogue will need to be established with members of the STS group, along with Alternative Concepts, Inc., the Tren Urbano Office, and local Tren Urbano Design-Build contractors. STS is known as an experienced systems integration leader for rail transportation development. An accurate understanding of their system control methods will be essential to obtaining the thesis objectives previously outlined. Alternative Concepts, Inc., a leading transportation operations firm, will be able to provide insight into the important concerns for the operations phase. The local Design-Build contractors can provide input on their participation in developing and implementing system control methods.

Case studies pertaining to the procurement method and the design, construction, and operations phases of transportation systems can be evaluated. Although Tren Urbano's project structure is unique, comparisons of system control methods to Tren Urbano may be attainable.

Conclusions

Research will reveal the key, common system elements throughout Tren Urbano as well as methods of control used by Siemens and the Design-Build contractors. This information coupled with that obtained from transportation case studies will be applied to develop a general systems control strategy for mass transit projects.

1. Project/Regional Background
 - 1.1. Puerto Rico, San Juan Metropolitan Area
 - 1.1.1. Demographics
 - 1.1.2. Need for a Mass Transit System
 - 1.2. Tren Urbano Background
 - 1.2.1. Transit Corridor
 - 1.2.2. Political Background
2. Turnkey/Design-Build-Operate Procurement Methods
 - 2.1. Definition/Types
 - 2.2. Benefits versus Deficiencies
 - 2.3. Federal Transit Authority – Turnkey Demonstration Program
 - 2.3.1. Goals
 - 2.3.2. Projects
3. Tren Urbano Procurement Method
 - 3.1. Project Structure
 - 3.1.1. Systems and Test Track Turnkey Contract – ST³
 - 3.1.1.1. Siemens Design-Build-Operate
 - 3.1.1.2. Alignment Section Responsibilities
 - 3.1.2. Design-Build Contracts
 - 3.1.2.1. Contractor
 - 3.1.2.2. Alignment Section Responsibilities
 - 3.2. Benefits of Procurement Strategy
 - 3.2.1. Economic/Schedule
 - 3.2.2. Political
4. Thesis Objectives
 - 4.1. Statement of Thesis
 - 4.2. Research Objectives
 - 4.2.1. Identify Common Systems Throughout Tren Urbano
 - 4.2.2. Identify System Control Methods in Tren Urbano
 - 4.2.3. Identify Alternative Project Control Methods Based on Relevant Case Studies
 - 4.2.4. Apply Information from Tren Urbano and the Case Studies to Develop a Project Systems Control Strategy
 - 4.3. Importance to Tren Urbano Project Procurement
5. General Analysis of Common Systems
 - 5.1. Criterion for Common Systems
 - 5.1.1. What is Important to Siemens
 - 5.1.2. What is Included
 - 5.1.3. What is Not Included

5.2. Project Control of Common Systems

5.2.1. Project Planning

5.2.1.1. Design Coordination

5.2.1.1.1. Conceptual Design

5.2.1.1.2. Preliminary Engineering Design

5.2.1.2. Contractor Coordination

5.2.1.2.1. Development of Communication Mechanisms and Documentation Processes

5.2.1.2.2. Assignment of Responsibility, Authority and Control in the Decision Making Process

5.2.1.2.3. Resolution of Disputes

5.2.2. Project Execution/Scheduling

5.2.2.1. Final Design – Shop Drawing Approval

5.2.2.2. Procurement – Long Lead Items

5.2.2.3. Construction – As-built Drawings

5.2.2.4. Start-up and Operations – Functional Testing

6. Common System Analysis

6.1. Common System Analysis Outline

6.1.1. System Description

6.1.2. Importance to ST³ Contract

6.1.3. Methods of Control

6.1.3.1. Design Specifications

6.1.3.2. Construction Oversight

6.1.3.3. Scheduling for Overall Project Completion

6.1.3.4. Performance Standards

6.1.3.5. Functional Operation Testing

6.1.3.6. Others

6.1.4. What are the Benefits/Deficiencies

6.2. Track/Rail System

6.2.1. System Description

6.2.2. Importance to ST³ Contract

6.2.3. Methods of Control

6.2.4. What are the Benefits/Deficiencies

6.3. Power Distribution System

6.3.1. System Description

6.3.2. Importance to ST³ Contract

6.3.3. Methods of Control

6.3.4. What are the Benefits/Deficiencies

6.4. Train Control System

6.4.1. System Description

6.4.2. Importance to ST³ Contract

6.4.3. Methods of Control

6.4.4. What are the Benefits/Deficiencies

- 6.5. Communications System
 - 6.5.1. System Description
 - 6.5.2. Importance to ST³ Contract
 - 6.5.3. Methods of Control
 - 6.5.4. What are the Benefits/Deficiencies
- 6.6. Fare Collection System
 - 6.6.1. System Description
 - 6.6.2. Importance to ST³ Contract
 - 6.6.3. Methods of Control
 - 6.6.4. What are the Benefits/Deficiencies
- 6.7. Emergency Detection/Warning Systems
 - 6.7.1. System Description
 - 6.7.1.1. Fire Detection
 - 6.7.1.2. Seismic Detection
 - 6.7.1.3. Accident Detection
 - 6.7.2. Importance to ST³ Contract
 - 6.7.3. Methods of Control
 - 6.7.4. What are the Benefits/Deficiencies
- 6.8. Car/Station Security Systems
 - 6.8.1. System Description
 - 6.8.2. Importance to ST³ Contract
 - 6.8.3. Methods of Control
 - 6.8.4. What are the Benefits/Deficiencies
- 6.9. Public Interface Systems
 - 6.9.1. System Description
 - 6.9.1.1. Safety Systems – Crossing Traffic or Pedestrian Route
 - 6.9.1.2. ADA Compliance – Handicapped Access
 - 6.9.2. Importance to ST³ Contract
 - 6.9.3. Methods of Control
 - 6.9.4. What are the Benefits/Deficiencies
- 7. Relevant Case Studies in Start-up/Turnover/Initial Operations of Transit Systems
 - 7.1. Central Artery Project
 - 7.2. BART Extension
 - 7.3. Taipei Subway
 - 7.4. FTA Turnkey Demonstration Projects
 - 7.5. Others
- 8. Conclusions
 - 8.1. Key Common System Elements
 - 8.2. Methods of System Control
 - 8.3. Operational Testing of System Functions
 - 8.4. Other Recommendations