Increased Private Involvement in the Delivery of Transportation Infrastructure: The State-of-the-Art in Transit System Turnkey Contracts

by

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A.B., Engineering Sciences
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Abstract

Turnkey procurement as applied to public transit systems represents a shift in the scope of
private sector involvement in transportation infrastructure delivery. Turnkey is fundamentally a
design-build contract between the owner/operator of the system (the public sector) and the
turnkey contractor (the private sector). The contractor is obligated to deliver a functional system
for a fixed price. The owner communicates system requirements to potential contractors as
conceptual, preliminary designs and minimum performance criteria.

This thesis presents the issues involved in the still unfamiliar strategy of turnkey
procurement, describes five cases in which the strategy has been or is being applied to rail transit
system procurement (both overseas and within the U.S.), and draws qualitative conclusions about
the issues based on the experiences of the projects examined.

Five case studies, all applications of a turnkey-style strategy to rail transit system
procurement, form the data baseline for qualitative analysis. The cases are: Docklands Light
Rail (London, UK); Manchester Metrolink (Manchester, UK); STAR Transit (Kuala Lumpur,
Malaysia); Hudson-Bergen Light Rail System (Jersey City, New Jersey); and Tren Urbano (San
Juan, Puerto Rico). Special emphasis is given to the Tren Urbano system procurement currently
in development in San Juan. This case study serves as documentation of the process of strategy
development and implementation in the context of the joint University of Puerto Rico/MIT Tren
Urbano research program.

The case studies (Chapter 3) shed light on many issues developed in Chapter 2. Chapter 4
presents the conclusions derived from the case studies. The difference in the climate for rail
infrastructure development between the U.S. and elsewhere is significant in light of historical
utilization of private-sector development strategies. The touted benefits of cost and schedule
savings under turnkey may be less important than the strategic control of the development
process afforded to the public sector under turnkey. In fact, the emerging role of the public
sector is one of pre-project conceptual design and approval with strategic oversight of the
process, while the private sector delivers the project in an efficient and effective manner. The
private-sector incentives applied to a broader project scope seem to result in improved life-cycle
benefits through innovation and internalized incentives for efficiency. Turnkey, often presented
as a step toward greater private involvement in transit development in the U.S. (i.e., private
capital investment), certainly enhances the opportunity for private investment; the current
projects in the U.S. are structured so as not to preclude involvement in future phases. In other
countries, private involvement in transit development is more comprehensive, to the extent that
private investment is not at all unusual.

These results extend to other aspects of the public infrastructure network. Transit
applications of the model will be strongly influenced by changes in federal procurement policy,
but overall, public owners wishing to develop transit facilities in the future will appreciate the
flexibility of having a range of procurement strategy option at their disposal.

Thesis Supervisor: John B. Miller
Title: Assistant Professor of Civil and Environmental Engineering
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I want to especially thank Sherry Showell, my editor and proof reader, for her thoughtful consideration of this work. Her fluidity in written language has helped shape the style and readability of this thesis. Oh, and there's also the four months of laundry and dinner services which I now owe her. Thanks a bunch for everything.

John Miller deserves significant credit in shaping the ideas and direction of this work. His involvement has helped me focus my interests into the form presented here. I want to sincerely thank him for his leadership, sincerity and discipline. The CEE Department and the Tren Urbano Project are certainly lucky to have a person of his commitment and warmth in their ranks.

Final acknowledgments go to the entire University of Puerto Rico/MIT Tren Urbano research endeavor, especially Fred Salvucci who has been intimately involved in the development of procurement strategy for Tren Urbano. His advice, rooted in years of commitment to effective procurement, has proved invaluable. Nigel Wilson, Antonio Gonzalez, Sergio Gonzales and Lydia Mercado have also played a large role in this work in making the UPR/MIT partnership operational. The opportunity to visit San Juan, the site of Tren Urbano, and other parts of the “continent” of Puerto Rico was instrumental in making these turnkey projects real in my mind. Thanks to Daniel, Claude, Alan, Susannah, and the rest of la gente de Tren Urbano for making the project an enjoyable and challenging experience over the last year and a half.
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title Page</td>
<td>1</td>
</tr>
<tr>
<td>Abstract</td>
<td>3</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>5</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>7</td>
</tr>
<tr>
<td>List of Illustrations</td>
<td>9</td>
</tr>
<tr>
<td>List of Tables</td>
<td>9</td>
</tr>
<tr>
<td>List of Boxes</td>
<td>9</td>
</tr>
<tr>
<td>Bibliography</td>
<td>149</td>
</tr>
</tbody>
</table>

1. **Purpose and Structure of Study** ................................................................. 11
   1.1. Turnkey and Increased Private Involvement .............................................. 13
       1.1.1. Definition and Scope of Turnkey and Its Context ......................... 14
       1.1.2. The Turnkey Model and Implementation Issues ............................... 14
       1.1.3. Project Structure and Implementation: The Case Studies .................. 14
       1.1.4. Analysis of Case studies ............................................................... 15
   1.2. A Final Word of Introduction .................................................................... 17

2. **The Turnkey Model: Definition and Issues** .................................................. 19
   2.1. Introduction .............................................................................................. 21
       2.1.1. Definition of Turnkey ......................................................................... 21
       2.1.2. The Definition in Context: The Larger Strategic Structure ................. 23
       2.1.3. Turnkey as One Option for Development ........................................... 24
   2.2. The Present Climate of Infrastructure Development ................................... 27
       2.2.1. Current Sequential Process ................................................................. 27
   2.3. Turnkey Issues .......................................................................................... 32
       2.3.1. Roles for the Public and Private Sectors .............................................. 32
       2.3.2. Risk and Authority .............................................................................. 35
       2.3.3. Operations ............................................................................................ 39
       2.3.4. Competition .......................................................................................... 40
       2.3.5. Financing ................................................................................................ 42

3. **The Case Studies** .......................................................................................... 43
   3.1. Case Studies Introduction and Selection Criteria ......................................... 45
       3.1.1. Modern Transit Technology ................................................................. 45
       3.1.2. New-Start Systems ............................................................................... 46
       3.1.3. Location in More Economically Developed Countries ....................... 47
   3.2. Case Study Outline ..................................................................................... 48
       3.2.1. Project Background ............................................................................. 48
       3.2.2. Project Structure ................................................................................ 49
       3.2.3. Competition ........................................................................................ 50
       3.2.4. Risk ....................................................................................................... 51
       3.2.5. Funding/Financing ............................................................................... 52
       3.2.6. Outcomes: Intended versus Unintended .............................................. 53
   3.3. Docklands Light Railway Case Study ........................................................... 54
       3.3.1. Project Background ............................................................................. 54
       3.3.2. Project Structure ................................................................................ 57
       3.3.3. Competition ........................................................................................ 60
       3.3.4. Risk ....................................................................................................... 62
       3.3.5. Funding/Financing ............................................................................... 63
       3.3.6. Outcomes: Intended and Unintended ................................................. 64
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4. Manchester Metrolink Case Study</td>
<td>66</td>
</tr>
<tr>
<td>3.4.1. Project Background</td>
<td>66</td>
</tr>
<tr>
<td>3.4.2. Project Structure</td>
<td>70</td>
</tr>
<tr>
<td>3.4.3. Competition</td>
<td>72</td>
</tr>
<tr>
<td>3.4.4. Risk</td>
<td>74</td>
</tr>
<tr>
<td>3.4.5. Funding/Financing</td>
<td>76</td>
</tr>
<tr>
<td>3.4.6. Outcomes: Intended Versus Unintended</td>
<td>77</td>
</tr>
<tr>
<td>3.5. Kuala Lumpur STAR Light Rail System</td>
<td>79</td>
</tr>
<tr>
<td>3.5.1. Project Background</td>
<td>79</td>
</tr>
<tr>
<td>3.5.2. Project Structure</td>
<td>83</td>
</tr>
<tr>
<td>3.5.3. Competition</td>
<td>87</td>
</tr>
<tr>
<td>3.5.4. Risk</td>
<td>87</td>
</tr>
<tr>
<td>3.5.5. Funding/Financing</td>
<td>90</td>
</tr>
<tr>
<td>3.6. Hudson-Bergen Light Rail Case Study</td>
<td>92</td>
</tr>
<tr>
<td>3.6.1. Project Background</td>
<td>92</td>
</tr>
<tr>
<td>3.6.2. Project Structure</td>
<td>95</td>
</tr>
<tr>
<td>3.6.3. Competition</td>
<td>99</td>
</tr>
<tr>
<td>3.6.4. Risk</td>
<td>102</td>
</tr>
<tr>
<td>3.6.5. Funding/Financing</td>
<td>103</td>
</tr>
<tr>
<td>3.7. Tren Urbano Case Study</td>
<td>105</td>
</tr>
<tr>
<td>3.7.1. Project Background</td>
<td>105</td>
</tr>
<tr>
<td>3.7.2. Project Structure</td>
<td>113</td>
</tr>
<tr>
<td>3.7.3. Competition</td>
<td>123</td>
</tr>
<tr>
<td>3.7.4. Risk</td>
<td>127</td>
</tr>
<tr>
<td>3.7.5. Funding/Financing</td>
<td>129</td>
</tr>
<tr>
<td>4. Case Study Results and Conclusions</td>
<td>131</td>
</tr>
<tr>
<td>4.1. Introduction and Results</td>
<td>133</td>
</tr>
<tr>
<td>4.1.1. United States Versus Foreign Experience</td>
<td>133</td>
</tr>
<tr>
<td>4.1.2. Time and Cost Savings</td>
<td>136</td>
</tr>
<tr>
<td>4.1.3. Emphasis on Front-end Strategy Development</td>
<td>138</td>
</tr>
<tr>
<td>4.1.4. Impact of Life-Cycle Incentives</td>
<td>141</td>
</tr>
<tr>
<td>4.1.5. Turnkey as a First Step to Greater Private Involvement</td>
<td>143</td>
</tr>
<tr>
<td>4.2. Ability to Generalize the Results</td>
<td>145</td>
</tr>
<tr>
<td>4.2.1. Issues of System Procurement, Not Merely Transit Systems</td>
<td>145</td>
</tr>
<tr>
<td>4.2.2. Federal Procurement Policy</td>
<td>145</td>
</tr>
<tr>
<td>4.2.3. Lingering Questions</td>
<td>146</td>
</tr>
<tr>
<td>4.2.4. Flexibility</td>
<td>147</td>
</tr>
</tbody>
</table>
ILLUSTRATIONS

Figure 2.1.1: Miller's Procurement Strategy Framework for Quadrant Analysis .................25
Figure 2.1.2: Quadrant Analysis; Turnkey and the Turnkey Procurement Context ..........26
Figure 2.3.1: The Scope of Competition under Alternate Procurement Strategies ..........41
Figure 3.3.1: Map of the Docklands Light Railway and Vicinity ..................................56
Figure 3.3.2: DLR Contractual Structure ........................................................................58
Figure 3.4.1: Manchester Metrolink and Rail Network ..................................................67
Figure 3.4.2: Manchester Metrolink Contractual Structure ..........................................71
Figure 3.5.1: Map of Recommended Transit Corridors in Kuala Lumpur .........................81
Figure 3.5.2: STAR System Alignment, Phase 1 .............................................................84
Figure 3.5.3: STAR Contractual Structure ......................................................................85
Figure 3.6.1: Hudson Bergen Light Rail System and Environs .......................................93
Figure 3.7.1: The San Juan Metropolitan Area ................................................................107
Figure 3.7.2: Vehicle Registrations in Puerto Rico (thousands) .......................................110
Figure 3.7.3: Tren Urbano Alignment, Locally Preferred Alternative ............................114
Figure 3.7.4: Tren Urbano Turnkey Contractual Structure ...........................................115

TABLES

Table 2.3.1: Fixed-Guideway Transit Project Development Risks ....................................36
Table 2.3.2: Risk Allocation Implications of Turnkey ......................................................39
Table 3.2.1: Division of Responsibility, Generic Turnkey Project ....................................49
Table 3.3.1: Division of Responsibility, Docklands Light Rail .........................................59
Table 3.3.2: DLR Allocation of Capital Grant ..................................................................63
Table 3.4.1: Division of Responsibility, Manchester Metrolink .......................................72
Table 3.5.1: Division of Responsibility, Kuala Lumpur STAR Light Rail .......................83
Table 3.6.1: Population Density, HBLRT Corridor (1992) ..............................................94
Table 3.6.2: Division of Responsibility, Hudson-Bergen LRT System ............................96
Table 3.7.1: Tren Urbano Project Goals and Objectives ...............................................112
Table 3.7.2: Tren Urbano Procurement Goals (December, 1994) ....................................121
Table 3.7.3: Division of Responsibility, Tren Urbano ....................................................122
Table 3.7.4: Bid Team Composition for the Tren Urbano ST3 Contract .........................125

BOXES

Box 3.7.1: Private Development of Road Infrastructure in San Juan ............................117
Box 3.7.2: The FTA Turnkey Demonstration Program ...............................................119
1. Purpose and Structure of study
1.1. Turnkey and Increased Private Involvement

The trend toward increased private involvement in transportation is a topic of concern to many parties. This involvement takes two forms: contracted transportation services and the delivery of transportation infrastructure.¹

Turnkey transit development falls into both of these categories. In a strict sense, turnkey might mean specifically the delivery of infrastructure (see Section 2.1 for the definition of turnkey), but in the context of implementing turnkey, public owners have often expanded the scope of the procurement strategy to include the responsibility of operations for an initial period.

There is currently private involvement in developing the design of transit systems; there is private involvement in the construction of transit systems; and there is private involvement in the operation of transit systems. The strategy of turnkey procurement is to bundle two or more of these steps in the quest to provide a transportation service to the fare-paying customer. In the bundling of these responsibilities, the contractor takes responsibility for integrating the steps into a final product. The customer is concerned with primarily two things: service quality and the cost of the service. Any improvement to the delivery of this service which results from turnkey contracting is a victory for everyone involved. This includes the rider, the tax-payer, the public sector and the industry players who deliver these systems.²

Fundamentally, this work is an analysis of new-start rail systems which make use of a flexible procurement strategy termed turnkey contracting. Because the potential benefits and pitfalls of this emerging model for private infrastructure delivery are so important, this study hopes to clarify the issues involved. First and foremost, the definition of turnkey must be clarified and integrated into the context of increased private involvement in infrastructure. Second, the issues involved in implementing turnkey must be enunciated. Third, the details of project structure and implementation emerging from recent turnkey projects must be documented. Fourth and finally, the project details must be examined for a preliminary evaluation of the benefits and liabilities of turnkey strategies.


1.1.1. Definition and Scope of Turnkey and Its Context

One reason to provide a strict definition of turnkey as it pertains to transit system development (and a description of the context in which turnkey procurement operates) is to avoid the politicization and confusion that has emerged around the term "privatization." This term is so vague that controversy has overshadowed a debate about potentially beneficial aspects of increased private involvement in public works and services. The analysis and implementation of turnkey, which is an aspect of the privatization of a traditionally publicly delivered infrastructure, can avoid being stuck in the morass of ideological furor surrounding privatization by starting with a detailed, specific definition of its scope.

The context in which turnkey is implemented is just as important to the analysis; since the turnkey strategy is so flexible, a rigid definition cannot capture the subtleties involved. The context of turnkey relates to the frequent modifications made to the simple turnkey structure in real-world projects. The operation of a completed system is often bundled into the contract with the turnkey procurement, but operations are not fundamentally within the scope of turnkey. The distinction between a strict definition of turnkey and the context of turnkey will facilitate rational analysis of pertinent issues. For instance, any debate about private contractual operations can correctly focus on this aspect of a project’s structure.

1.1.2. The Turnkey Model and Implementation Issues

As a background to the case studies presented in Chapter 3, Chapter 2 will focus on the issues involved in moving procurement strategy from today’s segmented, sequential process toward turnkey. Benefits and liabilities of the change are considered in this section as they relate to issues like new roles for the public and private sectors. Risk allocation is a major consideration which has emerged as a delicate issue when structuring any project that includes increased private involvement. Currently, traditional contractors have very defined risk exposure as compared with turnkey contractors. Risk-aversion and unfamiliarity with a new style of project structure could result in over-estimation of the cost of risk in bid prices.

1.1.3. Project Structure and Implementation: The Case Studies

Recent experience with turnkey procurement in rail transit system procurement is surprisingly varied in terms of scope of private involvement and geography. Not surprisingly, a
good deal of the work has occurred outside the United States. Based on the selection criteria presented in the introduction to the case studies, the following systems have been detailed:

- Docklands Light Rail (London, UK)
- Manchester Metrolink (Manchester, UK)
- STAR Transit (Kuala Lumpur, Malaysia)
- Hudson-Bergen Light Rail System (Jersey City, New Jersey)
- Tren Urbano (San Juan, Puerto Rico)

The impetus for this study has been the Joint MIT and University of Puerto Rico Research Project to study the development of Tren Urbano and its impact on the San Juan Metropolitan Area. Accordingly, the case study of this project is more detailed than the others. In the context of this joint research project, an additional rationale for this study is to document the development of the procurement strategy of Tren Urbano. Indeed, the structure of this project is more complex than any of the other projects and makes for an interesting example of how turnkey's inherent flexibility allows the project's procurement strategy to meld diverse project goals.

1.1.4. Analysis of Case studies

Based on the case studies, Chapter 4 qualitatively evaluates the performance of the turnkey process. In many forums, the potential benefits have been discussed at length, but the outcome of real-world experience is a better test of turnkey's ability to deliver infrastructure more effectively.³

As a component of the Turnkey Demonstration Program (see Box 3.7.2), the Federal Transit Administration (FTA) is developing evaluation guidelines and evaluation plans, on a project-by-project basis, for a systematic, quantitative evaluation of costs and benefits of the decision to pursue turnkey development. As FTA is an arm of the U.S. Government, the scope of this program extends only to the U.S. cases, and the full evaluation necessarily must wait for the completion of the demonstration projects. The qualitative evaluation presented here considers

foreign experience (which is farther advanced -- the Docklands Light Rail and the Manchester Metrolink have already entered revenue service) and is able to make preliminary evaluations of projects in development.

The analysis of the issues will also serve as a reference for future projects to aid in the process of developing procurement strategy. Together with the case studies, this is the most important aspect of this study.
1.2. A Final Word of Introduction

Whatever final collective judgment is issued on the applicability of turnkey procurement to public infrastructure, the philosophical rationality of this system is rooted in basic principles. Economic actors respond to incentives. This is the fundamental argument which underlies the study of human behavior known as economics. In basic economic terms, private firms are modeled as profit-maximizing interests. If provided with the right incentives, the parties which are involved with infrastructure development can focus the profit motive toward effective delivery of infrastructure. The hypothesis of turnkey procurement is that bundling two or more steps can internalize, within a single economic actor, many of the incentives that lead toward effective infrastructure development.

Another fundamental principle -- this one from mathematics -- states that the answer to an optimization problem can only improve if the feasible region is expanded. In this analogy to procurement, the feasible region depends on the scope of the procurement strategy; design, construction, operation. With any metric which is used to evaluate the process, expanding the scope of competition should result in a system which is in no case worse than before. When combined with the economic incentive argument from above, a metric such as the life-cycle cost of a transit system can potentially benefit greatly from a turnkey procurement strategy.

The task at hand in moving to a new procurement system is not to sacrifice the strengths of the current process. Fairness and accountability are the hallmarks of today's segmented procurement, with these benefits flowing from the openness of the process. Competition, coupled with clear, unambiguous criteria (like "low-bid") is a major component in this process. Public sentiment would turn against any changes which roll back these benefits.

Whether or not the purported benefits of turnkey prove true, public sector actors, already convinced of the benefits of the strategy, are making use of the turnkey procurement strategy in real decisions. For example, in the prospectus of the Request for Proposals (RFP) for the Hudson Bergen Light Rail Transit system, the New Jersey Transit Authority (NJ Transit) uses this language to introduce its procurement strategy:
There are significant benefits to both NJ Transit and the Contractor that accrue from the use of a DBOM approach. From NJ Transit's perspective, project cost can be reduced and the schedule can be accelerated. More can be built faster than using a conventional procurement approach. From the perspective of the Contractor, the use of a DBOM performance based approach will allow increased innovation and cost effectiveness which will reward a skilled contractor. Also, as a result of the increased efficiency of the DBOM approach, more funds can be directed to development of new projects.4

2. The Turnkey Model: Definition and Issues
2.1. Introduction

2.1.1. Definition of Turnkey

Much confusion in terminology will be avoided with a definition of turnkey and an explanation of the context into which this definition fits. The term turnkey is used broadly and loosely by many different parties in the discussion of increased private involvement in the delivery of infrastructure. The Federal Transit Administration (FTA) has included in the Turnkey Demonstration Program several diverse projects like a mixed-use intermodal center, rail line extensions and new-start rail systems (see Box 3.7.2). The term transit turnkey, applied to this broad of a range of projects, has come to resemble another term -- privatization -- in its broad usage and unfocused application. A simple, intuitive and concise explanation of turnkey procurement will benefit future discussion. The term turnkey did not originate within rail system development; an understanding of its common usage elsewhere will steer its application to transit procurement.

Other industrial sectors, especially the chemical processing industry, have a long history of turnkey procurement for plant equipment. In these other contexts, the common meaning of turnkey developed around the purchase of a complex system which is immediately ready for operation by the purchaser. A plastic manufacturer wants a batch plant to take ethylene gas and polymerize it into polyethylene. The purchasing company is not interested in the technology or the internal workings of this "black box," only in the service which the system provides: the production of a finished project from a raw material stream. Indeed, the process technology employed in a turnkey system is often proprietary, and the turnkey supplier will only provide the technology and equipment as a finished system. The system vendor builds the plant, and then hands over the keys to the owner who inserts the key in the "ignition" to begin operations.

This also demonstrates the core of a turnkey rail transit system. Fundamentally, the owner of the system who formulates the entire procurement strategy and process is concerned primarily that the system perform a certain task -- getting people from point A to point B within an urban metropolitan area. The owner defines the performance criteria of the system, and then the turnkey contractor supplies the system which can match the specified criteria for the least amount of money.
The FTA considers turnkey to be “an innovative procurement technique in which a public entity contracts with a single private entity to deliver a complete and operational product.”  

Another definition, offered by the American Society of Civil Engineers, stresses the performance criteria basis of a turnkey procurement: “a transit system project wherein the contracting agency enters into a contractual agreement with a consortium of firms, or an individual firm, a vendor or vendors to construct a transit system or system element that meets specific performance criteria.”

The performance criteria and goals of the system can vary across a broad spectrum of issues, but the fundamental idea of delivery of a transit system to match the project criteria remains the central definition of a turnkey procurement process. Also important is the transfer of responsibility for integration of the pieces and steps of the development process. But from this starting base, the following discussion can clarify and refine this definition.

**Design-Build with Commissioning (testing & start up)**

In effect, turnkey can be seen as a "design-build" effort applied to a complex system such as the electrical, electronic and communications aspects of a modern rail transit system. In other industries, turnkey implies elements of proprietary technology, and the same can be true of transit turnkey. As in the industrial model, a strict transit turnkey project is directly funded by the owner. Elsewhere in the world, where transit systems are often developed with private financing, the turnkey contract is separate from the legal structure of the financial project. In effect, the turnkey contractor designs and builds the system for a private owner.

The definition of turnkey as it applies to transit does not imply operational obligations of any sort. However, much of the potential of increased private involvement in infrastructure comes from the bundling of private operation with turnkey procurement. This bundling will be considered, but for the sake of a simple, intuitive definition, this study will take turnkey to mean strictly the design (with engineering), construction, and commissioning of a transit system. The image of "handing over the keys" is embodied in the very name of this procurement scheme, and so the operation of the system is excluded from the first-cut definition of turnkey.

---


6 ASCE, “Mini-Forum.”
It must be acknowledged that the issues involved with increased private involvement in transit procurement run well beyond this limited "design-build" definition for turnkey. The context in which turnkey would be placed is very important to a more rigorous examination of the overall implications of this emerging model of public infrastructure development.

2.1.2. The Definition in Context: The Larger Strategic Structure

Ultimately, the definition of turnkey fits into a broader context of system procurement. Each project is different, and the need for a flexible framework for procurement is paramount. This framework includes the regulatory and market structure of infrastructure and service procurement.

The rudimentary turnkey procurement which fits within the definition of turnkey presented above can be coupled with operations of the system for a fixed period after start-up. San Juan's Tren Urbano includes five years of operations and maintenance (with an optional extension of five more years) while New Jersey Transit's Hudson Bergen Light Rail System includes 15 years of service provision and upkeep.

In other cases, the turnkey contract is essentially a subcontract of a larger deal. This is the case in concession deals like Manchester's Metrolink and Kuala Lumpur's STAR Transit. The concessionaire holds the rights and responsibilities for development, operations and maintenance for a defined period, and this corporate entity signs a turnkey contract for the design and construction of the physical system. It is this work which gives value to the concession. For legal reasons, the design and construction is performed on a turnkey basis, with the only difference being that the owner who initially receives ownership of the asset is the private concessionaire (in a scheme like a Build-Operate-Transfer concession).

These case studies represent a diverse range of projects, all of which are built around the core of a turnkey contract. They are all legitimately called turnkey schemes, but the context of each project is very significant to the larger procurement strategy. By defining turnkey strictly, confusion can be avoided, but the diversity of project structures can still be accommodated. The salient feature of turnkey contracting is the innovative division of public and private sector roles which represents a change from current public procurement strategies in the United States.
Turnkey Variations: Split Turnkey, Super-Turnkey, Hybrid Turnkey

Much of the literature in the field of increased private involvement in infrastructure procurement attempts to delineate among the difference between a multitude of hypothetical project structures. "Super-Turnkey" gives the development rights of a station area to the turnkey contractor. "Split-Turnkey" has come to mean the separation of civil design-build responsibilities from the rail system elements. "Hybrid Turnkey" is a catch-all term for just about any permutation of the idea of shared project risk between the public and private partners. The net effect of the usage of these terms is that "turnkey" can mean almost anything which is not the traditional, segmented project delivery scheme. Super-turnkey could effectively be described as a simple turnkey with joint development of station area real estate, and in the interest of clarity, this specific definition will be used. Split turnkey is a useful distinction which will be retained (since it relates directly to the strict definition of turnkey as design-build). Other than this distinction for split turnkey, the analysis which follows will limit the use of turnkey to mean the responsibility for design and construction of a major piece of transportation infrastructure. Additions to this scope for a project contractor will be indicated by describing the responsibilities explicitly (i.e., operations).

2.1.3. Turnkey as One Option for Development

Turnkey procurement and its variants can be embedded within a larger franchise structure where the owner is not the public sector but a project company which holds the franchise rights to the system development. In that context, turnkey procurement as defined by the FTA ("...technique in which a public entity contracts with a single private entity...") is only one of a range of options available to the public sector to procure transit infrastructure. Private sector involvement in this development process could range from the roles of designers and constructors as in the current segmented process to a complete transfer of project development responsibilities in a franchise-style development.

Quadrant Analysis

In his doctoral dissertation, John Miller presents a framework for the analysis of infrastructure procurement strategies. This framework depicts public sector procurement strategies in two-dimensions. The horizontal axis spans the continuum from a segmented process to a system procurement strategy. The vertical axis refers to the public sector's role in financing the project. At the top end is the direct funding strategy in which government spends
its own money to push a project into the market; the opposite extreme is the indirect strategy of pulling projects from the private capital markets through incentives, mandates and subsidies. Figure 2.1.1 presents this concise framework with the numerical designations of the respective quadrants.²

**Figure 2.1.1: Miller's Procurement Strategy Framework for Quadrant Analysis**

Under this framework, the strict definition of turnkey procurement would fall just to the left of the vertical axis, in Quadrant IV (see Figure 2.1.2) — directly funded since the public sector is buying the system from a vendor/contractor; and segmented because Miller defines a system strategy (Quadrants I and II) to include the final delivery of a transportation service, not simply the infrastructure which permits this service. Turnkey, as defined here, involves the delivery of an infrastructure system, classifying this strategy as a Quadrant IV approach. However, turnkey represents a clear shift in procurement strategy toward the vertical axis from the extreme left position of the current segmented process, and often the scope of a turnkey procurement strategy is expanded to include operations, moving the overall procurement across the vertical axis into Quadrant I.

As discussed above, a turnkey supply contract can often be found imbedded in a Quadrant III franchise project. The quadrant analysis undertaken here presents the simplest form of design-build turnkey as the departure point for the analysis of broader procurement strategies. In these broader strategies, which include operations and even private financing, the overall project procurement can cross either one or both of the axes into Quadrants II or III. A privately-financed, franchised system developed as a Build-Operate-Transfer (BOT) could still have a turnkey contract element between the private project company and the system supplier; so the overall strategy of this indirectly financed project, in the context of the Miller framework, can be labeled as a Quadrant II approach (again, see Figure 2.1.2).

Figure 2.1.2: Quadrant Analysis: Turnkey and the Turnkey Procurement Context
2.2. The Present Climate of Infrastructure Development

The interest in turnkey procurement schemes recognizes that turnkey represents a departure from current procurement practices. The potential of turnkey to improve the infrastructure delivery process arises from this difference. The current process is an important starting point for this analysis. For the reasons described below, the United States has relied exclusively on Quadrant IV procurement for all manner of public works, especially transportation infrastructure.

2.2.1. Current Sequential Process

The designation for the current process is the “design-bid-build” system. The public sector owner develops an idea of what it wants through a system and project planning process. This project plan, usually developed to the level of a conceptual plan and/or performance objectives, is forwarded to a design consultant to flesh out. This design and engineering work is bid out on a qualifications-based competition, and the firm performing this work is compensated on a "cost-plus" contract basis. This design segment is completed when the owner receives a full set of plans and drawings which conform to the original conceptualization as well as the complete panoply of requirements related to public interest (access for the disabled, engineering safety standards, etc.).

The fully-developed designs are then bid out for construction. The construction contractor who is pre-qualified to compete for such jobs and responds with the lowest price contractually commits to building the project exactly as designed. When construction is complete, the contractor hands the asset over to the owner, and the project enters into the operations phase.

In the context of public funding for infrastructure, the sequential process is excellent for facilitating safety and transparency in the development process. This process emerged in the period after World War II, when public funding -- specifically, federal capital matching programs -- was the primary funding mechanism for infrastructure investment. But more and more, the assumption that future capital funding will come exclusively from public sources is in question. The mature infrastructure stock of many American cities and states is expensive to maintain and reconstruct: the need for infrastructure investment far outstrips the ability of government sources to provide the capital. The general trend toward more comprehensive

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8This comment describes many of the urban rail transit systems in the U.S. which date from the early part of this century. It also applies to the nation's infrastructure stock as a whole: the interstate highway system, many parts
private involvement in infrastructure delivery (of which turnkey is one first step) is thought by many to be the path toward future private financing of these same systems.⁹

Similarly, as emerging economies continue their rapid development pace, they will generate the need for increased infrastructure investment, which the public sector may not be able to meet without private capital involvement. Regardless of whether infrastructure investment enables economic expansion or economic expansion funds infrastructure investment, the fact remains that the two follow similar pathways in emerging economies. By World Bank estimates, investment in infrastructure in low- and middle-income countries is about 20 percent of total investment (40 to 60 percent of public investment for low- and middle-income, respectively).¹⁰ This hefty investment level is important because these rapidly developing countries do not have the same infrastructure finance system as the U.S. Public funds are severely limited due to unstable revenue sources for government accounts as well as a legacy of heavy debt burden remaining from previous periods of development loan programs. The mechanisms which keep the U.S. infrastructure development process exclusively in the segmented design-bid-build system do not apply in a vast majority of the rest of the world, and as a result, a wide array of project procurement strategies have emerged.

The current segmented process for delivery of infrastructure does have significant strengths which account for its adoption over the last 50 years; however, its weaknesses allow room for new and innovative approaches. The Quadrant IV segmented system is good for openness of competition: the public owner is required to advertise for bids on any construction project. Bid prices are made public, and the lowest bidder wins the job.

In the long history of segmented procurement, the engineering and construction industry has become very familiar with the process and the details of pushing projects through the pipeline. For example, risk allocation has been handled through standard contract language, accepted

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practices and the case history of litigation involving nearly every issue possible. The process
does have some drawbacks. Below is a discussion of some of the main shortcomings for which
the process has been brought into question.

**Structural Deficiencies in Segmented Process**

**Narrow performance incentives**

The low-bid system for awarding construction contracts has proven to be a narrow scope of
competition, especially in light of emerging concepts like life-cycle cost accounting. The
cheapest bidder will rely on the cheapest material and will respond to incentives to cut out
operationally helpful details which might cost more within the narrow scope of low-cost
construction.\(^\text{11}\)

The construction industry is traditionally one of the most competitive business ventures;
profit margins are thin with industry-wide returns to capital of less than 10 percent. The
pressures on low-bidders to economize have previously resulted in sub-standard work, and now,
as a result, the owner has assumed a tight oversight role in the construction process. Often, a
small public agency will rely on the services of a consulting engineer for this role, but most of
the large, public sector agencies involved in infrastructure procurement have established the
capacity to manage moderate-scale construction projects in-house.

**Public sector distraction**

The segmented procurement process requires an owner who is intimately involved with each
step of the process. The owner will approve any and all project tasks to be performed within the
scope of each of these segmented steps. The most palpable of these approval and oversight roles
is that of construction management. In a number of public agencies and authorities, the
construction oversight function has become a primary function of the bureaucracy. The
protection of the public interest has been so narrowed as to entail the verification of concrete
aggregate composition. This exaggerated concern is only hyperbole; quality concrete is a
fundamental aspect of public safety, but the critique remains intact that the incentives of a low-
bid procurement system necessitate such tight public controls over the minutiae of design and
construction work to ensure that the project is delivered as originally conceptualized.

When the public sector requires accounting oversight of cost-plus design work contracts and

\(^{11}\) U.S. Congress, Office of Technology Assessment, *Delivering the Goods: Public Works Technologies,
construction management oversight of low-bid construction work, the human capacity of the agency naturally drifts toward these roles. The staff is distracted from tasks for which the public sector is responsible, like strategic and long-range planning.

**Contentious and litigious influences**

The adversarial posture of public owners is required in a segmented procurement system. The segmented process provides incentives to shift responsibility for problems (design flaws, schedule delay, cost over-runs, etc.) to other parties.

Design flaws which are discovered during construction often result in claims being filed against the owner and against the designer. In cases where poor construction performance is threatening the integrity of the project, the owner will sue the contractor for non-performance, with the hopes of collecting damages from this private company's insurance policy.

The consequences of these interactions is that the process is highly contentious, with risk allocation being achieved through court-mediated litigation. This litigation is slow and can result in significant delays and added costs. The public interest in having the services that this infrastructure project will provide is lost in the delays of such a contentious process. The process also is inefficient in handling change orders (a change in design or scope of work once construction has begun).

**Low-bid gaming**

In a low-bid competition in which the value of change orders is negotiated, one can find bidders submitting fixed-price bids at below-cost rates. The value of the contract will likely increase over the duration of the contract due to change orders, and the incumbent contractor, who won the lowest bid competition now has negotiating power when determining the value of a redesigned project. An entire branch of contract economics has emerged around this class of problems in which asymmetrical information and negotiating power leads to less-than-optimal pricing schemes: the field is called game theory.

**Defensive posturing**

The risk and cost allocation of the segmented process also leads to a defensive posture in each participant. There are two ramifications of this defensive posture which are noteworthy: the problem of "overdesign" and the lack of incentives for innovation.

Overdesign is the effect of risk aversion on the effort put into the project pre-construction work. It relates not only to the design phase but also to the planning and preliminary
engineering steps within the delivery process. In an attempt to avoid being sued, all those performing a step in the sequential chain of project delivery will exhaustively prepare for even the most unlikely worst-case scenarios. Defensive engineering involves added time and cost in the site characterization process and may result in additional construction costs for overdesigned projects. In the context of the segmented design-bid-build process, this is a rational, risk-averse strategy for the firms involved in project development. The distribution of risk, while ad hoc, has been sorted out in the long experience of the industry with this process. In fact, the risk allocation is simple: the owner takes all risks except those that he can pass off to the other players through the narrow performance requirements demanded of the firms working on each particular step. Hence the defensive retrenchment to protect the firm from claims.

Use of the term overdesign should not be misinterpreted. It does not imply that infrastructure procurement should not stress structural integrity and public safety. The safeguards which insure these features are a fundamental strength of the current segmented system. But perhaps these goals are fundamentally a performance standard rather than a design standard, thus allowing innovation in the manner in which public safety is protected. The same safety and public interest outcome might well be achieved in a more efficient manner if the scope of the oversight process is broader.12

Lack of innovation is another incarnation of the defensive incentives built into the segmented procurement system. The designer will not get sued for drafting plans which rely on the same structures and materials which have been used previously. The low-bid construction contractor has no incentive to invest in new equipment for innovative techniques since equipment must be amortized over many projects and the new techniques may cost more initially. Moreover, the design process and construction techniques reinforce the other's defensive positioning. A designer will not draw up plans which cannot be built with standard construction technology; the constructor will not be asked to bid on projects which do not conform to the ideas which are acceptable to public owners.

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12To illustrate this idea with an example, we can look at the efforts to mitigate poor geological conditions found along the STAR alignment in Kuala Lumpur (see also Section 3.5.4). The design-build team had enough data to know that the risk of settling was high along portions of the alignment. Instead of spending the money and time to obtain full data on conditions on a micro scale, the team found it cheaper and safer to mitigate the entire section of the alignment, costing more for the constructor, but less for the team member working on preliminary engineering. Under a sequential process, the construction contractor would likely have the grounds for a claim against the designer if the same events had happened in that framework.
2.3. Turnkey Issues

Innovative procurement options may help overcome some of the problems presented above. The goal of developing different procurement options is to continue the positive aspects of the current system while incorporating improvements which will overcome the short-comings like outstripped government funds and the delays involved in the current process. A discussion of the roles of the public and private sector, risk allocation, operations, and financing will highlight the changes which turnkey represents and the impact of these changes.

2.3.1. Roles for the Public and Private Sectors

Along with risk allocation, the change in the roles of the public and private sectors represents the biggest change in contracting practice.

As discussed, turnkey contracting is just one option in a spectrum of procurement strategy options. A description of the exact roles of the different participants is not appropriate here; the case studies section details five examples of project structure which give this type of information. But the shift of roles, with the private sector generally taking a larger, more authoritative position in the design, construction and operation of infrastructure has important implications. Issues such as the structure of the industry and the private sector point to some of the benefits which potentially accrue from a shift from Quadrant IV toward Quadrant II and III.

Structure of the AEC and Transit System Vendor Industry\textsuperscript{13}

When the sequential process is dissected, one finds that the individual tasks of the process are generally all done by the private sector. Consulting engineering firms that specialize in planning begin the process by developing a region's comprehensive transportation plan. Another firm will perform the Major Investment Study once a project corridor has been identified. Some firms specialize in the task of moving major infrastructure projects like rail transit systems through the environmental permitting process. Specialist design firms are hired to produce the final drawings and specifications (specs) which will be built by any number of private sector construction companies.

\textsuperscript{13}The AEC (Architecture, Engineering, and Construction) Industry is collectively the private sector participants in the process of infrastructure delivery.
Comprehensive capacity, fractured structure

The bundling of several of these tasks into the same contract represent a change in the structure of the process but no change in the tasks required of the private sector. But the structure of the industry has evolved to accommodate the structure of the current process. In the context of segmented procurement, designers and contractors are often adversaries in the process. Turnkey asks them to work together and indeed, to bundle their fortunes together in the success of the project. U.S. Firms do not possess both of these capacities together in the same organization -- previously, it was considered a conflict of interest to bid on the construction of a project which the same company designed. Overcoming the impediment of structural deficiency will enable the U.S. Private sector to compete for turnkey-style projects more effectively.

The rest of the world, especially the emerging economy countries in Asia, Latin America and Africa, will be the biggest market for basic infrastructure in the next century. This is probably true even more so for high capacity urban transportation system like rail transit. One can expect the dollar value of turnkey and full franchise development projects to grow. Franchised turnkey systems could be a popular tool for indebted countries suffering under rapid urbanization and road-network gridlock due to a supply/demand imbalance in highway capacity.

The private sector companies which have experience with this procurement system will win the international competition for these projects. Experience will facilitate the submission of bids when qualifications are based on experience. The previous experience will help also in the partnering process to put together bid teams. A major contractor will only be as competitive as the team with which he has submitted a bid. This aspect of the effect of turnkey on private sector organizational structure is part of the hot current topic of strategic alliances and the value of cooperation among team members all working for the same goal.

Split cultures

In the discussion of transit turnkey, reference is made to the split of cultures between the civil construction firms (the "hardhats") and the mechanical and electrical engineers who primarily represent the transit system vendors (the "hard pencil" engineers). Combining these firms with different cultures into one team which must cooperate to advance the design and construction of a new rail system could lead to difficulties. In today's environment, the public owner deals with each culture separately; responsibility for the integration of transit systems (trackwork, communication, power, etc.) With this physical guideway structures remains with the owner.
Moreover, the culture of operations is most likely left out of the discussion all together. Integrating design and construction can benefit the delivery of the infrastructure, but the delivery of transportation services (the ultimate goal of infrastructure) can benefit enormously with the inclusion of operation and maintenance concerns in the design process. The points of view of other stakeholders in the transit development process are equally difficult to incorporate in the procurement process. This would include diverse interests like real estate developers and urban planners. Attempting to add them is difficult but ultimately can improve the product in the long-run.

As an indication of the seriousness of this problem, the turnkey structure has been called a "forced marriage" between the contractors and the vendors. The negative effects of this arrangement may be settled if one aspect of the project is given primacy; the dollar value is a good measure of the relative importance of the separate cultures. Another solution is the "split turnkey" project structure which consolidates civil concerns into one design-build contract and consolidates the procurement of systems components into a single systems turnkey deal.

**Structure of Public Agencies**

As discussed above, the public sector has become adept at protection of the public interest as it relates to the narrow performance incentives established by the sequential process. Many public agencies have evolved into a culture focused on issues of construction management oversight. Implementation of a turnkey strategy fundamentally shifts the focus of this public group to the up-front determination of needs and objectives, a strategic planning capacity which may or may not be included in the current focus of the organization. Institutional inertia may result in a reduction of the benefits expected to be generated immediately in the transition to a turnkey strategy.

For this reason, the potential of turnkey may be best captured by a region which is new to the rail transit development process. In this case, there is not "institutional relearning" involved in the adoption of a turnkey strategy. The cost of hiring consultant capacity to manage the procurement process is a net savings when compared to the cost of building public sector project control capacity.

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14GMAEC Tren Urbano Program Consultants, "Procurement Strategy Paper" (San Juan, P.R., : Puerto Rico Department of Transportation and Public Works, 5 December 1994, photocopied).
2.3.2. Risk and Authority

Fundamentally, risk comes down to the probability of an event occurring and the consequences of it happening (economists refer to this as the "size" of the event). Many negative events can occur in the infrastructure development process, and these are catalogued in Table 2.3.1. The impact that one of these occurrences would have on a project can vary from severe to incrementally negligible; the risk of such events is an amalgam of both of these properties.

The difficult question is the price of these risks as a net value. To illustrate the difference between the analytical cost of a risky venture and the willingness-to-pay of economic actors, consider the decision to play the lottery. A lottery ticket buyer will gamble a dollar at a time for the chance at a large pay-off. The expected value of this transaction is understood to be negative, the risk which the lottery player accepts is affected by the potential benefit if he "hits the numbers."

In the development of a traditional construction contract, most of the risk is absorbed voluntarily by the public sector owner. Turnkey hopes to reorder this risk allocation so that the party most well-positioned to mitigate the risk is the one responsible for it. This is simple to say but difficult to implement, given the years of experience with the segmented system.

The idea for a new allocation of risks to the private sector implies that the authority to mitigate the risk also goes with the package. If the project is on a fixed schedule for completion and some negative event occurs such as the discovery of an unknown utility line under the right-of-way, the turnkey contractor must have the ability to redesign plans and quickly resume construction. A situation such as this in the current contracting process would cause serious delays and added costs. No contractor would take the risk of undiscovered utilities without the authority to move them or redesign the structure when such an event occurs.
<table>
<thead>
<tr>
<th>Risk</th>
<th>Description</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Political</td>
<td>collective decision process, agreement among local government agencies, susceptibility to disruptions by opposition groups</td>
<td>System Planning, all others</td>
</tr>
<tr>
<td>2. Funding</td>
<td>commitment by public and private participants to monetary/in-kind support</td>
<td>System Planning, Preliminary engineering</td>
</tr>
<tr>
<td>3. Financing</td>
<td>willingness of financial institutions to lend money based on market for capital and risk, ability to match cash flow with expenditures</td>
<td>System Planning</td>
</tr>
<tr>
<td>4. Right-of-way</td>
<td>acquisition of right-of-way in timely manner (to avoid delay)</td>
<td>System Planning</td>
</tr>
<tr>
<td>5. Speculative Effort</td>
<td>project planning, preliminary engineering and permitting which precedes full funding agreement and contract initiation</td>
<td>System Planning, Preliminary Engineering</td>
</tr>
<tr>
<td>6. Bids Exceed Estimates</td>
<td>submitted bids are greater than construction cost estimates, so budget is insufficient to build project</td>
<td>Preliminary Engineering</td>
</tr>
<tr>
<td>7. Geotechnical</td>
<td>difference between what is known about subsurface conditions and what those conditions are</td>
<td>Construction</td>
</tr>
<tr>
<td>8. Hazardous Materials</td>
<td>materials discovered during construction which require expensive disposal</td>
<td>Construction</td>
</tr>
<tr>
<td>9. Underground Utilities</td>
<td>unknown and dislocated underground utilities</td>
<td>Construction</td>
</tr>
<tr>
<td>10. Inflation</td>
<td>growth in general or specific prices which are not correctly forecast, and thus alter the relative magnitude of cost components</td>
<td>Construction</td>
</tr>
<tr>
<td>11. Federal, State, Local Regulations</td>
<td>changes in regulations (or interpretation of regulations) which result in higher costs (i.e. Buy America, ADA, DBE, OSHA, etc.)</td>
<td>Final Design, Construction</td>
</tr>
<tr>
<td>12. Design Integration, Coordination</td>
<td>potential for design element or subsystem to be incompatible and result in malfunctioning system</td>
<td>Construction</td>
</tr>
<tr>
<td>13. Changed Requirements</td>
<td>change in owners requirement discovered/made after critical point in development</td>
<td>Construction</td>
</tr>
<tr>
<td>14. Construction Performance</td>
<td>hidden defects covered up, skill shortage, labor conflicts</td>
<td>Construction</td>
</tr>
<tr>
<td>15. Subsystem Test</td>
<td>possibility that subsystem does not function properly</td>
<td>Construction</td>
</tr>
<tr>
<td>16. System Integration</td>
<td>possibility that subsystem operates, but not compatible with whole system</td>
<td>Construction, Operations</td>
</tr>
<tr>
<td>17. Schedule Slippage</td>
<td>delay which affects subsystem development and/or completion date</td>
<td>Final Design, Construction</td>
</tr>
<tr>
<td>18. Construction Safety</td>
<td>unsafe conditions which threaten workers and property</td>
<td>Construction</td>
</tr>
<tr>
<td>19. Site Security</td>
<td>prevention of theft and sabotage</td>
<td>Construction</td>
</tr>
<tr>
<td>20. Act of God</td>
<td>natural catastrophe occurring during construction which affects completed work, materials, schedule</td>
<td>Construction, Operation</td>
</tr>
<tr>
<td>21. Failure to Complete</td>
<td>contractor fails to deliver contracted work</td>
<td>Construction</td>
</tr>
<tr>
<td>22. Seismic</td>
<td>finished facility is seismically unsafe and/or is damaged by seismic activity</td>
<td>Operation</td>
</tr>
<tr>
<td>23. Operating</td>
<td>possibility that system does not have adequate capacity, other unexpected operating conditions/costs</td>
<td>Operation</td>
</tr>
<tr>
<td>24. Market (Ridership / Revenue)</td>
<td>demand (ridership at given fare) is not high enough to meet revenue projections</td>
<td>Operation</td>
</tr>
</tbody>
</table>

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Cost/Risk Under Turnkey

One fact about risk allocation is that bid prices reflect the expected value of the risk. In the risk-averse environment of the AEC, the nominal dollar value of the contract increases with increasing risk. The cost associated with shifting this risk will seem higher at the outset since previously, the risk and its cost was borne by the owner. The interesting question to explore is the net cost implications of such a transfer. The cost is made explicit when evaluated as its own expense, but that cost can be lower than the embedded cost of the owner carrying that risk.

The link between risk and cost can be explained in the context of a simple model of interest rates. A risky investment is expected to offer a higher rate of return; the implicit function by which the market determines this interest rates is:

\[ i = R + E(\text{inflation}) + \text{Risk Premium} \]

\( R \) represents the risk-free interest rate, \( E(\text{inflation}) \) is the expected inflation rate over the term of the investment (this term could be left out if real dollar values are used), and the Risk Premium is a determined by the market to correspond to the chance of not being paid back. In essence, the Risk Premium would allow for every one-in-a-hundred (or some other appropriate fraction) project to suffer the negative event consequences, and on the average, the investor will still receive the market rate, \( R \).

The Added Cost of Not Specifically Allocating Risk

In the standard system of sequential contracting, default risk allocation to the public owner means that the cost is not expressly analyzed and monetized. This does not mean that the cost is zero. More specifically, the cost of certain risks may be unnecessarily high if the most appropriate party is not responsible for risk mitigation. The current system has proven to be a case in which neither risk or cost of risk is minimized, and the incentive scheme points toward costly (in money and time) ex post facto assignment of risk. The system in place now results in claims and litigation by construction firms against design firms who in turn bring claims against the owner who initially defined the scope of the project. The most appropriate and cost-effective mechanism for addressing issues which inevitably arise during development and construction.

would likely be less antagonistic, spending less to determine who is to blame and more on correcting the problem to keep on schedule.

Many have commented on the contentious nature of the relationship among different contractors and the owner, and even between contractors. The scope of work for each sequentially-contracted piece of work is narrowly defined, and the contractor is concerned with transferring risk away from itself through contract language or litigation. There is no provision for a price premium for a contractor willing to take on and mitigate any risks. Although the designer may be the most appropriate point of risk control, the confrontational nature of sequential contracting encourages the contractor for each task to reject risk which could be effectively handled internally.

The owner under this scheme, by nature, will be responsible for insuring compatibility of work among the sub-sections as well as quality assurance and job performance. With other risks to confront, the owner is positioned to cover risk generated in a traditionally-contracted scheme. But the cost is high and often unexamined. For instance, the cost of structuring the public owner as a "construction-management" institution means that a whole range of institutional difficulties arise when construction is complete and the period of operations presents the owner with a whole different set of roles to play. A construction-oriented public authority will be mis-aligned in terms of human capacity and experience to deal with this phase. Some have characterized state-level highway authorities as highway construction firms which are now, with the end of the interstate building period, making the difficult transition to being transportation systems operations and maintenance organization. The cost of such transformation can arguably be considered a delayed effect of the earlier risk assumption. When the public owner agreed to bear the construction coordination risks as well as the schedule/cost risks, the agency necessarily became the crucial link for quality control and construction oversight. This focus has had cost implications that come from increased maintenance and reconstruction costs as a result of decades of a lack of attention to maintenance.

A full assessment of the impact of turnkey implementation on risk allocation is presented in Table 2.3.2).
Table 2.3.2: Risk Allocation Implications of Turnkey

<table>
<thead>
<tr>
<th>Risk</th>
<th>Traditional Allocation</th>
<th>Change Under Turnkey</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Political</td>
<td>owner</td>
<td>shared (potentially)</td>
</tr>
<tr>
<td>2. Funding</td>
<td>owner</td>
<td>shared (potentially)</td>
</tr>
<tr>
<td>3. Financing</td>
<td>owner</td>
<td>shared (potentially)</td>
</tr>
<tr>
<td>4. Right-of-way</td>
<td>owner</td>
<td>shared (potentially)</td>
</tr>
<tr>
<td>5. Speculative Effort</td>
<td>owner</td>
<td>shared (potentially)</td>
</tr>
<tr>
<td>6. Bids Exceed Estimates</td>
<td>owner</td>
<td>shared (potentially)</td>
</tr>
<tr>
<td>7. Geotechnical</td>
<td>owner</td>
<td>shared (potentially)</td>
</tr>
<tr>
<td>8. Hazardous Materials</td>
<td>owner</td>
<td>shared (potentially)</td>
</tr>
<tr>
<td>9. Underground Utilities</td>
<td>owner</td>
<td>shared (potentially)</td>
</tr>
<tr>
<td>10. Inflation</td>
<td>owner prior to award, between stages</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>11. Federal, State, Local Regulations</td>
<td>regulatory changes only</td>
<td>full compliance</td>
</tr>
<tr>
<td>12. Design Integration, Coordination</td>
<td>owner</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>13. Changed Requirements</td>
<td>owner</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>14. Construction Performance</td>
<td>owner</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>15. Subsystem Test</td>
<td>contractor</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>16. System Integration</td>
<td>owner</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>17. Schedule Slippage</td>
<td>negotiated</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>18. Construction Safety</td>
<td>contractor</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>19. Site Security</td>
<td>contractor</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>20. Act of God</td>
<td>contractor</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>21. Failure to Complete</td>
<td>contractor</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>22. Seismic</td>
<td>owner</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>23. Operating</td>
<td>owner</td>
<td>full transfer to contractor</td>
</tr>
<tr>
<td>24. Market (Ridership/Revenue)</td>
<td>owner</td>
<td>full transfer to contractor</td>
</tr>
</tbody>
</table>

2.3.3. Operations

While operational responsibilities fall outside the formal definition of a turnkey procurement strategy, the incorporation of operations and maintenance (O&M) has emerged as a primary benefit of the decision to go with turnkey. Life-cycle cost issues are at the core of this trend which considers the full impact of infrastructure investment over the duration of its useful life.

Focus on Life-cycle Costs

Life-cycle cost accounting, long touted as a rational improvement to the simplistic "low-bid" selection criterion of the segmented process, has been difficult to implement in the context of the design-bid-build process. Under a turnkey process, the designer will ultimately be impacted by the financial ramifications of the "constructability" of his design. "Value Engineering" has emerged as an external process in the segmented approach to consider the dynamics of design/construction cost trade-offs. Turnkey removes this extra requirement from the design review process by transferring those concerns from the public sector owner to the team.

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By expanding the scope of the turnkey to include O&M, the same dynamic can expand life-cycle cost accounting to include issues such as ease-of-operation and energy efficiency. The lowest life-cycle cost may be a higher up-front capital investment: consider a motor which lasts longer and uses less electricity but costs more. This and other operations issues like the required level of training which a technician must achieve to operate a train can affect design significantly.

Perhaps the biggest advantage which might come from a turnkey-style project is the incorporation of the financial risk of meeting adequate ridership levels into the same package with design, construction and operation. Here the team is responsible for the total quality of the transit service: the design must be attractive and promote ridership, the service must be high quality with the lowest possible price. The transfer of ridership risk represents a fundamental shift of the scope of a transit project to an area beyond a turnkey procurement strategy. This brief discussion is merely an extension of the analysis of including O&M in the turnkey package.

Operations Lag

Realistically, the time frame involved in a transit development project means that operations cannot typically begin until two or three years into the construction process. The contract value of the operations phase is a small fraction of the capital value of rail cars, signals and the infrastructure aspects of the system. The likely outcome of the inclusion of operations is that the operating entity, when required, will be subcontracted by the main interests in the development team, much as a public owner would contract operations directly. The margin is thin in these sorts of operational contracts and the time delay between commencement of construction/car manufacturing and operations reduces the net present value of this contract clause to an insignificant amount. The prudent owner will consider this when setting up the contract structure. The danger exists that a simple turnkey plus operations contract provides a very weak feedback signal from operational concerns to the design process.

2.3.4. Competition

Competition is generally held as the primary mechanism by which privatization has the greatest impact. Again, privatization means so many different things, but in cases where privatization refers to the private operation of a traditionally public-operated service, often the threat of competition is enough to exact efficiency gains from the public operators who had not previously faced competition.
The issue of competition is considered in detail in the case studies which follow. The introduction explains the difference between the scope and scale of competition. While turnkey may reduce the scale of competition (when measured with the simple yardstick of number of rounds of competition or even the number of bids received for a particular job), the scheme increases the scope of competition. Teams are bidding for a much broader scope of work, and the price/task optimization process of bid development has captured more economies in a single round of competition. Figure 2.3.1 presents the difference between current segmented competition and turnkey competition as a line showing private sector effort in terms of bid development. In a rough sense, the scope of competition could be considered the area under the curve. Turnkey procurement represents a much broader scope.

**Figure 2.3.1: The Scope of Competition under Alternate Procurement Strategies**

![Diagram showing the scope of competition under different procurement strategies]

As might be interpreted from this figure, the bid development process represents a major expense to the consortia who choose to compete. This raises the issue of eliciting bids from parties who are qualified to compete. The industry of car/system vendors is already small enough that an owner would want a significant fraction of the potential bidders to be enticed into bidding. For this to happen, the public sector must be clear in its goals and objectives in the development of the RFP. The owner should firmly enunciate its needs for the system, and the political process must be finished debating the project. In short, the project strategy must be
clear and concrete. The criteria must be general enough to convince the vendor community that a particular technology or vendor has not been "pre-selected" in the very nature of the RFP.

One-half of all car makers should be expected to bid on any single turnkey project. A complaint heard from private firms involved in other aspects of the project process relates to the restriction placed on competition by the limiting number of systems vendors. Not every contractor who might have bid under a low-bid competition will be able to form a qualified team. In some sense, the informal process of team formation is a competition itself. Any contractor left out of the process should try to attract the attention of a system vendor by offering good value for the construction dollar. The ability to bid low while assuring quality guarantees any contractor a seat at the table with the systems contractors.

2.3.5. Financing

The implementation of a simple turnkey strategy has very little effect on the financial structure of the project or on the owner's financial responsibility. In short, the owner pays directly for the system, usually through monthly progress payments, while the private sector assumes new risks and responsibilities.

A simple turnkey strategy can be embellished in this area very readily. Many forms of private sector participation can be included in the strategy from vendor lease financing of the rolling stock to joint development in the station areas. The tax structure of the United States, with a lower tax rate on public debt for infrastructure investment, currently favors the continued influence of public sector finance for transit systems.

Federal funding is tied to the federal environmental review process. This source of funds represents a significant contribution to the capital costs for projects which are selected to receive it. In other countries, government money, both local and national, as well as private investment have special conditions which constrain the development of funding strategies.

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17In fact, the need for a very well-defined project extends beyond the issue of eliciting bids. In the structure of a fixed price, fixed schedule contract such as turnkey, any unanticipated change order executed by the owner would scuttle any benefits derived from the turnkey strategy. A turnkey contractor can bargain from a position of strength once the contract has been executed.
3. The Case Studies
3.1. Case Studies Introduction and Selection Criteria

“Turnkey procurement” has been used to denote a wide range of contracting options in the field of transit development. Many diverse regions have had experience with some form of turnkey procurement for transit systems, and the diversity of these contractual relationships is an interesting testament to the flexibility and options which this type of scheme offers. This diversity is documented by a set of case studies which looks at the turnkey experience of the United Kingdom (London Docklands Light Railway and Manchester Metrolink), Malaysia (STAR Transit) and the United States (New Jersey Hudson-Bergen Light Rail and San Juan Tren Urbano). The description and analysis of these projects will illustrate the details of the turnkey model presented in the previous section. The case studies will also offer several lessons for those who will be involved in future efforts to design turnkey contract projects.

Section 3.1.1 explains the selection criteria used in choosing the case studies. Following the selection criteria, Section 3.2 presents the outline used to review the case studies. The case study outline describes the issues addressed in presenting the project background, project structure and other details of the procurement process. After the case studies are presented, Section 4 provides an analysis of the key points and lessons to be derived from these turnkey projects.

The goal in choosing the case studies was to identify the most relevant examples of turnkey projects and extract lessons which can guide the formulation of procurement strategy in future projects. The case studies were chosen because they involved modern transit technology, they were “new-start” systems, and they were located in countries with a more developed economy. The following discussion elaborates on the rationale for these criteria.

3.1.1. Modern Transit Technology

The early history of mass transportation development is synonymous with turnkey development. System-level procurement was the rule rather than the exception for all modes of transport until well into the Twentieth Century. Under turnkey development, transit procurement is moving back toward system procurement; however, today’s transit technology represents a much more sophisticated system of operation. The driver-less trains built today have very little in common with the electric trolleys of the turn-of-the-century. Computer controls and closely specified tolerances in construction and operation have significantly changed the nature of system procurement goals.
The owner of a modern system will have more freedom to trade off capital investment for operational savings. With complex electronic systems like electronic train control, the owner of a transit system has to make the decision between increased capital investment and increased operational requirements (systems with electronic train control are capable of running unstaffed so the investment in this system option would allow for driverless operation). These aspects of modern transit systems make the design of turnkey procurement strategies very different than historical examples of such efforts.

3.1.2. New-Start Systems

The criteria of a new-start system (i.e., a system that does not interoperate with existing car/track/control systems) was chosen because these projects allow for the greatest flexibility in scope of competition; the owner has a wide range of choices available, and the procurement scope is a deliberate choice on the part of the public owner.

New-start systems represent the type of project in which design-build efficiencies can have the greatest impact. The new cars, communications systems and signals will not be limited by any existing system (as would be the case of a line extension). A new-start system is a "clean slate" on which to optimize the use of new technology and innovative operation schemes.

As a contrast, the extension of an existing system is constrained by the need for interoperability with the existing system. In a rail system like the Washington Metro, future line extensions, whether developed under a turnkey contract or a conventional process, will be constrained by the existing system operational controls and the distinctive design scheme of the overall system. A pre-determined set of operational and design characteristics limit the flexibility of the turnkey competition.

New-start turnkey systems are not necessarily limited to areas with no experience in rail transit. London’s Docklands Light Railway was developed as a turnkey project in the city which dug the world’s first subway (see section 3.3). In many of the historic rail transit systems, subsets of the system represent different generations of technology and hence operate as separate systems. The choice to procure a new line within an established rail transit system by means of

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18. Boston is a classic example of this phenomenon. The Green Line trolley system dates from the 1890’s. The latest “line” (currently under construction) is the South Boston Piers Transitway which consists of electric buses running in a tunnel right-of-way.
a turnkey contract is of interest to this study as long as the system does not interoperare with the existing car/track/control system. The potential for new technology and operationally-oriented design is preserved in such a case.

3.1.3. Location in More Economically Developed Countries

The choice to pursue turnkey procurement is only interesting when there is a real choice; public authorities must have the capacity to use the conventional process if so desired. This choice will exist more often in more developed economies. In contrast, turnkey procurement in less developed countries is often a scheme for buying a technology outright which, in many instances, is unobtainable by another means.

In some cases, developing countries receive assistance for mass transportation systems as bilateral development aid. The stipulations which the donor country attaches to this aid limits competition. For example, the suppliers of such systems might be required to obtain supplies from companies in the donor country. In this situation the decision to go with a turnkey system is effectively made by the vendor community seeking to control the development process.

Cities and regions in developed countries tend to invest in higher quality systems. There are many quality factors which represent an added cost in rail transit facilities. Labor costs in developed countries are higher, so the substitution of technology for labor (both in construction and operations) make for a more complex system which might allow for more innovation in the development of a turnkey proposal. Finally, a developed economy represents a completely different environment in which to develop mass transit. A higher rate of car ownership means that travelers have a genuine range of modal options when deciding to make a trip. A rail system which will integrate into this type of environment is fundamentally different from one which is developed for an emerging economy setting.

All three of these case study selection criteria tend to focus the study in on a narrow niche of the transit development market (itself a small part of the infrastructure market). Under these criteria, projects such as the Baltimore Light Rail extension and the Ankara, Turkey Metro are eliminated from consideration. But by focusing the study, more of the specifics of the conclusions will be applicable to similar future projects. The rapid development of emerging economies and the urban areas in these countries point to a large market for modern, new-start systems in the next century.
3.2. Case Study Outline

The case studies share a common outline to facilitate comparisons. They describe the details of the projects which are pertinent to the issues revolving around turnkey procurement; each case study is organized into the following sections:

- Project Background
- Project Structure
- Competition
- Risk
- Funding and Financing
- Intended Versus Unintended Outcomes.

The background context of the case studies affects both the objectives of the transit system and the objectives of the system procurement. In the analysis which follows, the contrast between the two sets of objectives takes shape and becomes a focal point.

3.2.1. Project Background

An understanding of the background setting for a project is crucial to the development of a procurement strategy. The setting of a project influences planning and procurement in different ways. The general characteristics of a region and the existing transportation framework will be discussed in each case study because these factors make up the setting of the project.

The pertinent general characteristics of a region include population dynamics and economic activities. For example, the population density as well as the employment density of an area are factors in transit ridership potential. High ridership potential could point to a procurement strategy which elicits more private involvement in the form of capital investment. The rate of change of a region's population could impact the schedule of the procurement. Aspects of the transportation framework include the current condition of the region's network and institutional factors like the region's previous experience with mass transit development and operations.¹⁹

¹⁹The following example illustrates the importance of the transportation situation of an area and distinguishes project goals from procurement goals: an area which suffers significant congestion may be considering the construction of transit to provide an alternative to this congestion. A separate goal of the turnkey strategy could be to reap the accelerated time-to-completion benefits of a turnkey procurement.
3.2.2. Project Structure

The structure of a given turnkey project reveals quite a lot regarding the goals of the project and the procurement. The details of a project's structure represent the core of the case studies and the base from which the analysis of the issues is built.

The division of responsibilities between the owner (the party paying for the system and who will ultimately own the hardware) and the turnkey contractor is the primary mechanism for fine-tuning the terms of the system procurement. Table 3.2.1 will be used as a standard aid in describing each of the case study projects. The list of the steps outlined in the table resembles the sequential process of traditional infrastructure projects, which is roughly the order in which the activities are performed. However, in turnkey, the same contractor performs all the steps, so this order is maintained here for convenience but may not correspond strictly to the project schedule. For example, when a rough alignment established, preliminary civil construction work can begin in a parallel process with the development of detailed final designs.

Table 3.2.1: Division of Responsibility, Generic Turnkey Project

<table>
<thead>
<tr>
<th>Planning</th>
<th>TURNKEY</th>
<th>OWNER</th>
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</thead>
<tbody>
<tr>
<td>system</td>
<td></td>
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<tr>
<td>project</td>
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<tr>
<td>Design</td>
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<td>30%</td>
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<td>Maintenance</td>
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<tr>
<td>Operations</td>
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</tbody>
</table>

Integral to the project structure is the refined roles of the different sectors. Turnkey is hailed as a new model for public and private sector interaction. Thus, in examining state-of-the-art procurement strategies, a specific parameter will be the effectiveness of this interaction. A final analysis will include the implications of these experiences on determining the proper roles for the public and private sector.
3.2.3. Competition

The analysis of any turnkey contract hinges on the competition by which the private contractor is selected. Competition is fundamental to the achievement of turnkey's potential benefits. The structure of competition in these projects is, with the details of contractual obligations discussed above, the primary means of optimizing procurement and project objectives.

As with project structure, the level of competition within a project will reveal the goals of the procurement. Increased competition is often a goal of turnkey procurement, but not in the strict interpretation of competition as the achievement of the lowest possible cost of construction. Certain constraints imposed upon competition serve to protect quality and safety at the expense of limiting competition. For example, some owners, whether pursuing turnkey procurement or the more traditional segmented procurement, will accept bids only from prequalified bidders. Each case study will be examined for details as to the structure of competition and the implication of this structure.

Scope and Scale of Competition

Critics of turnkey point to the fewer number of rounds of public competition in these projects as compared to traditionally structured projects as a potential liability in the system. A careful analysis of this issue must consider the scope and scale of competition as opposed to the raw number of rounds of competition.

The scope of competition is a concept which captures the breadth of the single turnkey competition; proposers are bidding on more than the lowest price delivery of a commodity good. Significant effort must be put into the development of a bid for a turnkey proposal, and this level of effort is a good proxy measure for the scope of competition.

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Turnkey, at the pure abstract level, involves only one round of lowest-cost, fixed price competition. Traditional project delivery involves multiple rounds of competition: a round for the design, a round for the construction, and possibly a round for operations.
A simplistic metric to measure the scale of competition is the number of bids submitted. But in turnkey, the cost to develop bids is high and the labor put into evaluating bids is high, so the interests of the owner and the industry is to limit the competition to those teams who have a plausible chance of winning. This is the effect of the prequalification stage of many turnkey-style competitions. The raw number of proposals received is not an adequate indication of the scale of competition.

**Preservation of Options**

From the perspective of the owner, an important aspect of competition is the range of options available to the owner. Some benefit may be derived from the preservation of system options until the last possible point. In an idealistic scenario, the owner would include only performance specifications in the Request for Proposals and the competitors could propose a light rail line or a reserved bus corridor or a high-speed moving sidewalk -- all technologies which would move the requisite number of people between two points. Evaluation of the proposals would require generic criteria for comparing the costs and benefits of dissimilar systems, but by preserving the option of accepting any technology, the owner can engage the creativity of the proposers.

Similar benefits could potentially accrue from not specifying the alignment for the new system. Property owners along alternate routes could, as members of the proposal team, bid against each other for the property value benefits associated with improved transportation access. None of the cases studied here leave these particular options open (technology or alignment), but the possibility of retaining this flexibility in the development of proposals serves as an example of how the preservation of options can benefit owner interests. Each case study will consider this issue by describing the point in the process of planning and design at which competition is held.

**3.2.4. Risk**

On one fundamental level, turnkey procurement is involved with the division of risk among the parties involved with the project development. One theory of turnkey procurement holds that a main benefit of such a system is the allocation of risk to the party most capable of mitigating this risk. The current system of risk assumption by the public sector by default is not the cheapest or the fairest; the party most capable of mitigating such risk is necessarily the party most capable of minimizing the damage and cost of any unforeseen problem.
In each case study, the discussion of risk will detail the pro forma allocation of risk and some of the issues involved with this allocation. One primary concern will be the contract mechanism which explicitly or implicitly addresses said risk.

**Market/Ridership Risk**

Market/Ridership risks are a very critical subject in the structure of any transportation project. Ridership risk is the "market mechanism" which ultimately determines the scale of private involvement in infrastructure projects. Where private capital has been elicited for investment in transportation infrastructure, market risk has traditionally been "insured" by the general obligation of government's taxing authority. In the case of turnkey transit, the government invests the capital in the project and the contractor does not assume the market risk associated with this investment of capital. In some cases, the turnkey scheme is structured within the context of a more comprehensive franchise agreement between the public and private sector. The effect of this extra layer of project structure is that the "owner" is, in effect, the private franchisee, and this party takes the risks and rewards associated with ridership (not the turnkey contractor, even though the contractor is often an equity investor in the franchisee).

**Alignment/Construction Risk**

Another general class of risks is that associated with alignment and construction. The discussion in the case studies will include the arrangements worked out for final alignment decisions and the risks involved in construction work such as utility relocation and property condemnation. The construction phase of these projects also includes many other risks like unforeseen conditions, acts of god, and disruption impacts. Traditional construction contracting practices have dealt with any and all of these risks in previous projects; the experience of the construction industry, the design community and public sector clients is well established. Turnkey, in some instances, has brought about innovative mechanisms for addressing these concerns, which are discussed in the case studies.

**3.2.5. Funding/Financing**

The different mechanisms by which turnkey systems are paid for are important in the overall structure of the turnkey strategy. While turnkey is fundamentally the direct purchase of a transit system by the public sector (or some other owner), some potential exists for private sector involvement in the financial aspects of the project. This ranges from lease financing of rail cars to joint development potential at station sites. Any of these mechanisms which are utilized in the
case studies are noteworthy from the point of view of turnkey as a gray area in the continuum of private sector involvement in the development of rail systems. The role of the private sector in future infrastructure development will be shaped by the experiences of these "state-of-the-art" projects.

3.2.6. Outcomes: Intended versus Unintended

Two of the projects included here have been completed and have entered service (Docklands Light Rail and Manchester Metrolink; see Sections 3.3 and 3.4, respectively). Where appropriate, the discussion will focus on the outcome of the turnkey scheme and issues such as operational quality. In this area it is again important to consider the outcome of the turnkey strategy as separate from the outcome of the system. Time to completion, cost savings, incorporation of private capital and public sector control will be evaluated in a qualitative manner. Ridership and other closely integrated performance measures are more difficult to evaluate on the basis of "turnkey" versus "no turnkey". Other benefits and liabilities will be discussed as appropriate.

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21 The ridership of a new system is a combination of latent demand and "quality-dependent" demand. The outcome of the turnkey strategy might be seen to be this component of quality-induced demand in as much as a well-designed, well-operated system will attract more riders.
3.3. Docklands Light Railway Case Study

The Docklands Light Railway (DLR) was developed as a strategic investment in a real estate redevelopment program. The system had been conceptualized to provide better access to the redevelopment site very near Central London. Procurement for the system had already commenced when the quasi-public London Docklands Development Corporation decided to repackage the project into a single design-build turnkey contract. The decision to use a turnkey procurement strategy was a response to a very firm offer of capital support from the national government and a need to convince private developers of the near-term availability of access to this vast area of prime real estate.

3.3.1. Project Background

General

The eastern end of London includes a historically industrial section known as The Docklands. East of The Tower of London and the well-known Tower Bridge, which spans the River Thames, the Docklands represent the changing character of the London economy. This area originally housed the active warehouses and wharves of the Port of London. With a significant decline in the industrial output of the greater London area in the Twentieth Century (especially in the period after World War Two), this part of town fell into disuse and decay.

This pattern of urban decay is manifested in a great number of Nineteenth Century industrial cities. But in contrast to some of the older industrial cities, London has maintained its important place in the current post-industrial economy and has actively sought to redevelop the potentially valuable waterfront area. In 1980, the City of London recommended the formation of an Enterprise Zone in this East London area, and in 1982, the government formed the London Docklands Development Corporation (LDDC) to forward the development of the area for commercial and residential uses.

Transportation

The Docklands area has been affected by transportation from its earliest development. The wharves of this area served the freight shipping enterprises of England’s maritime past. The area declined with the containerization of freight since the Thames river provided poor access to large
modern container ships. During this time, 100,000 jobs evaporated from the area.\textsuperscript{22} Accessibility to the area was low compared to other parts of London, but the prospects of 2500 hectares of land available for redevelopment was a large draw. The added attraction to the area was the potentially valuable waterfront site and the proximity to Central London.

In the area’s industrial past, rail freight service was very good. The area was left with abandoned rail corridors both within the area and linking it to other mainline rail lines. Unfortunately the transportation network was aligned around the movement of industrial shipments and did not serve the movements of people to and from residential areas of greater London.

Planners and developers were faced with the classic “chicken and egg” problem.\textsuperscript{23} Should commercial development of the area be undertaken first to build a demand for transportation; or should the transportation services come first to reassure developers that access to these sites is acceptable?

The London Underground provides good access to much of London and some sort of tie-in with this system would greatly leverage the access to and within the sprawling site. Tower Gateway to the west and Stratford to the north represented the closest and most likely stations to connect to (see Figure 3.3.1).

**Strategic Plans for The Docklands**

In 1976, the London Docklands Strategic Plan sided with an earlier London Rail Study in favor of building the River Line, a proposed underground rapid rail line which would have been a continuation of the then-under-construction Fleet Line.\textsuperscript{24} The estimated costs for this major work would be high; and at that time, there was less area available for redevelopment in the Docklands because some wharves were still commercially active.


\textsuperscript{23}Willis, “Docklands,” 10

\textsuperscript{24}The Fleet Line is London’s most modern high-capacity rapid transit line. Its development in the mid-1970’s was the major project for London for the decade.
Figure 3.3.1: Map of the Docklands Light Railway and Vicinity
Because of high costs and minimal redevelopment opportunities, the River Line proposal was dropped in favor of a light rail project. This decision was made for several reasons. The Flexibility of light rail technology allowed for the reuse of some of the viaduct and bridge infrastructure on the site. The capital costs -- including track and vehicles -- were low compared to the River Line Extension. And finally, the purpose of the system was to provide circulation and access to a sprawling site as well as connection to the rest of London. In this access role, light rail can provide more intimate access to more area through closely-spaced stops and more frequent service. The need for visible signs of activity to emphasize the LDDC’s commitment to the area also argued for an open air construction site where progress would be visible and palpable.

As part of a much larger investment in the LDDC, the central government pledged a capital support grant for this important access project. This grant amounted to a fixed sum of £77 million (roughly $115 million). From the point of view of the LDDC, the grant meant that this ground-breaking, strategic project could proceed; it also meant that the owner’s primary objective of the system procurement would be to come in under the price cap.

3.3.2. Project Structure

The Docklands Light Rail project was initially structured as a conventional procurement to be bid in two separately contracted parts: electrical and mechanical (E&M) and civil works. At the point at which E&M bids had been tendered and civil bids were about to be solicited, London Regional Transport (LRT) revised the strategy to include both packages in a design-build contract (see Figure 3.3.2 and Table 3.3.1). This shift allowed for more control over the contract price in light of the fixed funding guarantee. Six consortia were invited to bid on the turnkey contract. The bidders were competing to deliver a fully operational, automatic light rail system which met the specified carrying capacity. The alignment was tightly specified along the right-of-way which was already controlled by LDDC and LRT. The bid price was a firm, fixed price for all components of design, construction, and testing.\textsuperscript{25} The contract specified a strict three-year construction period. Service was mandated to begin in July 1987.\textsuperscript{26}


Figure 3.3.2: DLR Contractual Structure

- Government
  - £77 million
  - LDDC
    - London Docklands Development Corp
  - LRT
    - London Regional Transport
  - Docklands Light Railway
    - Turnkey contract (£58.5 million)
    - "Minimum Viable Railway" Turnkey Consortium
      - Electrical & Mechanical
        - GEC
      - Civil
        - John Mowlem & Co
Table 3.3.1: Division of Responsibility, Docklands Light Rail

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<th></th>
<th>DLR Contractor</th>
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After a negotiation period, the winning consortium was announced, with a fine-tuned scope of work to be delivered for the fixed price of £58.5 million. The contract centered on four specifications:

1. Performance Specifications.

   The system would need to meet the given train capacities, minimum headway and overall maximum flow requirements. This specification also dealt with issues of future expandability and design requirements related to refurbished structures and impacts on adjacent sites. The contract employed independent quality certification.

2. Technical Specifications.

   The design and construction would be subject to general standards of workmanship and quality of material. The level of detail was greater in the specifications for trackwork and electrical and mechanical aspects.


   These drawings acted as the specifications for vertical and horizontal alignment of the system. This alignment was very tightly specified, and no deviation was allowed. The plan also delineated construction staging areas as allowed by ownership of land and future plans.
4. Design Concept Drawings.

The drawings approached the level of detail of conventional plans for a typical construction bid contract. But the intent of this bid document was to convey structural form, layout and alignment. The specific details were left to the contractor to work out.

Finally, the contract specified a contract length of 32 months from signing the contract to the transfer of the operational system. In case of late delivery, liquidated damages were set at £155,000 (about $230,000) per week. This stiff penalty enforced the fixed contract period.

3.3.3. Competition

Initially, consultants for LRT drew together a set of plans and specifications for the mechanical aspects of the project. Bids had been solicited and returned in a conventional manner, and the consultant team was busy preparing the civil construction bid package. This was to be put out for bid as well in the traditional matter.

In light of the two conditions of approval given to the project (fixed delivery date and fixed funding agreement), LRT reconsidered the contract strategy. The decision was made to combine the E&M and civil contracts into a single turnkey contract to control the time and cost constraints in a more effective manner. The pre-qualified bidders who were planning to bid on the separate contracts then paired together to tender fixed-price, lump sum bids. The turnkey contract retained most of the specifications developed in the preliminary engineering work. The specificity of the contract was firm in the area of a fixed alignment and set performance criteria.

Six consortiums were interested in the project, and only six weeks after the change in contracting strategy, the proposals were due. In eight weeks of negotiation, the scope of the project was narrowed, and the winning team emerged with a fixed-price contract to provide a “minimum viable railway” for the constrained price and schedule.

The winner was a partnership between GEC Transportation Projects, ltd., and John Mowlem & Company, plc. This team was split exactly along the lines of the original dual contract structure that was abandoned in favor of the turnkey approach, but the negotiations of project responsibilities and details could be worked out directly between the team members rather than through a third party owner (a system which experience has shown to be more costly in delays).
**Scope And Scale of Competition**

Pre-selection of bidders is one common constraint to the scale of competition. In this case, the pre-selection process was part of the original traditional contracting process, so this aspect of competition was unaffected by the decision to restructure the competition as a turnkey process. After the restructuring, the teams that formed to submit turnkey proposals were based on the same prequalified contractors who had previously submitted E&M bids.

The final number of turnkey bidders was the same as the original qualified E&M bidders, so the pairing of electrical contractors with civil contractors did not reduce the scale of competition for the systems. But the limitation of the number of civil contractors does represent a reduction in the raw number of bids received for the construction work (the number of civil contractors qualified for such work is surely higher than the ultimate number of 6 bids). In another sense, one can consider the formation of joint ventures between the qualified E&M contractors and construction contractors as a sort of competition itself. From the systems contractor perspective, high value contractors (reputable, reasonably priced and high quality) will be the most attractive partners with whom to enter into joint ventures.

**Minimum Viable Railway**

This concept of "minimum viable railway" is certainly unique and well suited to the considerations of this project. Since this was to be a speculative transit system to serve a redeveloped industrial site, the owner was interested in capping the initial public investment as well as in serving as much of the large site as possible. The evaluation criteria of "minimum viable railway" meant that the bidder who could reach deepest into the site with the given budget won. Viability was included in the competition as an assurance that the system would tie into the London Underground at Tower Gateway Station to the east and Stratford Station to the north with a center core at the Canary Wharf site in the middle of the Isle of Dogs. Another goal of the minimum railway was to reach the southern tip of the Isle of Dogs where a pedestrian tunnel runs under the Thames to Greenwich on the southern banks of the river.

**Preservation of Options**

In this project, the late decision to use a turnkey method meant that the proposal documents had been very well developed. The owner's participation in right-of-way control meant that the

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27 Canary Wharf is the centerpiece of the LDDC redevelopment plan. It is a £3 billion commercial office complex with 10 million square feet of space and an estimated 40,000 jobs.
alignment was very well defined, and this alignment in fact included a large portion of active and inactive rail lines. So when the turnkey bids were solicited, the system was very well described in terms of technology (through performance characteristics) and physical design (alignment). The owner had decided what was needed as a strategic investment in access to the site and was seeking the lowest cost provider of this system. The bidders had flexibility in delivering this system but very little flexibility in the alignment and performance of the system.

3.3.4. Risk

The risk issues which can potentially ensnarl turnkey projects were not prominent in this project. This is both a reason and result of the decision to use a turnkey scheme. The overall Docklands project (of which DLR was a component) provided an institutional and physical setting which offered very controlled circumstances.

Market/Ridership Risk

The redevelopment project needed a means of access before any developer would build in the Docklands. So the understanding from the start was that DLR would serve a speculative market. The LDDC and LRT knew that no private group would assume that risk.

Alignment/Construction Risk

The site was undeveloped and controlled by the LDDC at the point when the contractor began work, so the alignment/construction risks were minimal compared to the siting and construction of a transitway in an existing commercial district. The use of existing railway structures (inherited from the industrial heyday of the Docklands) reduced the risks further. As discussed above, this contribution of right-of-way and some of the required structures represents a major involvement of the owner in a manner which narrows the scope of the turnkey contractor's flexibility but also solidifies the project in the mind of potential bidders. The allocation of these risks to the contractor is possible but can introduce large contingencies when bids are tendered. The special circumstances of the open Docklands redevelopment site and predetermined alignment made the DLR competition a minimal-risk construction job from the perspective of bidders.
3.3.5. Funding/Financing

The overall Docklands redevelopment plan was conceived originally as a Public-Private deal whereby the quasi-private LDDC would facilitate and reinforce the private development of mixed-use real estate. So the funding of the transit project by capital grant from the government was consistent with the concept of spurring development (the post-completion impact of the rail system on development is discussed in the next section). The firm fixed capital grant certainly had the effect of focusing the design and provision of the system on a workable, utilitarian system to prove LDDC's commitment to the redevelopment scheme.

The £77 million capital grant came in equal parts from the Department of the Environment and the Department of Transport. The final bid price for the turnkey contract was £58.4 million. This was spent roughly one-third on rolling stock and electrical systems and two thirds on civil construction (see Table 3.3.2).

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<tr>
<th>Item</th>
<th>Amount (£)</th>
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<tr>
<td>Turnkey contract</td>
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<td>81</td>
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<tr>
<td>Management</td>
<td>7.7</td>
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<td>Land acquisition</td>
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<td>Contingency</td>
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<td><strong>TOTAL</strong></td>
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The rail system has had a big impact on development in the area. This success has impacted the financing of several extension, boosting demand to the point that capacity constraints have warranted these expansions (as well as increasing fare revenues). Capital costs have also been defrayed with developers committing to financial assistance for the subsequent phases.

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28Gonsalves and Deacon, "General Contract and Design Principles," 605.
3.3.6. Outcomes: Intended and Unintended

DLR entered revenue service on the date originally specified and with no cost overrun. This is perhaps the most significant impact of the decision to employ a turnkey scheme.

Apart from the turnkey delivery, the existence of the line itself had much the intended impact on the development of the Docklands. As the structures of the railway began to take shape, construction of commercial space exploded along the alignment. Commercial development project boards sprouted with the sales pitch "Close to the light railway."29 Completed at about the same time as the railway was an eleven-story office block for the high-profile tenant The Daily Telegraph. In about two and a half years, land prices on the Isle of Dogs went from negative (the cost of demolishing the existing building exceeded the land value) to nearly £1 million per acre.30 Ridership vastly exceeded opening year projections of 20,000 daily passengers. August 9, 1988 (a typical midweek day) saw 28,300 passengers.31

Even before the initial section opened, planning was undertaken for extensions and capacity enhancement projects.32 In the summer of 1986, the contractor (GEC-Mowlem) negotiated an additional £50 million which included the provisions for double-unit cars, shorter headways and the signaling capacity for an extension westward to Bank Station.33 The developer of the Canary Wharf project also negotiated a revised layout for the stop to bear this name. The prospect of 40,000 high-profile jobs at this site called for the expanded capacity of a three track station and higher quality finish materials. This developer contributed £57 million to these improvements.

29Willis, "Docklands," 16.


33Gonsalves and Deacon, "General Contract and Design Principles," 615.
The fate of this system and its expansions is mostly a result of the huge potential of the site of the Docklands. The turnkey contract did allow for rapid commitment of construction money and rapid commencement of construction. This undoubtedly convinced real estate developers of the LDDC’s commitment to the redevelopment master plan. As a fast track project, DLR jump-started the entire area.

One fortuitous outcome of the accelerated project delivery was the timing of the start of construction. If the rail system had been scheduled for a longer delivery period, with construction commencing later in the process, the invigorated commercial development might have been delayed to a later period (to phase into occupancy at the same time as the system is entering service, say in 1990 or beyond). Hindsight shows that the downturn in real estate development which occurred just at the beginning of the 1990s might have meant the collapse of grandiose redevelopment schemes (as this downturn caused in this area and others) even despite the increased access to the potential site. Furthermore, the fevered activity of building a rail system in such a short period could well have contributed to the development frenzy in this period of speculation fueled by commercial credit.
3.4. Manchester Metrolink Case Study

The Manchester Metrolink project was successful in rebuilding two commuter rail lines for modern light rail operations. These spatially disconnected radial lines were joined by the construction of a city-center, street-running section of light rail track. The structure of this project was a full concession agreement with the private sector taking the ridership risk. This contract was a 15 year concession including design, construction, and operations and maintenance. Ownership of the facility remained with the public sector.

The existing commuter rail lines provided a proven market demand for the services, and the new connectivity with the city center and across the metropolitan area added to Metrolink’s ridership potential. After opening in 1992, ridership has grown to a level above that which was predicted, and the system is currently undergoing expansion negotiations.

3.4.1. Project Background

General

Manchester is a large industrial city northwest of London at the northern end of England’s north-south economic spine. The metropolitan area has a population estimated at 2.6 million, and the area has retained a good deal of its heavy industry base (as compared with other parts of the United Kingdom).

Located at a good location to serve as a hub for England’s textile industry, the region gained importance when the Manchester Ship Channel was opened (1821) to allow merchant ship access from the Irish Sea to the wharves of Manchester. The age of railroads followed soon after, and Manchester, established already as a distribution node, became a major terminal for freight and passenger movement in the north of England.

Transportation

Owing to the history of freight railways, the region’s populace is served by a very extensive commuter rail network (see Figure 3.4.1). This service, along with city buses, has been the primary form of public transportation in the metropolitan area. The region never developed a rapid transit network like London.
The commuter rail provided very good radial service to the center of the city, but the network had one major flaw which hampered the provision of service: lines from the north terminated at Victoria Station and lines from the south of the city terminated at Piccadilly Station. There was no rail link between the two stations, and thus the network could not serve any suburb-to-suburb or downtown trip demand. Originally, the radial lines were developed by separate commercial entities which had no incentive to integrate system planning. Since urban form has evolved to the point where totally centralized employment is a historical footnote, public transport must now try to serve dispersed origins and dispersed destinations. In the case of Manchester, the glaring constraint to this type of service was the physical discontinuity between the north and south networks. Metrolink was envisioned to serve as the missing link in the network.

**System Planning**

Metrolink traces its direct origins back to the 1968 Transport Act which restructured public transportation planning in Manchester and other UK cities.\(^{34}\) The provision of public transportation became a regional function carried out by the Public Transport Authority (PTA) and the Greater Manchester Public Transport Executive (GMPTE, or PTE). These agencies were integrated across the metropolitan area as well as across modes, making for a more unified public transportation planning framework. The Transportation Act also included capital grants from the central government for public transportation projects.

In 1972, the PTA took the long-standing idea of a central area north-south rail link and studied the many possible options. The goal of the analysis was to identify the best scheme for utilizing the existing commuter rail network to address current and future public transportation needs. This study considered the following options for individual lines in the network:

1. closure
2. conversion to busway
3. modernization as conventional railway
4. connection of railway lines in a central area tunnel
5. conversion to light rail with street-running section through city center
6. conversion to light rail with central area tunnel

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In a preliminary cost-benefit study, the full range of options were evaluated. Closure was deemed unacceptable and conversion to busway had the same capital costs as light rail but more expensive operating costs. Both tunnel options had high construction costs which outweighed benefits. The two remaining options were modernizing the existing system and converting lines to light rail with a street-running connection through the central city.

**Project Planning**

The PTE made a policy decision to seek the light rail conversion option. The next task was to decide which lines to upgrade in the initial phase of the project. Candidate lines included Bury, Altrincham, Rochdale, Glossop and Hadfield, Marple and Rose Hill, and Didsbury. British Rail service existed on all of these lines except Didsbury which was previously a British Rail corridor running out of Central Station. Service stopped on this line when Central Station was demolished to make room for Manchester’s new Convention Center. The Bury Line to the north and the Altrincham line to the southwest were ultimately chosen for the project.

These lines were chosen for multiple reasons:

1. Commuter train service on the Altrincham Line had previously been an obstacle to inter-city trains using the Trans-Pennine corridor (east toward Leeds and York).
2. Altrincham was already electrified to an appropriate voltage. This would reduce capital costs.
3. Both lines were in need of capital investment for new rolling stock.
4. Bury Line had a non-standard electric power system which needed replacing.
5. These two lines had the highest passenger flows of any of the candidate lines. Selection of these lines had the greatest potential for financial justification of the new central surface link.

By 1983, the project began to take shape, and the PTE took the lead in coordinating a number of project planning activities. These included planning the route through the city center (in conjunction with the Manchester city engineer), obtaining parliamentary powers,\(^{35}\) and evaluating the plan against its alternatives. This final evaluation step was required to obtain a capital grant from the central government (the Department of Transport or DTp). The final cost-benefit analysis arrived at a figure of £1.44 in benefits per £1.00 of cost.\(^{36}\)

\(^{35}\)This is a formal requirement which gives chartered railways the power of eminent domain and allows for the transfer of British Rail right-of-ways.

\(^{36}\)Tyson, “Planning and Financing,” 148.
This project was being developed at the same time that bus services throughout the UK were being deregulated. The climate of the national political environment was one of emphasis on private sector development and operation. Indeed, the final approval for a central government grant was subject to the participation of private-sector capital in the project.37

The PTE brainstormed with private merchant banks to generate ideas for private sector participation and the five most likely ideas were investigated:

1. rolling stock ownership and operation
2. complete system ownership and operation
3. rolling stock ownership and operation plus infrastructure maintenance
4. public-sector construction; system sold on completion
5. public-sector construction; system franchised on completion

The PTE decided that the most suitable option would be for private interests to own and operate the rolling stock. To the Department of Transport, who sought more transfer of risk to the private sector, this was not aggressive enough. Their final decision was to pursue a complete concession (option 2, above) even if the initial capital grant would have to be larger. The central government was responsible for the capital assistance, so the plan for complete concession moved forward.

3.4.2. Project Structure

The complete concession structure of Metrolink meant that a single contract would be signed for design, construction, operations and maintenance (DBOM) of the system for an established time period. Ownership of the assets remained with the PTE, but the private sector took control of a wide range of risks in this project (see Figure 3.4.2 and Table 3.4.1).

The performance criteria defined in the contract included service standards which would be enforced through penalties. Design criteria, which were influenced by operating concerns, included a requirement for vehicles capable of negotiating 25 meter curves and gradients of 6.5 percent as well as wheelchair accessibility.

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The modernization of the existing rail lines and stations was mostly straight-forward. The corridor and station sites existed, but both needed up-grading and renovation for accessible light rail vehicles. The four kilometers of track right-of-way and five new stations to be built through the city center represented a potential concern. PTE and the city's planning committee retained the rights to review station details, overhead line equipment and power supply in the central core. Noise performance specifications were also introduced for both construction and operations.
Table 3.4.1: Division of Responsibility, Manchester Metrolink

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Expansion Considerations
Since this project is envisioned as the first phase of a wider metropolitan system, consideration was given to the implication of future expansion on the concessionaire and the PTE. Expansion is allowed at any time during the contract period, and if expansion is possible in the first three years of operations, then PTE will negotiate with the incumbent concessionaire for the design/build and operations of this expansion.

3.4.3. Competition

Competition for the Metrolink concession was based on two volumes of "reference specifications" which were developed as one possible solution to PTE's requirements. Bidders were given the option to present their own solutions which could be refined and clarified through a two-stage bidding process. Initial ideas would be presented by the bidders followed by a negotiation and clarification period, after which the teams would present a final proposal which conformed more to the intent of the PTE.

The handling of the accessibility requirements illustrates the flexibility of this two-stage competition. The reference specifications depicted a short-length, high platform to be used in the inner-city section. The final design was developed as a "profiled platform" which included a ramp up to a mid-height platform which allowed level access to the middle two doors of the vehicle. This scheme represented a compromise between platform placement along the new
street-running section downtown and platform modification at the existing commuter train stops undergoing renovation. This idea reduced the impact of a high platform structure in the urban area. The competition process allowed the car maker to suggest a functional alternative to the initial design concept.

The PTE invited eight bids from DBOM consortia. Five teams made preliminary bids, and finally, three bids were submitted in the second round. The final evaluation criteria was the amount of the capital grant requested from the government. In formulating this final capital subsidy amount, bidders had to consider the capital costs: supplying cars and signal systems; upgrading the rail lines; and building the central city link and the maintenance facility. From this amount was subtracted the value of operating the line for 15 years. The bidders even had the chance to suggest other time frames for operations and maintenance.38 The winner was a consortium of GEC-Alstom, Mowlem, AMEC. The initial consortium which won the contract (GMA) did not include an operator. Very shortly after the contract was signed, the operating component was brought on board (Greater Manchester Buses, Ltd.), but the terms of the operational component were committed. The group formed a company named Greater Manchester Metro Limited (GMML; see Figure 3.4.2). Financial information such as the final bid and concession payment is commercially confidential.39 Jointly, the capital contribution of central government and the Manchester regional government has amounted to approximately £134 million, with total capital costs in effect being reduced by the value of the 15 year operations concession with the turnkey consortium.40

Preservation of Options

The PTE had developed this project to a reasonable level of specificity in terms of operational service plan and alignment. The public sector had spent more than a decade in planning this project. As discussed above, many factors went into the study of many options for modernized public transportation in Manchester, and thus the Metrolink Phase One scheme was

38Hall, “Manchester LRT,” 82.

39Tyson, “Planning and Financing,” 149.

a case of the PTE knowing what it wanted and turning to the private sector to provide the details of the design and operational efficiency. The use of performance criteria in the contract coupled with a determined alignment solidified the project and therefore facilitated bidding (but it also precluded a wide open competition of alternative technologies or route plans).

Within the constraints of performance criteria and preordained alignment, the PTE allowed a significant amount of design innovation on the part of bidders. The use of reference specifications as a possible solution to design requirements (and not as the final word on what must be constructed) represents one of the flexible mechanisms by which construction and operational concerns can inform the design in a turnkey scheme.

3.4.4. Risk

The stated goal of the Department of Transport was a greater involvement of private sector capital in the provision of transport services. This included a willingness on the part of the central government agency to provide a larger grant for capital assistance in lieu of continuing operational support. This trade-off was fundamental in establishing the complete concession structure of the contract. The private sector developer was encouraged to take a greater share of risks in this scheme.

Market/Ridership Risk

Revenue risk is one of the risks included in the Metrolink franchise contract. The nature of the project and the terms of the contract made this possible. The ideological commitment of the central government also made this necessary.

As a conversion of existing commuter rail services, the ridership on the two radial rail lines was well established with a good base of ridership data from decades of operation. The extended evaluation which formulated this light rail system as the best option was based on regional transport models which provided a forecast of ridership on the center city link and on "cross-link" ridership. The market for this project was as well-defined as any public transportation project could hope to be. And since the competition for the contract consisted of a single lump-sum capital grant in lieu of operating assistance, the market risk went straight to the operating entity. This group kept any and all fare monies, whether above or below the operating, maintenance and project debt costs.
The contractor was also free to set fares. This share of authority helped to make the GMML willing to take the risk. This group is free to optimize revenue and costs to maximize profits (within the minimum service guidelines as spelled out in the contract).

Alignment/Construction Risk

Construction risks were minimal in this project in the existing rail corridors. The real exposure to these risks came in the construction of the new surface link through downtown. By sharing the construction risk, PTE and GMML proceeded through this phase of the project at a fast pace. For one thing, the alignment was specified in the contract, and the PTE had secured parliamentary powers to condemn any land needed for the system. Also, PTE had separated the utility realignment portion of the work as a preliminary contract, which was completed before the track work began in earnest in the downtown area.

This advance work simplified the construction process since utility subcontractors did not have to coordinate construction schedules closely with the design/build team. On the negative side, the impacts of construction on the downtown area were multiplied since utility relocation work first tore up the street and later, street track construction disrupted the same area.

This project had quite a few issues of design coordination which were sorted through at a fast pace. The PTE, as owner, maintained a design review function, but the hectic pace of the design/build approval process did not, in the opinion of one PTE manager, allow enough time for a sufficient review of detail. The process involved liaison with many other critical parties such as British Rail, the city traffic engineer and the city planning committee (in respect to relevant issues like construction disruption and aesthetic impact of the design on the existing urban area).

In upgrading the Bury Line to the North of Victoria Station, GMML engineers determined that three bridges were in need of work. The original information provided to bidders included a description of existing conditions, but bidders were warned that they would be responsible for any conditions which were deficient but undocumented in the preliminary inspection. Also, four

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41 Hall, "Manchester LRT," 87.
kilometers of track which was transferred to the project from British Rail needed to be renewed after two decades of reduced maintenance. This work was discovered after the contract was executed, and the result was a three month delay in commencement of operations (from November 1991 to February 1992).\textsuperscript{42}

3.4.5. Funding/Financing

The previous discussion has detailed the influence of the DTp capital grant on the structure of the project and the contract. This grant amounted to 50\% of the estimated £134 million given to GMML for the construction. In lieu of capital investment in the system, the concessionaire has a 15 year concession contract with an annual payment as agreed to in the contract competition.

In theory, the two sections of the contract might be separated, but the joining of design/build and the operations and maintenance contract has had a positive impact on capital and operating costs. The GMML, as operator, was concerned with minimizing the potentially time-consuming ticketing processes. In some systems that involve many ticket levels and gradations, this process is slow and expensive in labor terms. As a result, the fare system was designed to be straightforward, and tickets are sold through a ticket vending machine (stations are unstaffed). As a barrier-free system, stations were designed more simply and openly.\textsuperscript{43} This system design resulted in lower capital costs and consequently lower operating costs. The simple ticketing policy was originally conceived of as a marketing tool to make the system easier to use in conjunction with other public transport operators (private bus operators).\textsuperscript{44}


\textsuperscript{43} In a barrier-free system, patrons are responsible for having proof-of-payment with them while aboard the train. A conductor may at any point demand the ticket, and those without one face a sizable fine, payable on the spot. In a barrier system, patrons pay and enter the system through a turnstile or some other gateway.

\textsuperscript{44} Eric A. Black, "Unique Funding Formula Pioneers Britain's Light Rail Rebirth," \textit{Railway Gazette International}, November 1991, 762.
While the financial details of the final contract are not publicly available, the preliminary estimates of capital subsidy were lower than the total capital costs of renovation and construction. This indicates that the second portion of the concession fees (the right to operate the system for 15 years) was a net positive value. Presumably, the market risk was rather minimal given the established ridership on the pre-existing lines and the potential ridership of the two new services; city-center circulation and "cross-town" transfers.

3.4.6. Outcomes: Intended Versus Unintended

From the point of view of turnkey procurement structure, the Manchester Metrolink has been a success. The private sector has, in effect, contributed to the capital cost of the new system. Ridership risk has been transferred to the private operator, thus providing the incentive to operate efficiently and attract ridership through effective marketing and an innovative fare structure. The schedule for system delivery was a mere three months late, with service commencing in February of 1992.

In considering the outcome of the initial contract and construction phase, problems did arise as in any major capital project involving construction within a built-up area. PTE, as the owner, provided valuable interface with city officials and other third parties, and it was a testament to the consensus opinion of the necessity of this project that the details ran as smoothly as they did.45

A two-year schedule for the entire refurbishment and construction was very aggressive and only allowed for a short period of commissioning and test running. The leaders of the GMML concluded that this important step needed more time, especially in the case of a new technology like street-running light rail which has the potential for serious disruption of the city's transportation grid in the case of an accident.46

45Hall, "Manchester LRT," 88.
46Black, "Funding Formula," 762.
Operational Outcome

Since becoming operational in 1992, ridership has grown to 14.5 million passengers per year. This compares to the previous ridership of 7.6 million in 1987 on the heavy rail British Rail service provided in these radial corridors.\(^{47}\) Operations have been characterized as highly reliable with outstanding safety and accessibility. Indeed, the accessibility has been attributed with inducing ridership of not only wheelchair patrons but also parents with baby carriages. Off-peak frequency had to be increased to accommodate this unexpected category of ridership. In the first year of operations, 99 percent of scheduled vehicle-kilometers were completed and 96% of trips departed within 2 minutes of scheduled time. No performance penalties have been assessed against the GMML.

Financial Outcome

Previously, the British Rail service required an operating subsidy of £3 million. In contrast, the first year of Metrolink operation saw an operating profit of £1 million which rose to £3 million in 1994 (on gross receipts of £12 million).

Expansions

No extensions or further conversion of heavy rail trackage has occurred since the development of Phase 1. This is true despite the vision of an extensive network of rail line conversions to take place. By now, the contract clause detailing exclusive negotiation with the incumbent franchisee has expired (the first 3 years of the contract), and the construction of any expansion could be contracted through another mechanism of competition.

3.5. **Kuala Lumpur STAR Light Rail System**

The Sistem Transit Aliran Ringan (STAR) light rail system is a joint venture between European engineers and system suppliers and Malaysian investors. This team is developing the first two phases of an ambitious light rail network plan first considered in the early 1980's. The initial work is structured as a BOT concession for a period of 60 years. STAR, the owner/operator, has signed a split-turnkey construction and system supply contract with the European firms which are equity investors in the project. Development is "on track" to commence operations of Phase I in July 1996.

3.5.1. **Project Background**

**General**

Kuala Lumpur, located on the west coast of the Malay peninsula, is the capital of the Republic of Malaysia. One of the fastest growing economies in the world, this Southeast Asian country has recently emerged from the shadow cast by Singapore, which in many ways, led the economic emergence of this whole region. England gained control of multiple protectorates in this region in 1867. In 1963, Peninsular Malaysia (including Singapore, also a British territory) was joined with other British territories on the island of Borneo to form the Republic of Malaysia.\(^{48}\) From the beginning, a rich resource base in natural resources like tin, rubber, forest products and petroleum has given this country the base of an industrialized economy. Now, the growth of Malaysian industry is well known in important sectors like steel and electronics. The country enjoys a high standard of living in comparison to other Southeast Asian countries. The capital city is home to 1.8 million people out of a total population of 18.4 million.\(^{49}\)

Kuala Lumpur started as a tin mining town in the middle of the last century. Located at the confluence of the Klang and Gomback rivers, this trading post grew as the tin trade prospered. Since becoming the national capital, Kuala Lumpur has solidified its position as the political, commercial and social center of Malaysia. The commercial success of the entire country is reflected in the dramatic development taking place in Kuala Lumpur: two office towers being

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\(^{48}\)Just after this liberation, Singapore split from the rest of Malaysia and became a separate state due to concern over the influence exerted by Singapore's Chinese majority.


79
built by the national petroleum company have recently captured the title of the world’s tallest building, and this is only the most visible sign of a rapidly expanding economy.

**Transportation**

Another sign of the rapid growth rate is the increasing congestion on the region’s roadways. Many commentators make the comparison between the development of Kuala Lumpur and that of Bangkok a decade ago.\(^{50}\) Population growth in the country is a hefty 2.4 percent annually, and the growth of the capital region is significantly greater due to the rural-urban migration pattern which brings job seekers to this economic center. The population of Kuala Lumpur is on pace to double every twenty years.\(^{51}\) Per capita incomes are also increasing. More importantly for congestion, the population of automobiles is expected to increase over four and a half times to 578 thousand cars in 2000 (from a base of 125 thousand in 1980). Traffic conditions are characterized as less severe as Bangkok, but the growth trend points to a future which looks very much like the gridlock of this other capital city in Southeast Asia.

**Strategic Transport Plans**

Predictions of congestion have been dire for the past few decades. The Malaysian government has periodically undertaken transport studies to address these conditions. Studies dating back to 1974 have focused on improving road networks and road-based public transportation options (buses). But a 1981 study first considered rail transit as a part of this strategy.

The state railroad company, Keretapi Tanah Melayu (KTM), holds an extensive network of rail lines along the Malay Peninsula and within the Kuala Lumpur metropolitan region. The lines within the city are the industrial legacy of Kuala Lumpur’s tin mining past, and were identified as an outstanding resource for the development of a transit network. The public transport study of 1981 examined the option of converting some of these rail lines for transit use and recommended the development of five transit corridors (see Figure 3.5.1).

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Figure 3.5.1: Map of Recommended Transit Corridors in Kuala Lumpur
Following this study, two attempts failed at developing an initial rail system. In 1984, Belgian/French contractors came close to winning a contract to build an elevated rail line. Again in 1987, an Australian consortium was awarded a contract, but the project collapsed soon after.\textsuperscript{52} The present STAR project was initiated in 1990 when Taylor Woodrow International (TWI) and AEG formed a consortium to study the construction of a city center-to-Ampang light rail line. This link connecting the commercial downtown center and eastern suburb was one of the five lines recommended for rapid transit development back in 1981. This alignment was a good candidate to be the initial segment because it hit major commercial centers downtown as well as dense suburban areas east of town.

At the same time as this private sector group was considering the rail transit system, the Malaysian government was developing a strategic regional plan to address transport issues into the next century. This plan, a product of KTM and Delcan Consultants, stressed the need to keep congestion from becoming a drag on economic growth. One primary instigator of this effort was the selection of Kuala Lumpur to host the Commonwealth Games in 1998. This major international sporting event will focus the world's attention on this newly developed country and will put additional stress on an already over-capacity system. Another strategic underpinning for the study includes the 1998 opening of Sepang Airport which is under construction 40 km south of Kuala Lumpur. This $3.5 billion project is slated to be the largest airport in Southeast Asia and will be a major asset to the Malaysian economy, provided that there is adequate access to the facility and that the entire regional transport network is not clogged with congestion.

The KTM/Delcan study focused on the need to integrate public transport services in the region. At the time, the STAR system had not been proposed. Rail transit existed as a conceptual plan to build a rail system along disused rail corridors. Bus service was a loosely regulated enterprise provided by 8 major private operators in addition to 200 minibus companies. As a result of the study, the private bus operators agreed to form an association to better integrate service with a new rail system, including route structure and fare payment systems. The study envisioned an integrated system with fares and schedules coordinated between modes. This would be possible with a "smart card" fare system. The traveler could prepay the fare and use the stored value smart card on both bus and rail. The goal of the integration was to achieve "door-to-door" service between the central city and the major suburbs.\textsuperscript{53}


\textsuperscript{53} Tsuruoka, "Transit Plan," 68.
3.5.2. Project Structure

The project began to take its final shape in April of 1991 when the TWI/AEG study team presented the government with a proposal for a phased BOT rail system. The entire system, to be composed of six phases, was estimated at M$6 billion (US$ 2.4 billion). The first phase would run from the city center of Kuala Lumpur to Ampang, a length of approximately 12 kilometers. Part of this alignment (9.5 km) is at-grade along one of the old freight rail right-of-way from Ampang to Pudu Raya. The other 2.5 km section is elevated through the central business district (see Figure 3.5.2).

In the quest to win the concession contract, TWI/AEG, in conjunction with other local parties, set up an operating venture called Sistem Transit Aliran Ringan (STAR) in September of 1991, and was awarded the concession contract in December of 1992. The concession agreement enables Phase I to be built and operated by STAR for a period of 60 years. Under the concession agreement, STAR is responsible for all aspects of the system development, including the arrangements for financing (see Table 3.5.1).

Table 3.5.1: Division of Responsibility, Kuala Lumpur STAR Light Rail

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<thead>
<tr>
<th></th>
<th>STAR</th>
<th>GOVERNMENT</th>
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<td>Maintenance</td>
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<td></td>
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<tr>
<td>Operations</td>
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</tbody>
</table>

STAR signed a turnkey contract with a joint venture of Taylor Woodrow International and AEG. This joint venture, called Kuala Lumpur Transit Group (KLTG) holds supply contracts with TWI for construction (US$185 million) and with AEG for cars and systems (US$220
Figure 3.5.2: STAR System Alignment, Phase 1
million). Figure 3.5.3 depicts the structure of this concession/turnkey arrangement. The turnkey contracts are denominated in hard currency -- this exchange risk impediment was overcome by the central bank which hedged the foreign exchange exposure for 34 months, the duration of the construction period.\textsuperscript{54}

\textbf{Figure 3.5.3: STAR Contractual Structure}

This project is breaking new financial ground in that the financing is based on non-recourse debt without a government revenue guarantee. The government is, however, participating in other ways. Primarily, the use of the land is provided to the project at far below the market rate.

Furthermore, the project is exempt from import duties as well as local sales tax, and capital
investors are given generous investment tax allowances. One analyst estimates that the project
will not pay any taxes for the first 15 years.\textsuperscript{55}

The system itself will consist of articulated light rail vehicles operating in pairs along a
grade-separated right-of-way. Thirteen stations will be built along the alignment with nine of
them being at grade in the suburban section and four of them being elevated in the central city
section. The cars and the stations will have a high-floor vehicle/high platform configuration
which makes for better accessibility and quicker passenger loading. The vehicles, while
technically a light rail system, will never operate at street level or encounter cross traffic. The
power will be supplied by a third rail to minimize the visual impact of the aerial viaduct through
downtown (this is possible since the system is completely grade separated). Initially, 17 two-car
vehicles will give a peak hour capacity of 15,000 passengers per hour with a three-minute
headway. The design capacity was formulated to meet demand up to the year 2000.\textsuperscript{56} Future
demand could be met by investment in more vehicles and a middle section addition in the
existing cars (the stations are being constructed to accommodate these longer vehicles). With
such an investment, capacity would increase to 35,000 passengers per hour.\textsuperscript{57}

Without the revenue backing of the government, fares are going to be higher than the
regulated bus fares (which bus operators claim are too low to support capital reinvestment, i.e.,
new buses). The government is warning the public about the higher fares: Prime Minister Datuk
Seri Mahathir Mohamed said, "The public must be prepared to pay more for better transport
facilities such as the LRT." \textsuperscript{58}

Construction of the first phase began in late 1993. Operations are slated to begin in July of
1996. But even before operations begin, work will commence on Phase II, a branch extension
from Chan Sow Lin to the site of the Commonwealth Stadium under construction for the 1998
games. The Phase II concession was signed in August of 1995, much in anticipation of having
this link ready for the Games. A Kuala Lumpur hamstrung by roadway congestion would be a


\textsuperscript{56}"A Star is Born", 46.


\textsuperscript{58}Tsuruoka, "Plan Secures Finance," 54.
disastrous image to project to the world during this opportunity for global exposure. A third phase is possible, extending to Bukit Jalil, but this is well down the priority list given the 1998 deadline for Phases I and II.

3.5.3. Competition

The competitive aspects of this project were minimal. TWI/AEG delivered a proposal for a phased delivery of a light rail system, and the government agreed to grant this group a 60 year concession to build, own and operate the system. The government subsidized the development with land grants, tax abatements, soft loan money and an equity investment in the operating company.

This project grew directly from the 1981 transport investment study which recommended a rail system for the old freight corridors which criss-cross Kuala Lumpur and its burgeoning suburbs. Other proposals had been offered in the 1980’s, but nothing materialized from these.

In some sense, the process of sequential proposals submitted by different consortia through the 80’s and early 90’s represents a serial competition. However, this is a very tenuous argument. In reality, this project was delivered in a non-competitive environment. As such, the proposers were responding to a well-established strategic plan for public transportation in the Kuala Lumpur region (as defined in the 1981 plan). The government had a strong interest in having this system developed in time to meet the challenge of hosting the Commonwealth Games, and the phased development of a light rail system as proposed by STAR was attractive from this perspective as well as generally, given the congestion increases in the area.

3.5.4. Risk

The Star transit project is a rarity because it is a BOT project financed through non-recourse debt. Moreover, the financing is from local banks. It is rare to find any sort of infrastructure project in the region not secured by revenue guarantees. And the use of local currency, facilitated by the currency exchange risk as assumed by the central bank, is different and very appropriate, given the local currency revenue stream and the long-term nature of the concession. As discussed above, the government is intimately involved in the structure of the deal but not in the often-assumed role of bearer of ridership risk.
Market/Ridership Risk

With the healthy state of the Malaysian economy and the long-term outlook of sustained economic growth, one could argue that the ridership risk is not so great in this project. It is certainly true that population in Kuala Lumpur will increase in the foreseeable future and that incomes will rise, and with that the mobility of the Malaysian people. In the absence of a major road-building push, congestion will only get worse, and the light rail system will be in place to capture future growth in trip demand. Over the 60 year franchise period, conditions look good for a very significant return on equity.

Still, the assumption of market risk is an important step in the development of infrastructure in this newly emerged economy. The capital markets are full of money (the Employees Provident Fund, the largest public pension fund in Malaysia, contains M$62.8 billion alone), and investors are looking for long-term investment opportunities. Infrastructure as long been established as an important long-term strategic investment in rapidly growing economies. In this light, the market risk in this project has easily been swallowed by the investment community.

Malaysians look immediately north at Bangkok as an example of a city whose continued growth is impaired by congestion (with no good alternative like the STAR rail system). The government refused to secure this project with revenue guarantees, but it did facilitate its development by giving the operating group the authority to charge economically competitive fares and by giving the group in-kind financial consideration.

Alignment/Construction Risk

The legal structure of the concession agreement has forwarded the construction risk to the turnkey contractors (KLTG). Since the turnkey contract is subsequently split along civil/systems lines, the alignment/construction risks fall to TWI, the civil construction party of the KLTG turnkey joint venture, while the system procurement and integration risks rest with AEG. Both of these parties are also equity partners in STAR; the long-term risks of 60 years of operation and physical maintenance rest with STAR as the concessionaire.

The construction phase of this project is dealing with some significant risks. Namely, the geologic conditions of the at-grade section have the potential to affect operations through uneven
settling. While the property has served as a rail right-of-way in the immediate past, the ground rock is limestone and the area has a history of being mined. These two conditions result in such complications as encountering "cavernous limestone" under the alignment and mine-pond encroachment on the right-of-way embankment.\textsuperscript{59} The method of hedging this risk has been to excavate the existing 2.5 meter embankment and replace this with stable soils. To accelerate settling before trackwork was installed, this new embankment was subjected to surcharge loading along the entire alignment. TWI determined it was more economical to treat the entire alignment than to bore test holes to identify poor conditions and apply the surcharge only to these sites. The first option proved more expedient and cost effective, given the aggressive schedule of the turnkey contract.

**The response to construction risks: design-build flexibility**

The construction of the 2.5 km elevated viaduct through downtown presented its own construction risks.

Locating the sites for column supports was one such factor. Test borings at each site revealed the necessary piling design. In some cases, these pilings are 18 meters deep, and in others they reach down 50 meters. In areas of great concern, single 1.8m-diameter piles were replaced with three 1.5m-diameter piles or sometimes even five 1.2m-diameter piles. Conditions dictated the pile design used, and the pressure to continue on schedule dictated that these designs be executed in "real time" as the construction progressed. The performance criteria of sixty years of operations will prove the soundness of this structure.

Another risk in pile-boring is the unwitting discovery of unmapped utilities. The goal of not stopping progress, coupled with the flexibility of the design-build arrangements, is seen in the expedient decision to relocate column locations when utilities were encountered. One column was shifted by a meter to avoid an unexpected major sewer pipe.

The response to construction risks: new techniques

The backlash against construction disruption in the busy downtown section was yet another risk encountered. The alignment is elevated in this corridor precisely because it is already a busy commercial district, and an extended period of construction chaos was not acceptable. To minimize disruption, twi has employed an aerial construction staging strategy with the use of a gantry crane. This means that pre-cast cross-sections of the viaduct are trucked out along the completed viaduct to the point of work. There the gantry crane can position the piece while cantilevered out from the completed section. The columns are completed in advance of the gantry work, and the pre-cast sections are matched, post-tensioned, and then the crane advances to the next column. At street level, disruption is minimized since the only work done at that level is the piling and column construction. The initial bid by kltg involved a structure built in segments using cranes from ground level, but the gantry system represented an application of innovative techniques to reduce congestion in an economically important area. The match-casting of the sections is precision work (each piece must have very precise curvature and camber and must match its neighbor and the column configuration), but it takes place in controlled conditions off-site in the confines of a fabrication yard.

In all, the response to these significant construction risks has been pragmatic and innovative. As mentioned, the sixty year concession period is a straight-forward mechanism for quality assurance stemming immediately from the contract structure. The equity owners of the concessionaire happen to be the turnkey contractors as well, so we see a non-confrontational, optimal assignment of risk to the party in the best position to respond and mitigate the uncertainties.

3.5.5. Funding/Financing

STAR has been shaped by the financial climate in which it has developed. It was developed as an unsolicited proposal, and thus the commercial marketability of the scheme was integral to system and project planning when the support of the government was untested. In the establishment of the concession contract, government support was solidified, but financial feasibility did not hinge on large capital support from the government.
The structure of the financing of this project was affected by the Malaysian government's commitment to curb off-shore borrowing. The project developers held that local financing was the goal from the very inception of the project. The revenue would be in ringgit (Malaysian currency), so the use of ringgit capital reduced foreign exchange risk.\textsuperscript{60} The largest public pension fund in Malaysia, the Employees Provident Fund, has been used previously by the government as a source of infrastructure capital (in projects such as the North-South Highway linking Malaysia to Thailand and Singapore), and the STAR project received M$300 million from EPF in the form of a loan. A consortium of local banks have loaned the project M$460 million in floating rate commercial loans; the rest of the capital (M$300 million) comes from equity investment on the part of TWI, AEG, EPF and other local investors.

As discussed above, the project is not financed on the basis of government revenue guarantees. This is new ground for infrastructure projects in the region and is testament to local confidence in solid growth forecasts for the Malaysian economy.

\textsuperscript{60}Bowman. "Project Finance," 12.
3.6. Hudson-Bergen Light Rail Case Study

The Hudson-Bergen Waterfront Light Rail, a new rail system for New Jersey's Waterfront corridor, has been in the planning stage for about 13 years. Conceived of for most of that time as a conventional design-bid-build project, now a new procurement strategy appears to be moving the project forward. A turnkey plus operations contract will soon be signed for design, construction and 15 years of operations and maintenance. In operations, the New Jersey Transit Authority (NJ Transit) will pay the contractor for on-time performance regardless of ridership levels, but the potential for high ridership seems to be good; the system links dense, established urban cores with transportation nodes and prime real estate ready for redevelopment.

3.6.1. Project Background

General

Hudson County is just across the river from Manhattan. The site of this project is a peninsula bordered by the Hudson River to the east, the Kill van Kull river to the south, Newark Bay to the West and the Passaic River and the Meadowlands to the northwest. Hoboken, Jersey City and Bayonne are located on this peninsula. The area has seen significant job growth in the last decade and the projections are for continued growth (see Figure 3.6.1. for a map of the area and project alignment).

Jersey City is the core of this region. The population of this city increased 2.3% in the period 1980-1992. This growth is extraordinary because it is an established industrial/residential area that is gaining in population while many similar cities in America are losing population at a similar rate. The cities in this corridor have some very dense residential development (see Table 3.6.1).
Figure 3.6.1: Hudson Bergen Light Rail System and Environs
Table 3.6.1: Population Density, HBLRT Corridor (1992)\(^{61}\)

<table>
<thead>
<tr>
<th>City</th>
<th>Pop / sq. mi.</th>
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<tbody>
<tr>
<td>Union City</td>
<td>44,000</td>
</tr>
<tr>
<td>Hoboken</td>
<td>25,900</td>
</tr>
<tr>
<td>Jersey City</td>
<td>15,300</td>
</tr>
<tr>
<td>Bayonne</td>
<td>11,000</td>
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</tbody>
</table>

The corridor is also the scene of a great deal of commercial development. The Jersey City “Waterfront” is the centerpiece of this growth, and the employment statistics reveal the rapid pace of growth: employment in Jersey City grew by 20% between 1980 and 1990 (to a total of 117,442). Many financial and other professional service establishments have jumped across the river to this area which has sprouted glass towers as well as redeveloped industrial buildings. Property owners and developers maintain that more redevelopment would be possible with better access to the area.

Transportation

The area on the west bank of the Hudson River has had an important role in the transportation network of the region. Links to Manhattan originate from nodes along the New Jersey shore. These include the Hoboken Ferry and rail and road tunnels. Hoboken Terminal is the major intermodal center in the area; NJ Transit commuter rail service has operated from this area for decades. Many commuters have been funneled through this area for over a century.

But the nature of the area’s transportation needs are changing. Increased employment along with dense population in this corridor means that access to and within the corridor is gaining in importance relative to the old need of access through the site. With this in mind, NJ Transit has planned to build a light rail system from Bergen County in the north through the urban core of Hoboken and Jersey City to Bayonne in the south.

The system will eventually stretch 21 miles from the southern part of Bergen County along the waterfront cities of Hudson County and end at the tip of the Bayonne Peninsula. In terms of goals for the project, NJ Transit is hoping the system will:

- Significantly improve transit mobility from established residential neighborhoods and outlying areas to the Waterfront’s commercial sites and Trans-Hudson transit tubes
- Promote investment in the Waterfront’s development sites by connecting the area’s transit hubs and making these sites more accessible
- Be constructed in phases that can be operated and financed\(^{62}\)

The conceptual design for the system is focused on linking existing nodes, residential areas, and newly-emerging/potential development sites. The system is also the impetus for developing new intermodal nodes in the form of park-and-ride facilities. The system will initially have 5 parking centers with 3,685 parking places. Later the system will include more centers like the 2,000 place facility currently under development at the Vince Lombardi Service Center beside the New Jersey Turnpike. Until light rail service reaches this spot, the park-and-ride will serve road-based carpools and bus service.

### 3.6.2. Project Structure

A single contract will be signed for the development and operation of the system (see Table 3.6.2). The winning consortium will take the 30 percent plans which are considered a part of the bid documents and develop the final plans. This same group will construct the system and be responsible for 15 years of operation and maintenance. The alignment is very well defined through the 30 percent designs (some street-running, some aerial structure, and a large section which utilizes abandoned freight railroad rights-of-way). In addition, NJ Transit has a specific strategy for allocating risk to the contractor (see Risk section below). In light of the funding issues, phasing is one of the most important components of the project structure.

### Phasing

The 21 mile system is broken into three phases: phase one, termed the initial operating System (IOS); phase two, the Subsequent Operating System (SOS); and phase three, the Full Operating System (FOS).

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Table 3.6.2: Division of Responsibility, Hudson-Bergen LRT System

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The first phase (IOS) consists of 9.5 miles. This section starts at the Hoboken Terminal and runs south to East 34th Street Station in Bayonne, including a western spur from the Gateway Park-n-ride (NJ Turnpike Exit 14c, West Side Avenue). This alignment provides a good link to the waterfront development of Jersey City (Colgate Center); the important Hoboken terminal which is now an interchange node for New Jersey Transit commuter rail; the Hudson River ferry service; and PATH, the trans-Hudson rail system providing links to Newark, the World Trade Center and Mid-Town Manhattan. The IOS includes 17 stations and 5 park-n-ride lots providing 3,685 parking places. It also includes the system control center and maintenance facilities which will be expandable for the full system.

Phase Two (SOS) will consist of an extension northward to 85th Street in Hoboken. This section is about nine miles exclusively in an abandoned rail right-of-way. The final operating system includes short extensions to major park-and-ride facilities: the Vince Lombardi center (described above) and the Route 440 Park-and-Ride to the west.

The DBOM contract is for the IOS and portions of SOS and FOS. A detailed scope of work for the contract lists these portions as the cars and signals for both the SOS and the FOS, and operations of the SOS. NJ Transit reserves the right to bid the construction of SOS and FOS separately.

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Newark City Subway

As a side portion of the contract, the contractor will supply 16 vehicles and the design of a car maintenance facility for the existing Newark City Subway. This work is in conjunction with a major rehabilitation of this single tunnel line. The new maintenance facility also requires a track connection to the existing subway line. NJ Transit has estimated this facility will cost $50 million. The winning turnkey contractor will draw the plans for this facility and then NJ Transit will procure the construction of it separately (just as in a conventional procurement). The design fees going to the contractor amount to 12 percent of the $50 million (in addition to the price of the cars).

Performance Criteria

Like other turnkey projects, the Request for Proposals for this project includes detailed performance criteria which the contractor must meet. These minimum requirements are influenced by technical specifications like alignment (grade-climbing ability and turning radius) as well as operations. They are discussed below in terms of service requirements, passenger comfort requirements and maintenance requirements.

Service requirements

Service requirements relate much more to the operation than the design of the system. Parameters like hours of operation and service frequency are covered. The capacity to meet projected ridership (25,101 weekday riders for the ios) is presented as a criterion, but the service schedule is a more rigorous requirement since trains operating at those frequencies more than adequately meet projected demands. Future extensions are projected to catch significantly more riders and may necessitate more frequent service to meet the demand.

Another component of the service requirements is a minimum service reliability and availability. The service will be measured by an index called the “service delivery quality index” which captures on-time performance and throughput performance (number of trains run versus scheduled trains). The contractor’s monthly compensation takes this service statistic into account. In fact, the contractor will have incentives for exemplary service in addition to penalties for deficient service.

/ 64 \n
64 Service Delivery Quality Index (SDQI) = (on-time trains + on-time trains, peak period) / (scheduled trains + scheduled trains, peak period) defined in NJ Transit, Invitation for Bids, IV-44.
Passenger comfort requirements

NJ transit delineates a number of quality factors which address the passenger’s comfort. An off-peak passenger should not have to stand for more than fifteen minutes. Changes in longitudinal acceleration (know as the “jerk rate”) must meet a certain standard as must the climate control system on each car. For example, the air conditioning system must make a 95° day comfortable.

Maintenance requirements

The contractor is responsible for all inspections and maintenance of the system. New jersey transit gives the contractor all the flexibility in performing these duties, but refers to the other sections of the performance specifications as guidance to the results expected from its maintenance program. Specifically, the maintenance program must assure that the vehicles are available to meet the service standards spelled out previously and that the maintenance schedule meets the terms of the manufacturer’s warranty. Furthermore, nj transit references the passenger comfort criteria already spelled out. This sort of self-referential performance standards illustrate the point that maintenance is not a contract goal in itself but more an input to consistent service. Theoretically, the contractor could calculate that a larger fleet of less-reliable cars might be able to provide adequate service availability at a lower cost. A smaller service staff would make repairs and routine maintenance a longer process, but extra cars could meet the service demands. These sorts of trade-offs can be optimized on a system-wide basis.

Revenue

The bid documents explain that the stations will be unstaffed. The fare system will be a proof-of-payment ticket which is dispensed through ticket vending machines. NJ Transit will be responsible for providing the machines, collecting the money from the machines and servicing the machines. Any activity which has any exposure to the revenue moneys will be handled by the owner. The invitation for bids only specifies that the station design include a sheltered, reinforced platform for the vending machines, as well as the power and communication connections required by such a system.

Another form of revenue is the concessions and advertising associated with the stations and vehicles. In one section of the documents, bidders are encouraged to submit proposals for advertising, development of feeder services, concessions within the parking areas or other sites, and other business opportunities which the contractor identifies. In another section, NJ Transit

\[65\text{NJ Transit, Invitation for Bids, I-6.}\]
reserves the right to all revenue from any of these sources. But as a means of explanation, NJ Transit has explicitly sheltered the contractor from any revenue risk. The system and service is strictly a contracted-out lump-sum arrangement, commonly called a Design-Build-Operate (or DBO). The Project Prospectus reads, “There is no contractual link between the generation of ridership of revenue and payment for capital work or improvements.” It continues on the next page, “There is no linkage in the contract between payment [for operations and maintenance] and the levels of ridership or actual revenue generated.”

3.6.3. Competition

NJ Transit has structured the competition as a two-stage contest among pre-qualified bidding groups. After negotiations and a “best and final offer,” the final contract will be awarded in June 1996, executed in July 1996 and work begun in August 1996.

The teams have already been prequalified. One is composed of Bechtel, ABB, and New York Waterways (a Hudson River ferry operator); another is Perini, Bombardier, and Alternate Concepts (Massachusetts rail operator); Flour Daniel has teamed with Siemens Transportation Systems and Herzog Transit Services; Raytheon Infrastructure Services is bidding with Kinkisharyo and Itochu Corporation (Japanese car builders and operators, respectively); finally, AEG Transportation Systems is bidding with Yonkers Contracting Co. and Granite Construction.

Scope and Scale of Competition

As an all-inclusive DBOM contract including phase one (IOS) and elements of phases two and three (SOS, FOS), the scope of the competition is very wide. Initially, one analysis of the

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67NJ Transit, Invitation for Bids, I-5.

project structure indicated that the low floor vehicle specification limited competition to a sole
car builder.\textsuperscript{69} Four teams have submitted initial bids, so the threat of no competition has not
borne out.

This project is not immune to the criticism that the scale of the package limits small-
contractor participation. The bid documents do address this concern by explicitly describing the
Disadvantaged Business Enterprise requirements applicable to the project. Still, the names of the
partnered teams are the big names in transit systems procurement and general contracting. One
consultant feels as though they have been frozen out of competition by the scarcity of car
makers.\textsuperscript{70} The documents also include requirements for experience in this sort of project as well
as audited financial statements attesting to the financial capacity of the team to undertake a
project of this size.

**Preservation of Options**

One aspect of the contract is the option to bid out SOS and FOS construction to another
contractor. The contractor who wins the DBOM is locked in as the systems provider (car,
signals, and operations) for these future phases, but other options are possible for the design and
construction of the infrastructure. This is important especially for the final phase which is three
short extensions to the sites of planned park-and-ride facilities. The potential for these future
projects to leverage a successful light rail access system (and significant parking revenue) for
private investment in infrastructure capital is great. If the development projections are correct
about the New Jersey Waterfront and other sections of this alignment, then the ridership could
well support some form of increased private participation. This would be similar to the case of
the London Docklands Light Rail in which a region with strong transit ridership used a new
system to link existing service with an area of land available for redevelopment. Later phases of
DLR were developed with private capital assistance, and that is one reason that the preservation
of options is important to the strategy in this project.

Within the structure of the initial phase of this project, many options are pre-determined such
as the alignment and the service parameters. Alignment risk and the concomitant land
acquisition issues are held by NJ Transit (see next section). But within the framework of the


100
service requirements, the bidders can determine such specifics as the number of light rail vehicles (LRV) needed to meet the specified service plan. One strategy might be to provide a larger fleet of cheaper, less reliable cars versus fewer, more expensive and more reliable cars. These specifications must be optimized by the bidding groups.

**Evaluation Criteria**

The fundamental evaluation criterion for awarding the contract will be the Net Present Value (NPV) of the bid price. The bid forms spell out the necessary calculations to standardize this aspect of the competition. This evaluation is made only for the proposals which pass the performance criteria tests which relate to system design. The bids will also be subjected to evaluation of the qualifications of the bidders: project experience, similar LRV systems installed and operating, credible operational expertise, and the like. Vehicle lease options and “bridge financing” (see Funding/Financing section) provided by the bidder are also a part of the evaluation.

The structure of this DBOM contract allows for an innovative aspect of competition: life-cycle cost evaluation. The contract makes an allowance for capital replacement during the fifteen year operations and maintenance period. The bid forms, which are explicit in the standardization of the final net price, include a mechanism to offset increased capital costs with decreased maintenance costs for a potential net savings. This DBOM format allows for a resolution of the age-old problem of low-bid competition: the lowest bid up-front is often not the lowest life-cycle cost. "Value-Engineering" is often specified for major system designs, but strategies like this turnkey procurement can by nature embody the sentiments of the value-engineering through internalized incentives.

Initially, some felt that the specifications for a low-floor LRV skewed the competition to a single manufacturer.\(^1\) The car specifications look very similar to the design of the state-of-the-art partial low-floor car built by Siemens for the Portland system. However, the number of consortia pre-qualified and the number of bids submitted tends to invalidate this argument. A consortia must have confidence that their system will meet the specified criteria to spend the time and money formulating a proposal.

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\(^1\)Reinhardt, “Turnkey Transit,” 27.
3.6.4. Risk

In the very first section of the Hudson-Bergen Request for Proposals, the allocation of risk is discussed and rationalized.

In recognition of the strengths of each partner in the development of the HBLRT system, it is important that the execution of work be assigned in a way that plays to the strengths of each partner. A key consideration will be the allocation of risk between the parties.\(^{72}\)

Below, the various risks are discussed in the light of the project structure.

**Market/Ridership Risk**

The project includes no market risk on the part of the private contractor. The DBOM structure can be called “turnkey plus operations” in shorthand, and this is a good way to conceptualize the project. The owner is buying a system and its operation, or in fact, NJ Transit is buying rail service for an area which currently does not have the tracks yet to accommodate this service. As discussed above, the contract explicitly disconnects contractor payment from any level of revenue flow. Although, as seen in the next section, the contractor does share some appropriate risks in conjunction with the design and construction.

**Alignment/Construction Risk**

NJ Transit has agreed to shoulder a good deal of the project risks. Many of these can be considered not specifically construction risks but more planning risks and alignment risk. This group includes utility relocation, hazardous material removal and right-of-way acquisition risks. The rationale behind public sector assumption of these risks is that once the construction starts, the least-cost option is to continue construction until completion. Delays cost everybody involved with the project. Another government-assumed risk is the force-majeur (or act-of-god risk) for the entire project span. Ownership of the assets remains with the public sector due to the lower-cost availability of insurance to public owners (such as federal disaster relief insurance in the case of a major catastrophe).

\(^{72}\)NJ Transit, *Invitation for Bids*, I-3.
Other inherent risks often assumed by the governmental sector are likewise assumed by NJ Transit. This applies to risks involved with environmental permitting and community involvement in project planning. These are typically long-lead items which are often years in development. Again, the idea is that the design-build team should be facilitated in its effort to rapidly complete the project once construction begins.

The contractor will take the responsibility for items within its control: schedule and cost in construction and the cost of operations and maintenance. The way has been prepared for the contractor through 13 years of planning and due diligence on the part of NJ Transit. The price of the contract will be a fixed price, including the supply of additional cars for future phases as well as capital replacement throughout the life of the 15 year operation and maintenance period. Inflation risk (inherent in fixed price contracts) is given to NJ transit by way of a price inflator mechanism for future investments.

3.6.5. Funding/Financing

In addition to the goals of the system discussed above, the procurement strategy has a set of goals unique to the development of a DBOM contract:

- potential gains and losses commensurate with the risk allocation
- lower capital cost
- lower O&M costs
- operating revenues exceed operating costs within a reasonable time\textsuperscript{73}

The capital costs of the first phase have been estimated at $350 million. NJ Transit, with the approval of the New Jersey Commissioner of Transportation, has approved $80 million dollars a year for capital funding in the years 1996-2000 (they also expect to allocate $80 million for FY 2001).\textsuperscript{74} The winning consortium will be expected to provide the “bridge loan” to allow construction spending to outpace the fixed funding amount (at least in the first years of the project). Eventually, the fixed annual appropriations will repay the capital advance made by the contractor. NJ Transit is trying to get the system operational as quickly as possible within a larger capital program that includes meeting other state-wide needs for continued bus and commuter rail service.

\textsuperscript{73}NJ Transit, Invitation for Bids, I-3.

\textsuperscript{74}Korman, “Figuring Super-Turnkey Risk,” 10.
Overall, NJ Transit has an annual capital program of $650 million per year. This includes 50-60 percent federal matching funds. The five year capital program (1996-2000) allocates $400 million to the project, of which $99 million is programmed for NJ Transit project costs. The project prospectus addresses the issue of potential reductions in state or federal funding for the capital program by prioritizing the DBOM commitment above other elements of the capital program. This signifies that the project has gained the commitment of New Jersey’s governor and the FTA. In the context of the uncertain political environment in the U.S. Congress (who makes final decisions about FTA discretionary funding), it is important to reassure the potential bidders, especially since private-sector construction spending will outpace the public-sector capital commitments for the term of the interim bridge loan.

3.7 Tren Urbano Case Study

Tren Urbano is a grade-separated, high platform rail transit system currently in development in the San Juan Region of Puerto Rico. The need for an improved transportation network is compelling, and many hope that this project can address that need while refocusing regional land use patterns into the metropolitan core areas which will be served by this system. Public transit in the area has been in a steep decline over the last thirty years; Tren Urbano will hopefully be the impetus for a revamped public transit focus and reverse this downward trend by providing an alternative to the horrific automobile congestion of the region.

In response to a set of detailed procurement goals, the structure of the procurement of Tren Urbano has evolved into a split/hybrid turnkey arrangement termed the Systems and Test Track Turnkey (ST³) strategy. One turnkey contract will be signed for a fixed-price delivery of the cars, systems, central operations center (including the maintenance yards and shops), and five years of operations and maintenance of the system. The guideway and station civil construction work will be broken into seven design-build alignment section packages; six of these will be contracted separately. The seventh will be included with the ST³ contract as a test track. The ST³ contractor will have interface management responsibilities among all the civil alignment segments to ensure that, in the end, the trains will run and the communications will flow.

3.7.1 Project Background

Puerto Rico is in the unique position of being a Commonwealth of the United States located in the Caribbean Basin. The culture has strong influences from the Spanish Colonial tradition as well as from contemporary United States. This duality of culture, along with its geographic location, means that Puerto Rico is strategically positioned to be a bridge between the United States and the emerging economies of Latin America. In this context, Tren Urbano can be seen as more than an improvement in the transportation network of San Juan. It is also a strategic investment in the development of the Puerto Rican economy that can help spur a new industry of transit system development to export to other areas and countries. Many other cities in Latin America are headed for the same congestion crisis which is now choking San Juan's roadways, and if Tren Urbano is successful at answering the challenge of this city's traffic problems, then the expertise gained in the development of this system will be a valuable commodity to sell to other regions in the Americas.
General

The historic district of San Juan retains much of the character of the Spanish Colonial era, but this section, called Old San Juan, represents a shrinking fraction of land area and population of the entire metropolitan area. As the population expanded, and especially as transportation technology changed, San Juan began spreading out into the land areas immediately surrounding the historic walled city. Eventually, development jumped across the San Antonio Channel to an area called Santurce. Santurce emerged as the primary government and commercial center during the first part of the Twentieth Century. The introduction of a street car line from Old San Juan to Santurce and beyond met the demands of an increasing population and a growing economy for more developable land. The path of the street car line, as well as natural barriers such as the extensive network of inland bays, directed urban growth along a north-south corridor from Santurce to Rio Piedras. As a testament to the influence of early growth patterns, this corridor is still the major axis of San Juan today (see Figure 3.7.1 for a map of the San Juan Metropolitan Area, or SJMA).

After World War II, Puerto Rico promoted rapid development of suburban-style housing in the agricultural lands all around San Juan. The emergence of the automobile made this separation of housing and commercial activity possible. This trend mirrored the style of development on the mainland U.S. Today, the San Juan Metropolitan Area has expanded to include 13 municipal districts and 1036 square kilometers. Of this total land area, 416 square kilometers are undevelopable and another 350 have already been urbanized. Urbanization has spread out from the City of San Juan to the extent that Rio Piedras, Bayamon, and Carolina (previously, small market towns distinct from San Juan) have been subsumed into the fabric of the urban metropolitan area. The developed areas between and beyond these old centers have been suburbanized with low-density residential and commercial/light industrial districts.

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76 Traditional Spanish colonial era influences are still very much present in the traditional town center of Rio Piedras. These include the central cathedral with an open plaza and a tight street pattern with buildings in the traditional Spanish Colonial architecture.
Figure 3.7.1: The San Juan Metropolitan Area
The San Juan Metropolitan Area has seen astounding growth rates in the last thirty years: growth of population, growth of auto ownership, growth of vehicle-kilometers-traveled and growth of congestion on the road network. Forecasts of future travel demand -- due to population growth as well as increased trip-making -- have presented a bleak picture of the future of mobility in San Juan. 77

Transportation

Rail transit in transportation planning

In 1964, San Juan entered the process of developing a modern transportation plan. The then-new urban transportation planning methodology employed detailed studies of origins and destinations as well as road capacities and public transportation routes. The outcome of the plan was intended to steer infrastructure investment toward the most critically needed links in the surface transportation network.

The results of this study pointed toward expanded highway links for a majority of the metropolitan area and a high capacity public transport link for the densely-developed North-South corridor from Old San Juan to Santurce to Rio Piedras. 78 For a number of years, sporadic efforts were made to advance the planning for this rail transit system, with no concrete results. In the mean time, a bus line has been operating along this corridor in contraflow lanes with significant ridership.

In 1992, an updated, comprehensive transportation plan was prepared for the San Juan area. The changes in the character of the metropolitan area over the intervening years were demonstrated by the huge growth in population, trip rates and automobile mode share. Investment in road infrastructure, while significant through this period, had not kept pace with the growth in demand; the result has been increasing congestion on San Juan streets and highways. Public transit ridership has been declining all the while. Not surprisingly, the 1992 transportation plan again reached the conclusion that a high-capacity public transit system would be a good idea to accommodate current and future travel demand in the core of the San Juan area.

77 Barton Aschman Associates, Inc., *San Juan Regional Transportation Plan* (San Juan, P.R.: Puerto Rico Department of Transportation and Public Works, November 1993).

Factors in the decision to act

In 1993, the Commonwealth of Puerto Rico decided to move on the plans for a rail transit system for San Juan. The twenty five years of studies for such a system, the newly updated metropolitan plan, and several other important factors were all critical to reaching this decision. Below is a discussion of some of the factors which weighted the decision to pursue Tren Urbano.

Decline of public transit

The last thirty years has seen a rapid decline in transit in Puerto Rico. As on the mainland United States, public transportation in San Juan has carried a shrinking share of trips. The provider of public bus service, Autoridad Metropolitano de Autobus (AMA), has suffered from image and management problems in the past, and total public transit ridership is declining not only in share but in absolute numbers. Contributing to AMA's problems, the very nature of buses running in mixed traffic puts collective transport at a disadvantage. The congestion which delays auto traffic also affects bus travel times, and San Juan bus service has seen a spiraling descent of ridership and service in which less ridership means less-frequent service which results in even less ridership.

San Juan's system of private jitneys (publicos) has experienced many of the same trends. Congestion has had a huge detrimental effect on publico ridership, to the point that publicos have joined AMA as the mode for those with no auto availability (no real choice).

Increasing car dominance and its high cost

In the urban core of the metropolitan area (Bayamon, Carolina, Cataño, Guaynabo and San Juan), car ownership has increased from 0.141 cars per person in 1964 to 0.405 cars per person in 1990 (also, see Figure 3.7.2). Much of this can be explained by the significant expansion of Puerto Rico's economy over the past two decades which has brought auto-mobility within the grasp of a large fraction of the population. The auto mode share is now over 90% for all trips in

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79Puerto Rico Department of Transportation and Public Works, Final Environmental Impact Statement (San Juan, P.R.: Puerto Rico Department of Transportation and Public Works, November, 1995), 1-7.
the SJMA. This growth in auto mode share must also be seen in the light of the growing number of total trips generated and the increasing average length of trips. As a summary of all of these dynamics, the number of vehicle-kilometers-traveled (VKT) in 1992 was 23 million per weekday. This measure of motor vehicle usage is expected to grow to 32 million VKT in 2010 (this is the forecast of traffic growth with Tren Urbano in place and operating).\textsuperscript{80}

\textbf{Figure 3.7.2: Vehicle Registrations in Puerto Rico (thousands)}\textsuperscript{81}

This explosion in auto travel has not been matched by new roadway capacity. By every measure, congestion in the metropolitan area is horrendous. Of the 90 segments of the highway network for which data is available, 36 segments are operating with total daily traffic flows above total capacity.\textsuperscript{82} This statistic reflects the fact that if the total daily flow were evenly distributed throughout the day, the road would still be congested. But traffic flow is not uniform throughout the day, indicating that peak hour congestion is much worse (according to anecdotal reports, the congested peak period lasts all day in much of San Juan). Only 28 of the 90 segments operate below 60% of total daily capacity.

\textsuperscript{80}Puerto Rico Department of Transportation and Public Works, \textit{Final Environmental Impact Statement}, 5-38.

\textsuperscript{81}Miguel Pellot. "Tren Urbano: A Feasible Alternative to Alleviate Traffic Congestion in the San Juan Metropolitan Area" (paper presented to the UPR/MIT Conference on Tren Urbano, San Juan, P.R., 11-20 January 1995), 14.

\textsuperscript{82}Puerto Rico Department of Transportation and Public Works. \textit{Final Environmental Impact Statement}, 1-24.
Other light rail new-starts

Another factor in the decision to develop the long-studied rail transit system was the impact that similar rail systems were having in other cities in the U.S. At the point when the commonwealth and the municipalities of the San Juan region needed to form a consensus about the value of such a system (as opposed to alternative investment strategies), the mayors of several of the large municipalities and representatives of the commonwealth went on a tour of cities with new rail transit systems such as San Diego, California and Saint Louis, Missouri. What emerged from that trip was a strong consensus that a rail system would be a great idea in San Juan. Since then, no threats to the political support of Tren Urbano have developed, and the system has emerged as the premier infrastructure development project on the island. In the current build-up to the gubernatorial election in November 1996, support for Tren Urbano is an issue of bi-partisan consensus.

Goals of the new rail system

Table 3.7.1 presents the goals of Tren Urbano as developed in the Final Environmental Impact Statement presented to the public and the Federal Transit Administration.

This list of goals and objectives is also instructive as to what is not included. The system is not being sold as a cure to congestion, but more an alternative to the clogged street network. And although the stated goals of the project do include some procurement goals like an accelerated construction schedule and technology transfer, they do not include lower cost.

The final goal -- to design, construct and operate Tren Urbano in an efficient and effective manner -- points directly to the issue of procurement structure. The government turned to a hybrid turnkey strategy to achieve this goal while balancing it with other goals; decision-makers see benefits from turnkey in accelerating development and enabling the early commencement schedule, and the complex hybrid scheme is intended to facilitate significant local participation. The goal of having an operationally-driven design underlies the entire process, and is the key reason for including operations for 5 (and possibly 10) years in the scope of the turnkey procurement.
Table 3.7.1: Tren Urbano Project Goals and Objectives

<table>
<thead>
<tr>
<th>Goal</th>
<th>Objectives</th>
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| 1. Improve mobility within the San Juan Metropolitan Area | • Maximize regional public transit ridership  
• Reduce travel time for transit patrons  
• Connect key institutions and job centers with residential populations  
• Improve service to the disabled and other transit-dependent populations  
• Reduce the financial burden of automobile ownership on low-income families  
• Provide alternatives to congested highway trips |
| 2. Provide for a major expansion in public transit service capacity | • Provide capacity to accommodate existing transit demand  
• Provide capacity to accommodate future passenger volumes  
• Provide flexibility to allow for expansion to other travel corridors |
| 3. Improve public transit service efficiency, convenience, and reliability | • Increase service frequency  
• Improve operating speeds and schedule reliability  
• Promote integration of all public transit services and improve intermodal facilities |
| 4. Minimize impacts on Puerto Rico's natural environment | • Maintain regional air quality standards by reducing vehicle-kilometers traveled  
• Minimize the need for highway construction and associated environmental and community disruption  
• Promote efficient land use  
• Minimize impacts on significant wetlands |
| 5. Support economic growth in the San Juan Metropolitan Area | • Stimulate job growth through project construction and operation  
• Support future economic development  
• Enhance access to employment opportunities |
| 6. Design, construct and operate in an efficient and effective manner | • Accelerate the construction and opening schedule  
• Maximize opportunities for local architecture, engineering and construction firms  
• Bring transit expertise to Puerto Rico through technology transfer |

It is important to understand that Tren Urbano has evolved over the years to be more than a transportation infrastructure project. As the previous section detailed, the San Juan region is in dire need of some new transportation capacity, but the decision to pursue a rail transit system in a region which has seen transit ridership whither and low density suburban development explode across the landscape is a bold decision of economic development policy. The pattern of ex-urban growth will have to be redirected to the core urban areas for Tren Urbano to serve new travel demand effectively. Also, the Commonwealth is hoping that, through technology transfer and local participation, Puerto Rico will have the expertise to manage the new rail system over the long term, including future expansions. The vision for the future is that Puerto Rico, an emerging economy which has "rounded the curve" of economic development ahead of much of Latin America, can potentially act as a center for transit expertise to other Caribbean and Central and

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South American cities which, in the coming decades, find themselves in the same condition of exploding travel demand coupled with a strained surface roadway system. Moreover, Puerto Rico also finds itself at the leading edge of turnkey development in the U.S., so the potential for transferring system development expertise to other parts of North America is also high.

3.7.2 Project Structure

The effort to develop Tren Urbano has progressed through the federal environmental permitting phase. Once the decision was made to push Tren Urbano forward, the Government of Puerto Rico, through the Department of Transportation and Public Works (DTOP) and its Transportation and Highway Authority (PRHTA), hired a consortium of consultants to perform the work of planning, preliminary engineering and contract/bid document development. This group, known as the General Management, Architecture and Engineering Consultants (GMAEC), has developed the Draft Environmental Impact Statement (March, 1995), handled the public participation process in response to the draft statement and issued the Final Environmental Impact Statement (November, 1995). The alignment for this project has been inherited from previous development efforts, and in the interest of expediting the environmental permitting effort, no drastic departures have been made from the “Bayamon Crescent” route established in a 1979 plan (see Figure 3.7.3 for a map of the locally preferred alternative alignment).84

More importantly, the GMAEC has worked with the Commonwealth in structuring the procurement of Tren Urbano. Early on, the government committed to pursuing a turnkey structure to increase private involvement in the project and move forward the schedule of the project.

After serious consideration of a range of options, the final structure of the procurement will be a hybrid systems turnkey with design-build civil sections bid separately. The primary contract includes the cars, electrical and mechanical systems, the central control and maintenance facility, and operations and maintenance for a five year period. It also includes the responsibility to design and construct a simple section of the alignment and two stations (which are adjacent to the yards, shops and operation center site); from this scope of work comes the name used for the entire procurement strategy, the Systems and Test Track Turnkey (see Figure 3.7.4).

Figure 3.7.3: Tren Urbano Alignment, Locally Preferred Alternative
Rationale for a Turnkey Strategy

The decision to use the turnkey approach was driven by several factors. It is primarily intended to accelerate the start and completion of construction. The start of construction is a politically sensitive issue, with the current administration wishing to have the project committed and underway before the November, 1996 election. As noted earlier, Tren Urbano is the premiere infrastructure project on the island, with a strong public consensus built around its implementation. The current administration wants the project ground-breaking to happen during this campaign season with visible, active construction activities taking place at the time of the election.

85Adapted from Puerto Rico Department of Transportation and Public Works, “Tren Urbano Industry Outreach Seminar Presentation Materials” (orientation seminar held for potential contract bidders, San Juan, P.R., Puerto Rico, 15-17 May 1995).
The expected time savings in the acceleration of completion means that the transportation benefits of the system will accrue earlier. But this transportation project must be seen in the broader framework of Puerto Rico's infrastructure and public service delivery strategy. This strategy includes a much more prominent role for the private sector than in a traditional U.S. segmented model. The current wave of public-private interactions cuts across many segments of the island's economy and represents an ideological commitment to facilitating private sector growth.

Puerto Rico's economy stands out in the Caribbean Basin as one of the most developed. This can largely be attributed to a program in the 1950's which provided investment incentives to mainland pharmaceutical companies that located production facilities on the island. This was part of an over-all development program called Operation Bootstrap, which is credited with the emergence of an industrial economy in Puerto Rico. The private sector involvement which constituted a major piece of this development program has had ramifications through all of Puerto Rico's public policy.

In the realm of public services, many utilities have been the focus of privatization efforts. These include the telephone, electric and water utilities. Transport services have increasingly been considered as opportunities to engage the private sector, both in the development of infrastructure and in contracted bus operations.

Private infrastructure development

To understand Tren Urbano's turnkey strategy one needs to consider other Puerto Rican efforts in the private development of infrastructure. Other transportation infrastructure as well as water infrastructure has been or is slated to be developed with significant private sector involvement. Toll-financed road capacity is one broad category of new infrastructure which has and will be developed in this manner (see Box 3.7.1), as is water supply infrastructure. The Puerto Rico Aqueduct and Sewer Authority, also part of DTOP, is developing a turnkey aqueduct and water treatment plant to bring water to the san juan area from the dos bocas reservoir in the central western part of the island. The financing will come from water user fees, and the pipeline will run in the right-of-way of a highway leading to San Juan.86

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Box 3.7.1: Private Development Of Road Infrastructure In San Juan:  
The Case Of The Teodoro Moscoso Bridge

The Puerto Rico Highway and Transportation Authority (PRHTA) has been very effective in the development of revenue-bond-financed highways throughout the Commonwealth of Puerto Rico. Over the last 20 years, more than 140 km of toll roads have been built — with an additional 225 km identified for future development. These new roads will serve the rapidly growing periphery of the San Juan Metropolitan Area (SJMA) as well as island-wide mobility needs.

To accelerate the development of these new roadways, PRHTA has turned to a model of public-private partnerships for the delivery of this infrastructure. The program was first formulated in 1989, and the first project to be undertaken was the Teodoro Moscoso bridge across San Jose Lagoon, connecting the municipality of San Juan with the airport region in Fajardo. Primarily this route serves as an alternative for airport-bound traffic from southern San Juan (Rio Piedras) and the other western municipalities of the SJMA.

This project is a build-transfer-operate deal: financed and built by a private concessionaire, transferred to the government at completion of construction (for liability reasons), and operated by this same concessionaire for a period of 35 years after which control reverts to the PRHTA. The process of procuring the bridge took 48 months from project inception to opening. The construction took only 20 months once the concession agreement had been negotiated.

In dividing responsibilities, the PRHTA agreed to take responsibility for right-of-way acquisition as well as disposal of any hazardous waste discovered on the project right-of-way. The concession agreement also included a carefully structured termination clause which amounts to a traffic guarantee. The concessionaire can terminate the agreement at its sole discretion if traffic volumes are below the forecast volume. PRHTA would compensate the concessionaire for costs incurred up to that point, including a 12.5% return on equity. The termination clause has a sliding scale for the traffic level deficit (as a percentage of the forecast) which can trigger the termination. After the ninth year, that level is 100% of the forecast.

The termination clause secured the project a much more favorable bond rating. The bond issue totaled $123 million, and the bridge construction costs were $83 million. The initial toll of $1.50 was met with a great deal of public outcry ($1.00 per mile versus a PRHTA toll road average of $0.04 per mile), and traffic has been well below the projections. As to date, the concessionaire has not exercised the termination clause, potentially because of the future option to develop some of the planned 240 km of new toll roads.

Privately operated bus services

Metrobus is a privately operated fixed-route bus line in San Juan, running from Rio Piedras along the north-south spine of Hato Rey, through Santurce to Old San Juan. Much of this route runs in contra-flow lanes through the congested main corridor of San Juan. The service quality is specified through the contract signed by PRHTA and the operator, with financial incentives to

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87 Jack Schnettler (Manager; Post, Buckley, Schuh & Jernigan, Inc.), “Concession Agreement and Keys to Success Case Study: Commonwealth of Puerto Rico San Jose Lagoon Bridge Project,” 36th Annual Transportation Research Forum, Daytona, Fla., 3-5 November 1994.
meet the scheduled headways. Since commencing operation in 1991, ridership has risen to 23,000 per day and has consistently been above the baseline predictions.

The success of Metrobus demonstrates the demand for a high quality public transit option. At a fare of $0.50, Metrobus costs double the AMA fare of $0.25. This demonstration of demand (and the willingness to pay more for better service) has spurred AMA to improve its service and image. And in the past six months, Metrobus II has entered service. This is another high-quality bus line operated under contract with PRHTA which includes the same performance incentives as in the original Metrobus contract. In a twist on the usual private-sector operations contract, the provider of this new service is AMA. This is a chance for the previously moribund public agency to move toward "corporatization" or private-sector-like performance. AMA will have a directly comparable private sector benchmark (Metrobus) against which to measure Metrobus II service performance. These private and quasi-private bus operations represent only one facet of Puerto Rico's introduction of private sector involvement in transportation.

**Tren Urbano designated as a FTA Turnkey Demonstration Project**

In 1993, the Federal Transit Administration designated Tren Urbano a demonstration project to be evaluated under the Turnkey Demonstration Program (see Box 3.7.2). Then in November, 1994, GMAEC took on the tasks of project planning and preliminary engineering. The first job of the group was to structure the procurement and develop a draft environmental impact statement to meet federal NEPA regulations. The commitment had been made to formulate a turnkey strategy and to proceed with the "Bayamon Crescent" alignment.

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88 The Metrobus II service route does not use contra-flow lanes along its route. The congestion factor of Metrobus II's operating environment is significant and a major factor in measuring the operator's performance.
Box 3.7.2: The FTA Turnkey Demonstration Program

The Intermodal Surface Transportation Act (ISTEA) of 1991 included a section which directed the Federal Transit Administration (FTA) to develop a Turnkey Demonstration Program. This program will evaluate the application of turnkey procurement strategies to major transit capital projects.

The demonstration program has identified five projects for participation. In addition to Tren Urbano, these are:

- Maryland Maes Transit Administration, Baltimore Central Light Rail System
  3 extensions of light rail
  $106 million

- Bay Area Rapid Transit District, BART extension to SFO International Airport
  6.4 miles, 3 stations
  $900 million – $1,300 million

- Los Angeles Metropolitan Transportation Authority, Green Line Union Station Gateway Transit Center
  intermodal station and office complex

- New Jersey Transit, Hudson-Bergen Light Rail System
  $1,300 million for 21 mile system
  design-build-operate-maintain turnkey

The projects range widely in scope. The Gateway Center in Los Angeles is a public-private joint development of a multi-modal hub and office complex. This project is complete and opened, with the primary tenant being the LAMTA itself. Other projects, such as Baltimore Light Rail and BART, are design-build section extensions of existing systems. As discussed previously in the introduction to the case studies, these extensions are fundamentally different from new-start systems.

The major focus of this demonstration program is the evaluation of the promised benefits that many people expect from turnkey procurement. The program will try to quantify cost savings and schedule savings as well as consider the implications of risk and responsibility allocation.

(continued)
The Volpe National Transportation Systems Center is involved in this demonstration project in developing evaluation guidelines for this program. Each project will be tracked through development and completion, and the final results will be evaluated. Ideally, each project would have a baseline “no-turnkey” project against which to compare itself. The nature of these major infrastructure projects is that project-specific details make such a comparison impossible. In the case of the BART-SFO extension, evaluation will be made in reference to a conventionally-procured extension now being completed to Colma. Many aspects of the two projects will be comparable, but many will not.

In the case of Tren Urbano, evaluation will be handled with a “counterfactual model” for comparison. This will consist of cost and schedule data from construction projects completed within recent years in Puerto Rico. The projects selected for inclusion in the base line are ideally ones executed by PRHTA with similar elements. Airports, ports, buildings, toll facilities, and bus facilities are given as examples.

GMAEC and the Refinement of the Turnkey Strategy
The GMAEC very quickly developed an initial Procurement Strategy Paper. The paper briefly defined the background of the project and the goals of the procurement strategy (see Table 3.7.2). The turnkey options were laid out (single turnkey, split turnkey, hybrid turnkey). These options were contrasted with the conventional procurement system and a recommendation was made as to which structure best addressed the procurement goals.

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Table 3.7.2: Tren Urbano Procurement Goals (December, 1994)\(^*\)

<table>
<thead>
<tr>
<th>control interfaces (quality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>maximize technology transfer</td>
</tr>
<tr>
<td>owner control</td>
</tr>
<tr>
<td>accelerate start of construction</td>
</tr>
<tr>
<td>operational design</td>
</tr>
<tr>
<td>private funding</td>
</tr>
</tbody>
</table>

"Mini-Tumkey Plus Civil"

The recommendation from this strategy paper was a hybrid procurement structure termed "Mini-Tumkey Plus Civil." This formulation resembles very much the fully-developed ST\(^3\) which has been implemented with a systems turnkey responsible for one short segment of civil work leading into the yards and shops and six additional civil line-segment contracts divided by alignment geography. The discussion of this option included a consideration of all of the goals of the procurement. Interfaces are controlled through the single systems contract, insuring interoperability between sections and providing a single party accountable for this (but it is acknowledged that the recommended approach is weaker than a single turnkey would be for this criterion); local participation is facilitated through the larger number of smaller parcels for which Puerto Rican firms are better qualified to bid; owner control is retained through the increased number of contracts and the reservation of fare collection equipment responsibilities; acceleration of commencement is achieved because the turnkey contract can be bid before the preliminary design is completed on the entire alignment; and operationally-driven design and finance are presented as "alternative-neutral," meaning that the decision on which form of turnkey to use would have minimal impact.

Split cultures

Beyond the procurement goals, this split/hybrid turnkey scheme was structured to address certain issues such as the difference in cultures between the systems suppliers and civil construction organizations. The entities which end up bidding on these sorts of projects are usually a consortium or joint venture of private sector firms, each of which brings its peculiar

\(^{91}\text{GMAEC, "Procurement Strategy Paper."}\)
style to the endeavor. A single turnkey contract amounts to what some have called a "forced marriage" with a series of related negative aspects of such a relationship.\textsuperscript{92} The \textsuperscript{ST3}, as structured, will be dominated by the car/system manufacturer since the dollar value of that part of the contract is by far the biggest.\textsuperscript{93} The development of the final design will thus be more likely driven by operational concerns (in contrast to a construction firm-headed enterprise which would likely be organized around construction issues).

**The Request for Proposals**

The \textsuperscript{ST3} Request for Proposals was issued by DTOP and the PRHTA on August 28, 1995. Currently, final bids have been accepted, and the contract winner is to be announced very shortly.\textsuperscript{94} The final structure for the contract, summarized in Table 3.7.3, is similar to the originally recommended strategy. The responsibility of 5 years of operations (plus an option for an additional 5 years) is included in the contract to reinforce the desire for operations-driven system design. Other details of the \textsuperscript{ST3} contract will be discussed below.

**Table 3.7.3: Division of Responsibility, Tren Urbano**

<table>
<thead>
<tr>
<th></th>
<th>\textsuperscript{ST3}</th>
<th>PRHTA (GMAEC)</th>
</tr>
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<tbody>
<tr>
<td>Planning</td>
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<tr>
<td>system</td>
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<td>project</td>
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<td>Design</td>
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<td>5%</td>
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<td>30%</td>
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<td>60%</td>
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<tr>
<td>100%</td>
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<td>Build</td>
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<tr>
<td>civil</td>
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<tr>
<td>systems</td>
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<tr>
<td>Maintenance</td>
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<td></td>
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<tr>
<td>Operations</td>
<td>•</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{92}GMAEC, "Procurement Strategy Paper."

\textsuperscript{93}By contrast, in a single turnkey contract, there is no \textit{a priori} primacy in the relationship between the system and the civil parts of the work.

\textsuperscript{94}In fact, the winner has already been announced. The late timing of this event and the production of this report preclude a major elaboration of the winning bid. See Note _ _ for more information.
3.7.3 Competition

Competition is a primary concern in the structuring of the procurement strategy for Tren Urbano. Also, clear and rational evaluation criteria were very important for potential bidders to be convinced that the winner had not been pre-selected through a specifically structured RFP. Both of these issues have been addressed in the development of the turnkey strategy.

The Commonwealth, through the Tren Urbano Office, has been interested from the very start in increasing general participation in the competition for the systems turnkey contract. In May of 1995, in the period when the turnkey strategy had been formulated but all of the fine details of its structure had not been finalized, the Commonwealth hosted an "Industry Outreach Seminar" in San Juan. Representatives of any interested company were invited to this event which served as an introduction to the project and procurement scheme. It was also intended to solicit a response from contractors and vendors as to the reasonableness of the project structure. The conference was well attended and the representatives who attended from major international rail system vendors had the opportunity to meet local AEC and potential operating firms with which to form bidding teams (local participation being a primary goal of the procurement and one of the evaluation criteria). Also, the conference served as an official conduit through which potential bidders could seek clarification. The Commonwealth and GMAEC wanted to answer all questions in an open arena and then cut off communication during the proposal submission and evaluation stages of the procurement. The practice of answering questions for one bidder and not another is often interpreted as anti-competitive behavior and can be the source of a claim on the part of a losing bidder.

With the attention of all potential bidders already directed at the project, the Commonwealth pre-negotiated the terms of the contract to be signed with the winner. This innovative technique secured the terms of the contract in an open forum before the winner was announced. Thus the bidders all had a firm grasp of the contractual obligations of the competition. The playing field was leveled for the competitors. Also, the negotiation process, typically undertaken after the announcement of the winner, was not influenced by the power of the winning bidder as is often the case. All of this process took place in the context of follow-up bidders conferences.

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95GMAEC Tren Urbano Program Consultants, “Vendor Outreach White Paper” (San Juan, P.R.: Puerto Rico Department of Transportation and Public Works, 6 March 1995, photocopied), 3.
Scope and Scale of Competition

The scope of the ST³ contract represents a conscious reduction in responsibility on the part of the systems provider (as compared with a single turnkey-style procurement). Many factors already discussed come into this decision (split culture, owner control of quality) as well as considerations of project risk (to be discussed below). The project can adequately be described as a reduced-scope turnkey procurement in which potential turnkey benefits have been balanced with the concerns of local participation, early commencement of work and reasonable risk allocation.

The structure of the overall procurement has probably increased the scale of competition when the civil design-build packages are included. Each of these packages will be contracted in a manner in which a broader range of construction and design firms can compete for work. If the entire Phase 1 alignment were packaged as one contract, the number of firms which would be able to submit bids for the construction responsibilities would be limited to major U.S. and international contractors, and local participation would be limited to the role of junior member of some conglomerate joint venture. ⁹⁶

The multiple packages for construction also introduces the issue of conflict of interest between a firm which is engaged in more than one segment of the project. Any firm which has an ownership interest in the ST³ consortium is precluded from bidding for any of the other section packages. One response to this prohibition has been the structuring of a sub-contract arrangement between the design/systems/operations components of the ST³ ownership structure and the construction team member. ⁹⁷ The construction firm will be free to bid on future work for the project whether or not they win the ST³.

One rough estimate of the scale of competition is the number of bidders. The initial estimate by GMAEC was that the project might expect three or four bidders. ⁹⁸ The final number of teams qualified to submit initial bids was six. Due to a merger and a withdrawal, four teams submitted initial proposals. The composition of these teams is given in Table 3.7.4. Ultimately, The AEG

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⁹⁶Bonding requirements represent the strictest limiting factor. Performance bonding capacity of firms is a function of their size, experience and equity. Surety companies are conservative by nature, and the GMAEC, in a survey of Puerto Rico's construction industry, found that local firms would not be able to lead such a large project.


⁹⁸GMAEC. “Procurement Strategy Paper,” 5-16.
consortium was eliminated for non-conformity, and the final proposals numbered three. So indeed the selection of the split/hybrid turnkey strategy over a single turnkey scheme does not appear to have reduced the number of systems bidders and has opened up many more opportunities for local firms in the architectural, engineering and construction stages of the project.

Table 3.7.4: Bid Team Composition for the Tren Urbano ST³ Contract

<table>
<thead>
<tr>
<th>Consortium</th>
<th>Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tren Urbano Consortium</td>
<td>SNC Lavalin Int., Breda Construzioni, Ray Architects and Engineers, Rodriguez &amp; Del Valle, Union Switch and Signal, LS Transit Systems, SUROTEA, Soffertu, Metromovil-ACL</td>
</tr>
<tr>
<td>Grupo Tren Urbano</td>
<td>Bombardier, Fluor Daniel Inc., Caribbean Architects and Engineers</td>
</tr>
</tbody>
</table>

Preservation of Options

As is common to all of the turnkey projects examined for this study, the Commonwealth has, through the project planning and procurement process, already tightly limited a number of options that a potential bidder might have considered. The transportation system will be steel-wheel rail technology with a “third rail” power system. The alignment has been defined in the development of 30% designs. The preservation of options is a secondary concern to the interest in progressing through the environmental permitting process and starting construction.

As this project is envisioned to be the first phase of a larger system which will eventually extend to other parts of the metropolitan area, proposals are to include a firm option price for more rail cars which would be needed for service on any extension. The phasing strategy, while

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99 Just before the deadline for this work, the winner was announced. Siemens will be the ST³ contractor.

only tentatively spelled out, is to develop an extension from the northern terminus at Sagrado Corazon into Minillas as soon as possible, effectively extending the north-south portion of Tren Urbano to serve the full extent of San Juan’s spine. This phase, Phase I(a), could potentially begin the permitting process before Phase I becomes operational. The option for additional cars becomes even more critical in the more substantial extensions to Carolina, Old San Juan and the International Airport, all major extensions from the north-south spine to regional sub-centers. These extensions would give the over-all system the shape of the letter “H” laid horizontally over the metropolitan region.

Another important option built into the contract is the pricing structure for additional service. The baseline operational performance is 5 minute headways in the peak period, 10 minutes in the base period (weekday mid-day) and 15 minutes in the off-peak/weekend. This schedule, plus other characteristics such as hours of operation, is the basis for the fixed-price operation price which the proposers will quote. The price will be subject to adjustments for inflation as well as to adjustments in the service schedule. The mechanism which allows service schedule adjustments is the unit price quote required of bidders, expressed in terms of "dollars per revenue service train hour" and "dollars per revenue service vehicle kilometer." This marginal cost represents the added labor cost of another hour of service and the added operational cost (capital depreciation and increased utilities) of an additional unit of service, respectively. Schedules will be more flexible with this mechanism build into the contract because changes to the specified schedule will be less contentious.

**Evaluation Criteria**

The process has been set up as a two-step submission of bids, with the first technical and management proposal having been evaluated and negotiated prior to the submission of a "Best and Final Offer" complete with a fixed lump sum price figure. The Request for Proposals spells out three categories of evaluation criteria which parallel the structure of the competition. The first category is the evaluation of technical and management proposals. This category focuses on experience with similar projects and the quality of the plans presented for operations, maintenance and management. The second category in the evaluation is the financial capacity. This includes compliance with bonding and insurance requirements (100% performance bond, 101

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5% proposal guarantee) as well as the demonstrated financial and manufacturing capacity to meet the project delivery schedule. The third category is the price evaluation; in the best and final offer, the dollar price for all the elements of the scope of work are totaled up and submitted as a total fixed price.

3.7.4 Risk

The allocation risk in Tren Urbano leans heavily to the side of the government. This is by design. The tradeoff has been made to gain and keep relatively more owner control as compared to a single turnkey contract and avoid the cost premiums involved in transferring risk to the private sector.

The speculative effort of working through the federal approvals process and developing 30% designs has been undertaken by the GMAEC as a direct representative of the Government of Puerto Rico. As of this writing, the speculative risk has been managed well with the project receiving its federal Record of Decision,signifying the completion of the NEPA environmental review phase. Furthermore, the FTA has extended to Tren Urbano a Full Funding Grant Agreement, obligating the administration to include the project in its annual Section 3 discretionary funding request. This agreement means that federal capital assistance is close at hand. The government has taken on the project development risks and successfully moved beyond those risks into the next phase of the project.

Along with the project planning risk, the political risk inherent in any major infrastructure project seems to be well in control. The engagement of the GMAEC to handle the planning and preliminary engineering has been a big factor in this smooth implementation phase. The public response in the planning phase has run smoothly with few if any vehement objections to the preliminary plans. Everyone agrees that these risks are appropriately taken by the public sector. Indeed, the government will want to take the political risk on a popular project like Tren Urbano so as to reap the credit for implementing the project.

Market/Ridership Risk

The ST³ operator will take no ridership risks at all. As an indication of the distance between contractor and market risk, the ST³ will not even know what the fare collection system looks like until a few years later when the PRHTA and ST³ jointly develop a separate contract for supply of this equipment. The operator will receive a flat, fixed price to run the trains regardless of the ridership. Indeed, the contract provides incentives for the operator to achieve higher-than-
projected ridership. In theory, the details of the operational plan as implemented by the contractor will offer a chance to induce ridership. A percentage of the revenue of the surplus riders will be given to the ST³.

This clause is in effect an "up-side" reward without any "down-side" risk. This is a deliberate imbalance in the traditional risk-reward profile of contract structure. It is not indefensible; ridership will ultimately be determined by many policies outside the control of the turnkey contractor. These include policies to integrate other modes of transport as feeder services to Tren Urbano as well as fare policy, which the public sector has reserved the right to determine. In mass transit technology, the marginal cost of an additional rider is close to zero. The operator can potentially elicit more ridership through customer-oriented operational policies, and the public benefits of a heavily-used system are, in the opinion of the procurement officers responsible for this reward mechanism, more valuable than the fraction of marginal fare revenues which would be transferred to the operator. High ridership is a factor in the perception of the ultimate success of Tren Urbano. Inducing ridership may also help to reduce the growth of traffic congestion in San Juan (another potential public benefit).

An innovative aspect of this up-side ridership incentive is the Commonwealth’s requirement that proposers include an employee profit-sharing plan in their bids. The goal is to include the company employees in the incentive structure. After all, a helpful and responsive staff can affect ridership positively. With a well-developed employee profit-sharing plan, this incentive is targeted at the right level of the operating organization to directly affect ridership.

Alignment/Construction Risk

The fundamental risk which the ST³ contractor assumes is the schedule and cost of the entire system, within the constraints imposed on it by the other segment contractor’s schedule. The ultimate responsibility for the section interfaces and a fully operational system by 2001 rests with the winner of the contract. The role of contract administration (interface design review, section compatibility with all technical systems, etc.) gives the contractor the authority to manage this risk. Fundamentally, the ST³ contractor will also assume some of the authority of an owner of the separate alignment sections; the turnkey contractor is given the right to inspect the work of the other segments before the government accepts the final project. The installation of the trackwork and systems as well as the operations and maintenance of the facilities are the responsibility of the ST³ contractor, so this oversight authority goes along with these obligations.
The normal classes of construction risks like geotechnical risks also apply to the test track section of civil work included in ST\textsuperscript{3}. But the major risks of hurricanes and earthquakes (and any other "acts of God") remain with the owner. The contract includes a line-item budget provision for hazardous waste remediation, which indicates a shared risk with the government (the budget for this item is $1 million; any more serious hazardous waste encountered would presumably be the responsibility of the contractor). The government will still carry a good deal of the ancillary risks which would potentially be expensive for the private sector to bear. This kind of risk includes alignment procurement risks and some of the detailed permitting risk.

\subsection*{3.7.5 Funding/Financing}

The outcome of the federal environmental permitting process is the Locally Preferred Alternative (LPA) for the alignment of Tren Urbano which includes aerial structures for the guideway through Bayamon and Hato Rey as well as a tunnel section through Rio Piedras. The LPA includes 14 stations along this alignment. The total capital cost of the system including these pieces is estimated at $1.1 billion.\textsuperscript{102} The annual operating costs have been estimated at between $28 and $39 million. This project represents a significant investment in the context of Puerto Rico's overall Construction Improvement Plan for capital expenditures on transportation infrastructure. Including Tren Urban, new highway construction and highway reconstruction, the PRHTA plans to spend over $3.5 billion over the period 1995-1999. The evaluation section of the final environmental impact statement details these programs as well as the financial capacity of the PRHTA to undertake these plans.

Tren Urbano will be paid for by three primary sources: PRHTA revenues from motor vehicle registration fees and gas taxes; flexible U.S. DOT surface transportation funds which are awarded to Puerto Rico annually by formula; and FTA Capital Program funds from its Section 3 discretionary funds program. Federal discretionary funds are being sought in the amount of $300 million or about 1/3 of the project. The FTA has recently granted Tren Urbano a Full Funding Grant Agreement (FFGA), which is a very promising step toward the project receiving that capital assistance.\textsuperscript{103}

\textsuperscript{102}Puerto Rico Department of Transportation and Public Works. \textit{Final Environmental Impact Statement}, 2-56.

\textsuperscript{103}A Full Funding Grant Agreement is a commitment by the FTA to include Tren Urbano in the annual budget request sent to congress by the executive branch. There is no precedent for the congress to reject assistance for any project approved by the FTA.
The Highway and Transportation Authority has an investment-grade bond rating, and the financial plan outlined is based on the authority's well established revenue stream. The projections of future revenue growth are conservative, and this is one of the strengths of the financing plan.

The final piece of the puzzle is the federal transportation funds which will be leveraged to meet the final capital cost requirements. Puerto Rico has received $78 to $85 million from the Federal Highway Administration over the past two years. This flexible funding will be applied to the Construction Improvement Program of which Tren Urbano is an element. It should be noted that Tren Urbano's capital plan includes a contingency allowance of $136 million for an added margin of safety.\(^{104}\) The operating deficit of Tren Urbano is an obligation which is projected to grow to $29 million in 2006. This cost is covered by other PRHTA revenue sources like tolls and gas tax receipts.

As originally envisioned, this project was one which was to involve the private sector in ways new to transportation infrastructure development. The potential for joint development was considered to be a prime example of private capital assistance for the transit station capital costs with an immediate feedback to operational revenues from the ridership generated. The Commonwealth ultimately decided to prioritize concerns about efficient operations and maintenance above the joint development potential. One explanation for this decision is that the introduction of real estate interests in the context of system procurement is a distraction from the goal of operationally-driven design. Joint development can be incorporated as a second program at a later date (perhaps in conjunction with an extension), but the same is not true of operations and maintenance concerns.

\(^{104}\)Puerto Rico Department of Transportation and Public Works, *Final Environmental Impact Statement*, 6-2.
4. Case Study Results and Conclusions
4.1. **Introduction and Results**

Chapter 4 evaluates the case study experiences with an eye toward the turnkey issues presented in Chapter 2. Qualitative conclusions are drawn on the following subjects:

- United States versus foreign experience
- Time and schedule savings
- Public and private roles
- The impact of life-cycle incentives
- Turnkey as the first step to more private involvement

The range over which these projects vary is impressive and will affect the conclusions drawn. This variation makes the point that turnkey is a flexible strategy for procurement and makes the conclusions anecdotal in nature. But as these cases represent a large fraction of the new-start, modern turnkey projects in the rail transit arena, the experiences can be considered the state-of-the-art in the field.

Finally, this chapter concludes with a discussion about the ability to generalize from the case studies considered here to other future projects.

4.1.1. **United States Versus Foreign Experience**

Infrastructure development policy varies significantly from country to country. The United States has relied on a Quadrant IV approach for the last half century (see Section 2.1 for an introduction to Miller’s Quadrant analysis). The success of this system for procurement has been overshadowed by the public sector’s complete reliance on this single mechanism for infrastructure procurement. As a contrast, other regions have maintained a wide array of procurement options. One trend evident in the case studies is that foreign examples of turnkey-style project structures are more aggressive than U.S. cases. Risk and reward allocations are still primarily tilted toward the public sector in U.S. projects, while foreign projects assign more risk and reward to the private sector.
Foreign Projects Are More Aggressive

As explained in the introduction, turnkey contract structures can be found embedded in more aggressive franchise and concession agreements. The private sector has assumed revenue risks as well as the rewards of better-than-predicted ridership. In the case studies, one can see that foreign projects such as Manchester Metrolink and Kuala Lumpur STAR fall in this category. In both of these cases, the private project company set up to operate the transit system holds a long-term contract with the public sector. Docklands Light Railway, being an earlier example of the turnkey strategy, remains as the simplest project structure with no transfer of any risks beyond the design-build scope.

U.S. Projects Exhibit Scaled-Back Scopes

Both of the U.S. projects studied are carefully structured to give none of the ridership risks to the turnkey contractor. Hudson-were Light Rail and Tren Urbano both have a wide scope across which the turnkey consortium will exert control (through the first years of operation and maintenance), but, at the fundamental level, the contractor gets paid for building the system and running the trains on time.

The U.S. climate for transit development is very different from the environment in which the non-U.S. projects have emerged. The dominance of the automobile in U.S. transportation planning in the last forty years is unrivaled in the world. The market share of public transportation is an order of magnitude lower than that of foreign regions, and ultimately, the ridership risks in U.S. projects may thus approach a level higher by an order of magnitude as compared to other areas. In many cases, U.S. transit systems are developed not to maximize ridership, but to provide mobility for an under-served population in a lower income urban area. The service is subsidized as a policy decision.105 The private assumption of ridership risks in such cases is an impossibility.106


106 To prove the point that U.S. transit development (and not the U.S. generally) is an imperfect market for the transfer of financial risk, consider the willingness of private capital markets to assume the financial risks involved in private toll road development. This willingness is grounded in the historical private investment in quasi-public toll road authorities since the 1940’s as well as the modern toll-financed projects such as California’s State Route 91 project and Virginia’s Dulles Toll Road Extension project.
Projects have been attempted in the U.S. which were more aggressively formulated in terms of private sector involvement. Houston, Texas and Honolulu, Hawaii both are cities which had formulated a strategy for turnkey procurement of a transit system. In both cases, the project was not implemented. The Houston project was not supported by a majority of the metropolitan area, and a mayoral election defeat of the primary political sponsor of the project resulted in withdrawal of local support.\textsuperscript{107} The Honolulu system, a super-turnkey project positioned to be financed with a third of the capital from non-fare revenue real estate development, disintegrated when the City Council balked at approving a 0.5% sales tax option to cover the final third of the capital costs (federal support would have been the other third).\textsuperscript{108} In 1992, these projects were canceled within months of each other, which appears to have had a chilling effect on such projects. Now, four years later, with Tren Urbano an HBLRT, the U.S. has a pair of more carefully structured, less aggressive projects finally reaching the competition stage.

Furthermore, the U.S. transit development environment has long been on the receiving end of federal government matching assistance for capital expenses. This incentive has effectively pushed procurement strategy into Quadrant IV exclusively. The Federal Government has invested $60 billion dollars in mass transportation over the last thirty years, usually in the form of matching grants which cover up to 75 percent of the capital expenditures on the basis of a fixed percentage share (rather than a capped real dollar value of assistance).\textsuperscript{109} This capital assistance mechanism, coupled with federal procurement regulations which apply to projects which receive federal assistance, is the primary explanation of the reliance on Quadrant IV. As discussed in Section 2.3, the structure of the U.S. contracting industry has evolved in this environment and has become unfamiliar with the risks and rewards of more aggressive risk sharing.


\textsuperscript{108} U.S. DOT, FTA, \textit{Turnkey Procurement: Opportunities and Issues}, B-3.

4.1.2. Time and Cost Savings

Estimates of the time and cost benefits of turnkey procurement are appropriately vague: 10-25 percent cost savings for design and construction bundled; 10-40 percent in cost savings in private operation; up to 40 percent less time from preliminary engineering to completion. These savings are quantitative estimates of the benefits of a strategy which is, by design, flexible. The implications of this flexibility is that precise savings are only relevant on a project-by-project basis. Any range which would be broad enough to capture the true savings would be too broad to provide meaningful insight. The true benefit in terms of schedule savings may be the flexibility available to project strategists in customizing the procurement structure. In essence, the question to answer is not whether a turnkey strategy saves time or saves money, but whether the strategy saves time, if time is the critical factor (or likewise, whether the strategy saves money, if money is the critical factor).

Quantitative Evaluation

The detailed cost accounting work which would make up a quantitative assessment of the impact of turnkey is beyond the scope of this study. The FTA is undertaking this work for the projects included in the Turnkey Demonstration Program, and estimates of these numerical benefits will be available as the first round of demonstration projects are completed (Los Angeles Gateway Center is already complete and open). Both case studies from the U.S. will be evaluated as part of this program, but as these projects are only now in the competition stage of the development cycle, final evaluation will not be available for a number of years. The framework for estimating these benefits includes the construction of a counterfactual case of what could have happened under a conventional contracting scheme. This analysis method is perhaps the best tool to use in developing an overall cost-benefit analysis framework, but the validity of speculating what might have happened is debatable. Moreover, the right question to ask is whether turnkey gave more control to the government in developing a more advantageous cost structure and schedule. In almost every case, this is the most important benefit of a turnkey strategy.

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110Various sources, compiled in U.S. DOT, FTA, Turnkey Procurement: Opportunities and Issues, 11-12.
Schedule Control

The evaluation of a turnkey project schedule should not overlook the benefits of early commencement of construction as distinct from the benefits of early completion. Early commencement is perhaps the most important feature in San Juan’s Tren Urbano turnkey strategy.

The issue of schedule is entwined in the politics of major capital investment. Major projects, which generate immediate construction jobs and a general sense of progress, are an age-old component of political campaigns. Often, mega-projects like a new rail transit system are years in development, and the long-term nature of the project means that no political “champion” emerges to forward the project. In some instances, the environmental permitting stage alone can take longer than the re-election cycle, and the political risk of having no visible work at re-election time can outweigh the benefits of the actual project in the electoral calculus of political decision-makers.

The Tren Urbano project exhibits elements of this dynamic. The current administration wants a contractual commitment to the system in place before the gubernatorial election in November 1996. The turnkey procurement strategy for development allowed this objective to be met. The Governor and his officials took control of the project after the 1992 election and pushed this “back-burner” project through the entire development process to the construction phase over the course of four years. Come November, voters will be able to see bulldozers moving dirt around the vicinity of the test track alignment section and the adjacent yards and shops complex.

The Docklands Light Rail (DLR) project also benefited from schedule control more than pure time savings. The commercial development community was impressed with the alacrity of progress on the system, and the promise of near-term accessibility to the Docklands redevelopment sites spurred investment in a period shortly before the real estate collapse. Delays in the system development could well have pushed back developer confidence to the point where market conditions precluded any new investments. Only now (eight years later) are the real estate markets recovering enough to consider new buildings; a decade of below-capacity DLR operations would have been detrimental to the image of the area. Prior to the building frenzy and the high system ridership, DLR was considered a “white elephant” project and a waste of money.
Schedule savings can also be less important in the context of a sensitive development environment. Construction disruption is a significant concern in urban areas (which is often the site for transit system construction). Most likely, the urban area is already congested, hence the justification for the capital expense of building a transit system. Schedule savings are often associated with more intensive, disruptive construction processes which can encounter much opposition, especially in urban areas. However, with turnkey projects, schedule savings can be achieved with innovative construction techniques like the aerial gantry crane technique used in Kuala Lumpur and concurrent design and construction.

4.1.3. Emphasis on Front-end Strategy Development

A second major conclusion coming from the case studies (as well as from the failed projects in Houston and Honolulu) is the importance of a solid pre-project development effort on the part of the public sector. This conclusion points toward the emerging strategic role of government in an era of increased private involvement in transportation infrastructure.

The Effective Public Sector

All five of the projects considered here include an important role for the public sector in setting strategy and priorities to channel and focus private involvement. The concern that turnkey procurement is a step toward the complete loss of public sector control has not proven to be true. If anything, the planning process which has been undertaken by the public sector early in the pre-project stage has solidified, rather than weakened, public control over projects; Docklands was developed to provide access to a particular area within the framework of a larger redevelopment plan; the Manchester Passenger Transport Executive formulated the Metrolink procurement with an eye toward attracting private investment in the central city link between the northern and southern commuter rail networks; the national rail company in Kuala Lumpur developed a strategic plan to utilize surplus rail rights-of-way in the development of a regional rail transit system; New Jersey and San Juan both are structuring the procurement of a rail system to meet a regional transportation need and to peg operating costs to a fixed (inflation-indexed) value.

Under turnkey, the role of the private sector is in delivering a specified product in a specified time for a specified cost, all in a competitive environment. The pre-project process is responsible for generating the specification of this product in a manner such that it will enjoy popular support. Through the use of performance criteria, public strategic decisions can be
communicated in a manner which still preserves options for private sector competition as to how to deliver this system. That balance, specificity versus maneuverability, is the crux of the issue and the source of most of the potential advantages of turnkey. When the public sector has invested sufficient attention to developing an appropriate procurement strategy, the project can often be delivered effectively by the private sector, achieving a final form which is closest to the conceptual functionality of the original idea.

The public sector maintains the crucial role of assuming risks which are inappropriate for the private sector to take such as right-of-way assemblage (as done in all of the projects). Another role of the effective public sector is that of structuring the procurement process in a way that promotes competition and effective interaction between the public and private sector.

**Reaching consensus and “laying the track”**

Perhaps the most important role for the public sector is as bearer of political risk. This identifies the strength of the government as a stabilizing force as a project sponsor and as an appropriate facilitator of public debate from which support for a conceptual plan must emerge. Before any procurement strategy is formulated, large projects should have the consensus support of a well-informed citizenry. Such a climate surrounding project development will attract the private sector to implement the procurement strategy.

Preparing the way for a contractor is another important risk mitigation role for the public sector. This includes such things as completing the environmental permitting and assembling the right-of-way. The private sector is not adept at these activities, and the cost of shifting these risks to the private sector would take the form of expensive proposal bids. Even in a project like STAR, in which the concession contract transfers ridership risks to the private sector, the government assumed the right-of-way and political risks. The Malaysian Government donated use of the abandoned freight right-of-way in addition to initiating the idea of rail transit for Kuala Lumpur through a strategic study of the possibilities (see Section 3.5).

Once the procurement strategy is developed and implemented, the turnkey contractor should be able to come in and get to work immediately, with the stage set for rapid progress in the physical construction of the system.
**Focus on strategy**

When a public agency can stay above the fray of construction oversight, the public interest in the overall framework of the system plan and implementation can be better preserved. This is not to say that the public sector should ignore the detailed issues involved in construction management and oversight; the response of some of the owners in the case studies has been to hire an owner’s representative in a general management capacity (i.e. Docklands and Tren Urbano). When the project is over, the consultant can move on to a similar project elsewhere, and the public sector can continue its role of strategy development and planning the next element in improving the network of related infrastructure and services.

**Public involvement: financial as well as strategic**

Rail transit is likely to remain a huge investment which cannot support itself from farebox receipts (particularly in the U.S.). Rail transit turnkey projects will still need financial help from the public sector. The case studies show some ways in which this assistance can be offered effectively. One example is the donation of right-of way. Another is the equity investment in the private joint venture which takes ridership risks over the life of an extended franchise period (60 years in the case of Kuala Lumpur, 15 years in the case of Manchester).

In the U.S., Where financial support from governments is a much larger part of the project structure, public involvement can take the form an operating revenue guarantee to the private turnkey party. When the contractor is committed to operating a fixed schedule for a fixed annual price (Tren Urbano and Hudson-Bergen), the revenue stream is channeled to the public sector which absorbs the risk of ridership revenue not covering expenses, and the operator gets paid for service provided. The private sector invests no equity and bears no ridership risk in the operations. The incentive structure in the operations aspect of the Tren Urbano ST3 contract is a unique clause that acknowledges the link between the operating environment and the traveler’s decision to use Tren Urbano (see section 3.7).

**The non-traditional owner**

Most of the owners involved in the case study projects tend to be non-traditional owners. This has emerged as one of the key enabling factors which point toward beneficial turnkey procurement. When the public sector explains its traditional procurement strategy with the phrase, “that’s the way we’ve always done it,” the hope of realizing any benefits from new procurement methods is bleak. It seems the “non-traditional” owner is an agency which is new to rail transit contracting or is in some other way freed from reliance on the segmented process.
In the case of Docklands, the owner was the London Docklands Development Corporation, a quasi-public redevelopment authority which focused on a strategy for attracting development to the area. The rail system was a means to that end, so LDDC left development of the system up to the experts at London Regional Transport and its consultants.

Manchester Metrolink grew out of a public sector restructuring. The Passenger Transport Executive, created specifically to handle the planning of passenger services outside the context of the operating responsibilities, was given a mandate from the central government to increase private involvement in the project. From that directive came a successful turnkey project.

In Puerto Rico, the public sector leans strongly towards private involvement in the provision of services. Not having an established rail system, the government is new to the field of transit development. This has helped the decision-makers maintain a strategic view of the process while using consultants for much of the task work in implementing the strategy.

New Jersey is an interesting case of a very traditional owner, very experienced in rail system procurement and operation, that decided to withdraw to a strategic position in the development process. The Waterfront area of Hudson and Bergen counties has been under study for many years, but the strategy of going to a turnkey Design-Build-Operate-Maintain structure has moved the project into development rapidly.

An effective public sector agency does not necessarily come from explicit restructuring of the government sector; nor is turnkey limited to neophyte transit system owners with no experience in rail system procurement. The enabling structure seems to come from a commitment to strategic rather than specific point-by-point control of the development process.

This interest in strategic control, together with a commitment by the public sector to deal with pre-project risks like political consensus and permitting, make up the bulk of the institutional framework for the successful implementation of a turnkey strategy. From this, the benefits of strategic control and private sector efficiencies in design, construction and operations can bloom.

4.1.4. Impact of Life-Cycle Incentives

One issue which must be considered separately from the general cost savings of turnkey is the impact that life-cycle incentives have in generating private sector efficiencies. Transit is traditionally a commodity bought on the basis of low price, but the long life-span of transit
infrastructure and the feedback between service quality and ridership revenue make this market a perfect situation in which to apply the concept of life-cycle cost accounting. Section 2.3 introduces the ideas of life-cycle efficiencies, and the case studies confirm the beneficial nature of turnkey strategies in improving life-cycle cost controls. Innovation in design, technology, and construction techniques is the mechanism which achieves this improvement.

By expanding the scope of a turnkey project to include operations and maintenance, a project owner may get a better long-term price when costs such as operations, capital replacement and ridership revenue is netted out from the original capital cost. For example, the added investment for an advanced electronic control system will pay handsome dividends in reduced operational costs over the life of the system.

An innovative design in the Manchester system has had the unexpected effect of creating a new market for transit service. The accessible design of the Metrolink, originally designed for wheelchairs, has led to more passengers of all types using the system. The level access platforms means that people with all sorts of baggage find it easier to use the system. That system feature added to the initial costs, but the additional ridership revenue has made the investment in an accessible system more than pay off.

By considering the "costs" of construction more broadly than a traditional contractor in a traditional segmented low-bid job, the STAR system constructor lowered the life-cycle costs of the project. Construction disruption in the heart of Kuala Lumpur would have been costly; the construction technique of bringing pre-cast viaduct sections to the site and assembling them from above street-level with a gantry crane was more expensive than other methods of building aerial structures would have been, but the life-cycle cost is lower.

The feedback from a fixed-period operational commitment has not yet had a chance to prove the life-cycle incentive benefit. The two projects which include operations and maintenance, Hudson-Bergen and Tren Urbano, are both years away from entering operations. Perhaps the design will improve ridership and/or reduce operation costs,\textsuperscript{111} but the strict dollar analysis of net present value would argue that, in the absence of more explicit ties between design and operations, this feedback link is weak. More immediate than operations is the effect of design on construction, and the likelihood that design-build efficiencies will save money is high, based on the results of the Docklands design-build turnkey.

\footnote{\textsuperscript{111}Increasing revenues and decreasing costs are two sides of the same profit-maximizing coin.}
4.1.5. Turnkey as a First Step to Greater Private Involvement

Docklands Light Rail proved to be a wise investment in spurring private sector development. The Canary Wharf developer spent money upgrading the capacity and image of the system, and extensions built after completion of the starter set have been privately financed or leveraged through increased land value along the alignment. This is perhaps the best-case scenario for a turnkey rail system to spur new investment in future phases. Beyond the Docklands example, is it possible to speculate on the ultimate success of these projects in terms of stimulating more private development? This question addresses two points, both of which seem inconclusive: the first is future private involvement in system extensions of these specific systems and the second is future private involvement in other similarly-structured projects in the future.

In the case of future projects which are developed in areas other than the United States, the future potential of continued private involvement is clear and not an issue. The private sector has already entered into projects at all levels, including equity investment and ridership risks. The more tricky question is private sector investment in transit projects in the United States.

Both examples from the United States are structured to permit future involvement. Tren Urbano has the stated goal of reshaping development patterns in the San Juan Metropolitan Area. The general support enjoyed by the project means that it is possible for land use planning to be strategically coordinated to match this goal. Station area development is the primary means by which future private involvement may be channeled into the project. The phasing strategy for the Hudson-Bergen project has been carefully structured to enable investment in future phases. The system turnkey contractor is responsible for the cars, signal and operation of future system extensions, but the responsibility for the physical guideway and station structures is purposely left open. The planned park-and-ride lots represent a good potential for future private involvement. In short, both projects are structured so as not to preclude private investment.

Whether this enabling strategy will result in concrete results in these two projects is too early to tell, but in recent experience, parking lots have been at the vanguard of the U.S. experience in private investment in transportation infrastructure. One of the most successful projects to emerge from the State of Washington’s Public-Private Partnership program is the King County/Metro park-and-ride lots which are served by the county bus operator to take commuters to downtown Seattle. The revenues from this project are sufficiently strong and stable to support private sector investment. This may well be the next step in private investment in rail transit systems.
The prospects for future U.S. rail transit projects to be formulated around a strategy of private real estate-financed development ("super-turnkey" in the parlance) do not seem bright. The mode dominance of the automobile is hard to work around when calculating ridership and the added value of rail access for commercial and residential real estate values. As postulated above, other areas of the world do not have this auto-oriented development legacy, and in these cases the prospects of rail system investment by the private sector have been and will continue to be good. This trend can only improve as roadway congestion grows in urban areas of the developing world. These areas will have to choose between expanding their transportation network capacity or watching economic expansion migrate to other regions. Rail transit will be a good option for high-capacity, accessible infrastructure investment.
4.2. Ability to Generalize the Results

The prior discussion of results and conclusions coming from the five case studies has addressed the issue of applicability of these experiences to future projects. This is primarily important in the United States, where turnkey and turnkey-style projects represent such a departure from “business-as-usual” in the area of transit system development. The ability to generalize impacts the prospects of increased private involvement in rail system development, be it turnkey procurement or some other form.

4.2.1. Issues of System Procurement, Not Merely Transit Systems

The issues of risk, competition and other aspects of a more flexible procurement process will continue to be applicable to all sectors of the transportation infrastructure market. In that sense, the issues of increased private involvement in transit infrastructure are transferable to private toll road development and park-and-ride facilities. Because the climate for new-start rail transit systems is limited, perhaps the next topic to research is the future prospects of increased private involvement in system extensions. Many of the biggest cities in the U.S. and the world are in this market by the fact that existing systems can readily be added to.

4.2.2. Federal Procurement Policy

The influence of federal procurement regulations in the structure of procurement strategies is currently overwhelming. Decisions about discretionary capital support affect both project planning and procurement strategy formulation. The future of private involvement in rail transit systems may well depend on future trends in these policies.

The Turnkey Demonstration Program has enabled public owners to consider stepping back in the development process to assume a more strategic policy stance. Whether or not this trend is just another adaptation on the part of local project sponsors to compete for limited federal funds will be revealed when the program is over. It is plausible that just as federal matching grants have resulted in thirty years of Quadrant IV development, the influence of the Turnkey Demonstration Program has opened up a new range of options for public sector development
strategy without the implied risk of withdrawal of federal support. Now, if the benefits inherent in owner flexibility (in formulating development strategy) are valuable enough, or if the influence exerted by federal capital support does not retrench to exclusive Quadrant IV mechanisms, the applicability of the turnkey results discussed here have a great potential to be factors in future projects.\textsuperscript{112}

4.2.3. Lingering Questions

Other issues affecting the applicability of turnkey results to future endeavors include the historical dominance of Quadrant IV and the impact of the two prominent U.S. project failures mentioned earlier (Section 4.1.2).

As discussed in Section 2.2, the traditional process of segmented procurement is effective in delivering pieces of the infrastructure network in a transparent process which stresses public interests like safety and low initial costs. The environment of infrastructure development in the U.S. will not allow a regression to unaccountable, non-competitive contracting practices. As a result, the applicability of turnkey and more aggressive procurement strategies which harness private sector ingenuity and efficiency is linked very much with the ability to retain the strengths of the current procurement system while broadening the options for public owners to control infrastructure in a more strategic way. This can result in the decisions to spend public capital money on projects which serve a non-economic public interest and to make use of private investment in commercial-quality projects.

\textsuperscript{112}The influence of federal support is the product of two components: the dollar value of the capital grants distributed and the regulations to which that aid is tied. Retrenchment would require two components: continued capital assistance (which is mentioned in light of the current roll back of federal discretionary spending) and a rejection of the liberalization of procurement regulations, of which the Turkey Demonstration Program is a part. In the case of reduced federal capital assistance, localities might actually respond to the need for capital assistance by more actively including the private sector in investment decisions. A continuation of the policies which underlie the Demonstration Program will give localities even that much more flexibility in formulating procurement strategy.
The failure of Houston and Honolulu, while a setback to innovative contract structures in the minds of some, point to the emerging roles of the public and private sector. The turnkey model is most applicable in cases where the government knows what it wants, and goes to the vendor and contractor community to buy it. Political risk and pre-project risk are considered and resolved before the project is advanced beyond the conceptual stage. The public role is evolving into one of strategic policy formulation and path-clearing, all of which must be conducted in an open and competitive environment. The private sector role is to effectively deliver a rail system which meets the performance criteria specified in the political and regulatory process.

4.2.4. Flexibility

If the public sector is to move toward the role of strategic policy formulation and control of infrastructure development from a higher level, then flexible tools like turnkey procurement must be available to the decision makers. The applicability of turnkey to future projects is bolstered by the flexibility of these schemes. The range of projects which have been considered in these case studies, from a straight-forward design-build contract for Docklands Light Rail to a full concession contract for STAR in Kuala Lumpur, prove nothing more plainly than the value derived by public owners in having a range of options available. U.S. transit procurement decision-makers will likely come to appreciate the flexibility which is being demonstrated with the first round of turnkey projects now in the pipeline. The applicability of this model to future projects will necessarily be determined on a case-by-case basis, and this is the ultimate objective of opening up a wider array of procurement options: to match procurement strategy with the unique conditions of each separate project.
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