End-of-Year Reports and Theses
MIT/Northeastern University
Covering the period September 2001-August 2002 (Tren Urbano Group VIII)

Name	Title of Report for Tren Urbano, end of summer 2002	Type of Report
Ardila-Gomez, Arturo	(1) Organizational Capacity Requirements of PRHTA once Tren Urbano is Functional *(official report)* (2) The Planning Process for the Tren Urbano Project	End of year
Altun, Selman (Northeastern)	Improved Signal Control Strategies For Bus Priority In The Old San Juan Corridor	**End of year**
Barker, David	Communication, Information And Responsibility Distribution Strategies For Effective Real-Time Transit Service Management	Thesis/Ex Sum (MST, June 02)
Bent, Elizabeth	Urban Transit: Reconciling Accessibility, Preservation And Development	**End of year**
Chang, Cybele	Improving Jitney Service Quality: An Appropriate Governance Model For San Juan, Puerto Rico	Thesis/Ex Sum (MCP, June 02)
Covarrubias, Alvaro	Financing Rail Transit Extensions Through Area Development	**End of year**
Crockett, Cordy	A Process For Improving Transit Service Connectivity	Thesis (MST, Sept 02)
Curtis, Elizabeth	Park It Over There, Buddy: An Inquiry Into Station-Area Parking and Transit-Oriented Development	Thesis/ExSum (MCP, June 02)
Davis, Allison	Innovative Strategies For Managing Increasing Costs Of Paratransit Operations Under The Americans With Disabilities Act	**End of year**
Lee, Derek	(1) Understanding Capacity and Performance of Urban Rail Transit Terminals (2) Case study of Tren Urbano Sagrado Corazon terminal	(1) Thesis (MST, June 02) (2) EOY paper
Lee, Esther	Does Training Matter? Construction Quality For A New Start Transit System: The Case Of Tren Urbano	Thesis/Ex Sum (MCP, June 02)
Moore, Angela	A Process For Improving Transit Service Management During Disruptions	Thesis (MST, Sept 02)
Perez, Juan (Northeastern)	Bus Priority Treatment on Congested Arterials	Thesis/Ex Sum (MS, Sept 02)
Proakis, George	Strategies For Design: Shaping Private Development Adjacent To Transit StationsCase Studies For Tren Urbano	Thesis/Ex Sum (MCP, June 02)
Pulichino, Michael	Implementation Of Policies For Transit Systems Preferential Treatment	**End of year**
Sholler, Matt	Brand Positioning As A Strategic Tool For Transit Competitiveness	End of year
Switkes, Frances	(1) Making The Changes Happen: Current Institutional Coordination And Funding With Regards To Station Area Improvements (2) A Quantitative Look At The Affects Of Design On Mode Choice	**End of year**

End of year report as part of the MIT – UPR Tren Urbano Technology Transfer Program

By

Selman Altun

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Improved Signal Control Strategies for Bus Priority in The Old San Juan Corridor

June, 2002

Research supervisor: Prof. Peter Furth

Beginning Summary

Bus priority at traffic signals is important for providing fast and reliable bus service , which is crucial for Tren Urbano's success, especially on Avenida Ponce de Leon.

On her 2001 M.S. thesis, Melanie Tilgner showed that there would be substantial benefits of bus priority; however, her research left important issues unanswered that I intend to address. Like Melanie, my primary research tool will be VISSIM, a micro traffic simulation model.

First, I will develop and test improved signal control and priority methods for higher volume / capacity ratio settings.

Second, I will develop and test improved methods for determining segment running times, which are important when using conditional priority.

Third, I will determine the impacts of using different stop-locations – near-side, far-side, mid-block, and various alternating schemes (e.g. alternating near-side and far-side), considering cultural expectations, and evaluate the benefits of changing stop locations on Avenida Ponce de Leon. I will propose better stop locations for Avenida Ponce de Leon.

Preliminary Findings

Reorganizing the San Juan metropolitan area around high quality transit service is one of Puerto Rico's important societal objectives, leading to its investment of hundreds of millions of dollars in Tren Urbano Project. In order to accomplish that objective, Tren Urbano must be complemented with high quality and attractive bus services. The Avenida Ponce de Leon corridor between Sagrado Corazon station and Old San Juan is one of the most important bus corridors feeding Tren Urbano, projected to carry 20 buses per hour. The bus service in this corridor needs to

coordinate well with Tren Urbano. To help insure Tren Urbano's success, bus service in Avenida Ponce de Leon must be fast and reliable. However, benefits of reliability are more important than benefits of faster service. People tend to use transit when its cost in terms of walking time, waiting time, in-vehicle time, transfers and actual cost of a trip is less than the cost accompanying the same trip by auto. The waiting time component, in general, is calculated assuming a fixed headway between two buses. Thus, waiting time in average is half of the headway. However, a frequent bus service is rarely able to maintain this desired design headway. On the contrary, buses tend to catch each other. When there is a bus departed late compared to its schedule will have more people waiting at the first stop. Boarding will take more time. This will make the bus more late for the next stop and there will be even more people waiting for it. On the other hand the following bus will see less people waiting at the bus stops. Thus, the follower bus will catch the bus ahead.

Reliability can be interpreted as regularity (maintaining the desired headway) and punctuality (schedule adherence). Along with exclusive lanes (already in existence), these objectives can best be met by an effective traffic signaling and operational control strategy. This strategy requires a detailed transit schedule including scheduled running times for every section and scheduled departure times at every signalized intersection.

Melanie Tilgner, a student in the Tren Urbano program, who finished her master's thesis on this topic in July, 2001, produced useful findings on her work. She developed a highly interruptible, actuated control strategy with conditional priority. Compared to fixed time control, her strategy reduced transit travel time by over a minute in each direction, while leaving travel time for general traffic unchanged.

However, more research is needed to further develop traffic signal control and operational control methods for Avenida Ponce de Leon and similar roads. Three issues stand out.

First, a better method of generating scheduled run times by segment for conditional priority is needed. Conditional priority -giving priority to late buses and withholding priority from early buses- is a powerful method of operational control that improves service quality by keeping buses on schedule. However, conditional priority

can only be applied if a bus knows whether it is late. That requires scheduled departure times at each intersection, which in turn require scheduled segment running times for each segment. Thus, compared to traditional operations, conditional priority requires a much more detailed and carefully constructed schedule. An important issue is how those scheduled segment running times are generated. Melanie generated scheduled running times following the approach suggested in Muller and Furth, using 85-percentile completion times predicted by simulations using absolute priority. This approach is intended to offer a balance by being generous under an operating environment that is unusually fast. However, when applied to Avenida Ponce de Leon, this method resulted in a schedule that was too generous. Buses rarely ran late, and therefore made few priority requests, on average only 0.9 per northbound trip and 3.3 per southbound trip. With a tighter schedule that demanded priority more often buses would run faster, benefiting both passengers and the operator, using priority to speed them along. A tighter schedule would also be consistent with the scheduling concept of Furth and Muller, namely, that signals should give priority about 50% of the time in order to provide push-pull control needed to keep service on schedule. Therefore, one aim of my research will be exploring and developing a better method for determining scheduled segment running times for each segment to have the benefits of conditional priority more effectively.

Second, previous research by numerous authors indicates that priority control is much more of a challenge at high levels of volume to capacity (v/c) ratio. In Melanie's thesis, v/c ratios, which were based on the data she had available, were relatively low. However, at certain times of day, Avenida Ponce de Leon is very congested. There is a lot of double parking mainly between De Diego and San Jorge. Melanie was not able to consider this issue at all. This double parking on Ponce de Leon is mainly due to some government buildings, which attract a lot of trips without efficient parking places; also there are some currier service buildings such as FedEx causing lots of parking problems. All those lead to double parking along this section. So, for my thesis I am going to use only one available lane for northbound direction on Ponce de Leon between De Diego and San Jorge.

This adjustment will also help us to understand the conflict in the volume / capacity ratio. The results I was able to obtain showed Melanie's operational control with conditional priority gave priority to all the buses at every intersection in outbound direction. This is due to the tight schedule. Before considering double parking it was nearly negligible. Her schedule was very generous for that v/c ratio.

Third, an important means of speeding bus service is to rationalize bus stop locations. Melanie's research did not explore this issue at all. Near-side, far-side, and mid-block locations have different implications for traffic signal control and priority. We need to see whether changing stop locations can have a positive impact on traffic and travel times. We want to use a different control strategy other than Melanie did. In her strategy buses were detected just before the intersection. If there is a bus stop, buses are detected just leaving the bus stop. The control logic was then deciding the lateness parameters of the bus and giving priority if necessary. If a priority was granted, lights were changing to green by interrupting the fixed cycles of the traffic lights. This was disturbing the traffic on the side street and also needed recovery strategies after disturbing traffic.

Our new strategy includes detection of the buses one or two intersections before. In terms of cycle time I can say that it would be three of four cycle times. Once the bus is detected, our control logic is going to predict the approximate arrival time of the bus to the intersection. This arrival time will be an interval during which the lights will be granted to be green. Traffic lights will have a maximum and a minimum amount of cycle time during preparation interval which is the time after detection until the bus passes the lights. Traffic lights will be actuated but cycle times will not go below or above a certain time. This will enable the lights to be green while the bus is passing. By this strategy we aim to improve the disturbing effects to the side traffic and improve the transit service by less impact on other traffic.

Data and Research Tools

Our primary tool is VISSIM, a microscopic, time step and behavior based simulation model of urban traffic and public transit operations. I will also use TriTAPT, a transit operations analysis tool, for bus schedule design and for operations impact evaluation.

Much of the data needed for this study is already available having been collected by Melanie.

Tasks

1) Develop higher traffic volume scenarios on Avenida Ponce de Leon corridor between Sagrado Corazon station and Old San Juan, test and analyze the impacts of this more-than-predicted traffic volume on the bus system with the existing control strategies. Determine weaknesses, and develop and test improvements. The product of this task will be improved signal control strategies and reassessment of the impacts of signal priority on transit operations and traffic in a more crowded environment.
2) Explore and develop a better method for determining segment running times to have the benefits of conditional priority more effectively which will improve service quality and reliability by keeping buses on schedule. To do this I will apply the suggested method of Furth and Muller, which says signals should give priority about 50%of the time in order to provide push-pull control to keep service on schedule. Design the segment running times for Avenida Ponce de Leon accordingly.

   The product of this task will be an improved method for determining segment running times for bus operations with conditional priority. It will be applied to Avenida Ponce de Leon, and used in Task 1.

3) Test different stop locations considering cultural expectations and signal control strategies to determine impacts and benefits of different configurations, which will include near-side, far-side, mid-block, and various alternating schemes (e.g. alternating near-side and far-side) Propose better stop locations for Avenida Ponce de Leon and estimate benefits of changing.

Up to now I became familiar with the VISSIM software and VAP logic. I made necessary adjustments on our simulation for all our tasks. First part of task 1 was accomplished.

Changes in priority requests at actuated intersections after adjusting the simulation can be seen in Appendix 1

Appendix 1

	Before Double Parking		After Double Parking	
	inbound	outbound	inbound	outbound
int2	1/26	2/28	1/26	10/29
int3	4/26	0/28	5/26	22/29
int8	4/26	0/28	5/26	27/28
int9	4/26	0/28	5/26	27/28
int11	5/26	1/28	5/26	27/28
int12	5/26	0/28	5/26	27/28
int15	8/26	0/28	8/26	27/28
int16	6/26	0/28	5/26	27/28
int17	6/26	0/28	5/26	27/28
int20	7/26	0/28	6/26	27/28
int23	4/26	2/28	5/26	27/28
int26	7/26	2/28	8/26	27/28
Int32	7/26	3/28	7/26	27/28
int35	3/26	6/27	4/26	27/28
int45	0/26	0/27	2/26	27/28

Organizational Capacity Requirements of PRHTA

Once Tren Urbano Is Operational

Executive Summary

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1. Introduction

Metro systems such as Tren Urbano are complex to operate and maintain. On the operational side, metros require great expertise on tasks such as scheduling, assigning crews, running the fare collection system, and providing a bus-based feeder service to the rail line. On the maintenance side, heavy rail requires giving preventive and routine maintenance, and repairing damages and failures as they occur.

Many of these tasks will be directly assumed by the system test track and turnkey (STTT) contractor, which has the broad responsibility of designing, building, and operating the Tren Urbano project for a period of five years after opening day. Under this approach, consequently, the government of Puerto Rico, represented by the Puerto Rico Highway and Transportation Authority (PRHTA), has the role of overseeing the correct evolution of the STTT contract and of undertaking other tasks, such as feeder service and emergency planning.

This research answers the following questions: Does PRHTA have the organizational capacity to oversee the operations and maintenance of Tren Urbano done by the STTT contractor? Does it have the organizational capacity to implement feeder service, provide transportation services to society at large, and handle emergency situations, among other situation that the overall operation of Tren Urbano implies? If the agency does not have the required capacity, what strategy should it follow to acquire this capacity? If PRHTA *does not* implement the minimum level of organizational capacity required to adequately oversee the operations and maintenance of Tren Urbano are there any negative consequences, and if so, what are they?

The research done suggests that the answer to these questions is that PRHTA *does not* have the required organizational capacity at the time of writing this document. A simple but important reason that explains why this is the case is that the Authority currently does not need to be able to oversee the operations and maintenance of Tren Urbano, simply because the project is still not operational. In a matter of a little over one year, however, when the project opens to the public the authority will need to have a minimum level of organizational capacity. Otherwise, the overall functioning and success of Tren Urbano will be imperiled. As a result, PRHTA has to develop a strategy

for building this capacity *before* the project opens to the public. The remaining of this document substantiates these arguments and suggests possible strategies for building the required capacity.

2. Organizations, Environments, and Organizational Capacity: A Theoretical Framework.

Government agencies in charge of implementing policies need to have a minimum level of institutional and organizational capacity to do so. Organizational capacity can be defined as "the ability of a government agency to institute the structure, routine tasks, and coordinate the efforts of talented people to convert a policy into real achievements." A review of the literature indicates that organizational capacity is a function of the funding available for implementation, organizational structure, personnel, knowledge, and the organizational environment in which the agency operates.

Funding and personnel are important for only with them can organizations perform adequately. An adequate organizational structure is also important for it allows an agency to cope with uncertainty and process information effectively. Finally, knowledge is also important for it provides the required know-how. Knowledge is different from information in the sense that the latter is factual whereas the former is conceptual and tacit.

Regarding the organizational environment it is important to point out that it is the main source of uncertainty and that organizations must learn how to cope with the threats and advantages that the environment offers. For example, public agencies when implementing a project have to deal with the complex political environments in which interests, values, and power interact so as to determine what gets done. Furthermore, agencies have to interact with other agencies and organizations, each with different organizational objectives and vested interests.

When this framework is applied to a concession scheme the conclusion that emerges is that for good performance the public agency in charge of monitoring and overseeing the private concessionaire has to have adequate organizational capacity. If

this is true, the private concessionaire will face the right incentives since there is a capable and powerful public agency in charge of monitoring it.

3. Analysis of the Case Studies

The case studies analyzed are first, the privatization of the traffic light system in Bogota, Colombia. Second, the turnkey contract for designing and building two rapid rail transit lines in Medellin, Colombia, and thirdly, the Madrid, Spain, Metro extensions. Cases one and two are considered a failure, whereas the remaining one is considered to be successful. By comparing the two sets we will be able to analyze what determines a successful interaction between government agencies and private contractors.

The three cases presented show that the theoretical framework developed is valid. First, when the public agency lacks organizational capacity a private contractor does not perform as expected and does not achieve the objectives, or it does at a much higher cost. When, on the contrary, the public agency has the required capacity –human and financial resources, structure, and knowledge– the situation can be the exact opposite. The contractor performs as expected, makes a profit, and society at large is better off, because the objectives set to the contractor are achieved at a lower cost.

Second, when the government agency lacks the required organizational capacity the contractor enjoys an advantage that can allow it to capture the public agency, and even extract large profits, at the expense of the public welfare. Indeed, the solution is for the government to develop a reasonable level of institutional capacity and in this way counterbalance the implicit power that the contractor has vis-a-vis the government.

Finally, the investment the government agency does in developing in-house capacity is clearly profitable, for results are achieved at a lower cost than when there is no capacity within the public agency. Objections to developing in-house capacity because of the implicit redundancy are thus disproved. Society at large wins when public agencies invest in developing the organizational capacity required to adequately overseeing private contractors. Further, private contractors also win, for they carry out their work in a better way and do not risk their reputation or future contracts.

4. Organizational Analysis of PRHTA: Current Activities

The analysis from an organizational perspective shows that PRHTA has adequate organizational capacity for performing the responsibilities it is *currently responsible for.* The agency has adequate structure, funding, personnel, and funding for overseeing the performance of the contractors that build the projects that the agency is responsible for. The analysis indicates that the agency has several strengths and weaknesses.

The strengths are first, the agency has independent sources of funding, and these sources provide the agency with a large amount of recurrent income. These resources allow the agency to finance the undertaking of many projects per year and also allow it to finance the functioning of organization itself. Second, the structure of the agency can be modified very easily, literally with the stroke of a pen. Finally, another advantage that is the power that its director has, as well as the power of the secretary of the Department of Transportation and Public Works.

To analyze the weaknesses it is important to emphasize that the analysis is made in light of the future requirements that PRHTA will have to meet for successfully overseeing the operations and maintenance of Tren Urbano. The weaknesses are: First, PRHTA enacted an early retirement plan at the end of 2000 thanks to which approximately 200 experienced middle-management professionals retired from the agency. These people were highly knowledgeable and had a wealth of experience about the agency and about how to do their work. Second, partially as a result of the retirement of these 200 middle management people but also because of other reasons, some of the units within PRHTA are overwhelmed with work and cannot cope with all the duties at hand. Third, the authority has historically specialized in the construction of transportation facilities, such as highways, and lately a mass transportation project such as Tren Urbano. However, the authority has little experience operating facilities and overseeing contractors handling the operations and maintenance of transportation projects. In light of the future operations of Tren Urbano, this bias towards administering construction contracts has both positive and negative repercussions. On the one hand, the agency knows in general what it takes to administer a contract. On the other hand, however, the Authority might have a narrow perspective of what

administering a contract is. Administering operations and maintenance contracts is more difficult because of the difficulties that measuring performance entails.

In conclusion, for adequately facing the organizational requirements derived from the operational stage of Tren Urbano the Authority will have to change the way it oversees contracts, and learn the new skills and knowledge it needs for doing so. Skills and knowledge that are specific to the operations and maintenance of a train and that are quite different to those required for a construction contract.

5. Future Organizational Capacity Requirements in Light of the O&M contract

The analysis of the contract signed between PRHTA and STT for the operations and maintenance stage of Tren Urbano reveals that the contract is not self-enforcing and that adequate monitoring and supervision are needed to make it work in the expected way. Probably the main incentive in the contract for adequate performance is the possibility of extending the contract for an additional five-year period; a decision that is made solely by PRHTA based on its own considerations. This feature can work, however, in the opposite direction by inducing the contractor to under perform to get out of the contract. This can happen if the operation is not profitable for the contractor or if the contractor is not interested in the contract. The solution is on the one hand to have a high level of organizational capacity within PRHTA to oversee STT. On the other, the solution is to make STT believe that the extension of the contract will take place regardless of its performance. This threat will force the contractor to perform, because otherwise it will risk losing money during the extension period. Further, PRHTA can also exercise at the beginning of the O&M stage the option to extend the contract, and achieve similar results.

Additional examples also show that the contract is not self-enforcing. First, the contract establishes that the contractor according to pre-specified standards shall do the operation and maintenance of Tren Urbano. The use of standards is adequate but in order to be effective, PRHTA has to measure to what extent actual performance differs from the standard. Second, PRHTA has to approve all maintenance procedures used by the contractor. Third, PRHTA has to have organizational capacity to understand the

wealth of data that will be generated constantly, analyze it, and make the management decisions necessary to ensure the adequate performance of Tren Urbano. Fourth, PRHTA has to be able to carry out the full inventory prior to starting operations of the entire Tren Urbano system in order to enforce the part of the contract that establishes that "the contractor shall keep the Service Property in the same good order, condition and repair as the same were in on the revenue service date..."

What STT will have in place: For operating and maintaining Tren Urbano, STT's philosophy is to have in-house personnel and contractors to perform the maintenance and operations of Tren Urbano. Furthermore, STT will have in place a complete schedule of preventive and corrective maintenance, as well as quality control to insure meeting the standards. Finally, all this will be done in a cost-effective manner, which is obvious, given the fact that STT is a profit maximizing company, as it should be. STT's plans call for establishing an organization that has a reasonable structure (see E.S. Figure 1), funding, personnel, and knowledge; that is, what seems to be a capable organization for operating and maintaining Tren Urbano.

Minimum Organizational Capacity for PRHTA: PRHTA should have a minimum organizational capacity in order to adequately monitor STT. Only if this capacity exists will STT perform as expected and consequently will Tren Urbano operate as desired. PRHTA will have to develop capacity to:

1. Understand the complexity of Tren Urbano.
2. Understand to the fullest extent possible its rights and obligations as defined in the contract.
3. Review, analyze, understand, and evaluate all procedures used by STT regarding both service provision and maintenance of the trains.
4. Measure the actual performance of the contractor and compare it to the performance standards specified in the contract and determine whether they are being met or not.

5. Understand and analyze the wealth of information that will be constantly collected and periodically reported by the contractor to PRHTA.
6. Carry out research and development in order to improve its understanding of how Tren Urbano functions.

6. Future Organizational Capacity Requirements: Feeder Service, Stations, Power Failures, and Other Issues

Issues such as station operations and management, feeder service, power failures and emergency situations, and the planning and construction of future faces of Tren Urbano impose on PRHTA additional organizational capacity requirements. Current STT plans indicate that it will not carry out these tasks, or not to the level desired for Tren Urbano to render its full benefits. The contract, moreover, does not oblige STT to carry out most of these tasks.

Station Operations and Management: Adequate station operations and management require that both the inside *and* outside of the stations be managed. For example, it is in the outside of the stations that critical issues such as feeder service take place. The contract and the maintenance and operations plans developed by STT focus only on the inside of the station. Consequently, PRHTA will have to develop organizational capacity to make sure that in one way or another the outside of the stations is adequately operated and maintained. This implies coordinating with other agencies so that plans to manage traffic outside the stations are enforced.

Feeder Service: For ridership forecasts to be met, feeder service must be in place and work properly. When feeder service is present, passengers from farther away than walking distance can still find it convenient to use the train, hence increasing ridership. In the specific case of Tren Urbano the stakes are even higher for the contract specifies performance objectives for STT in terms of ridership. The accomplishment of these objectives is contingent upon the existence of adequate feeder service. However, the responsibility for supplying this service is not part of STT's contract with PRHTA.

To establish adequate feeder service, services provided by AMA, Metrobus and Publicos will have to be adjusted (routes and frequencies) to reflect the new conditions, where Tren Urbano is the backbone of the transportation system and the others make a better use of resources if they adjust to feed the train. PRHTA will have to accompany and most probably lead the planning of feeder service, paying particular attention to the changes needed in routes and frequency for AMA, Publicos, and Metrobus –stakeholders that should also participate in the planning process if it is to be successful. In addition, PRHTA will have to develop organizational capacity to carry out this planning, which should involve the leadership of the head of PRHTA and the Secretary –who are ultimately accountable.

Power Failure and Other Emergency Situations: PRHTA has to start, first, to develop the organizational capacity required to plan and implement contingency plans for emergencies. Second, PRHTA has to secure the mechanisms that will allow it to coordinate with other agencies the sound implementation of these measures. Specifically, AMA should be involved in the overall planning process for power failures and other emergencies, because it will be its bus fleet that will be used to supplement metro service. Notice that PRHTA could think of acquiring its own bus fleet to be used only during emergency situations. While this is clearly an option, it will be probably difficult to justify it on economic and financial grounds, because the bus fleet will be stored most of the time. That is precisely why it is AMA's fleet that should be used and that therefore it becomes critically important to involve this agency in the design of the contingency measures and in the process of getting prepared to tend emergencies.

Planning and Implementing Future Extensions of Tren Urbano: The current line under construction of the Tren Urbano project is the first phase of what is expected to be a system or network that covers the larger part of the San Juan Metropolitan Area. If PRHTA is to build new extensions of Tren Urbano then it will have to develop sufficient organizational capacity to perform *at the same time* the following tasks. First, oversee the operations and maintenance done by STT for the first line of the project. Second,

PRHTA has to be able to address the issues mentioned above, adequate station management, feeder service, and emergency management. Third, PRHTA has to be able to plan extensions of the Tren Urbano project, including procurement and funding aspects, as well as the actual implementation strategy.

Minimum Organizational Capacity for PRHTA Emerging from the Analysis: PRHTA on its own will not be able to carry out the tasks described above and that are essential for Tren Urbano. Agencies such as AMA and the Public Service Commission are critical for the good development of these tasks. Specifically, PRHTA should strive for improving its communication and coordination mechanisms with these agencies. A good way to start building these mechanisms is by initiating the planning and decision-making processes that these tasks require.

7. Recommended Strategy for Capacity Building at PRHTA

A feasible strategy for developing this organizational capacity includes efforts in the four constituent elements of capacity: organizational structure, personnel, funding, and knowledge.

Organizational Structure and Personnel: At the core lies the creation of a unit within PRHTA in charge or overseeing the operations and maintenance of Tren Urbano by STT. We have dubbed this unit Tren Urbano Operations and Maintenance Office (TUO&MO) and argued that it should have a structure that mirrors the structure that STT assigns to its own organization for operating and maintaining Tren Urbano (see E.S. Figure 1). While the structure is similar, it should be clear that TUO&MO should not devote the same amount of resources, human and monetary, as STT does, for TUO&MO is in charge of supervising, whereas STT is in charge of the actual operation.

This call for introducing some redundancy in the scheme reflects the theoretical and empirical findings of this research. Indeed, investing in this "redundant" capacity is the best that PRHTA could do to maximize the performance of Tren Urbano and society's welfare. PHRTA should not forget that the contract with STT allows it to change the organizational structure of STT's operations and maintenance unit.

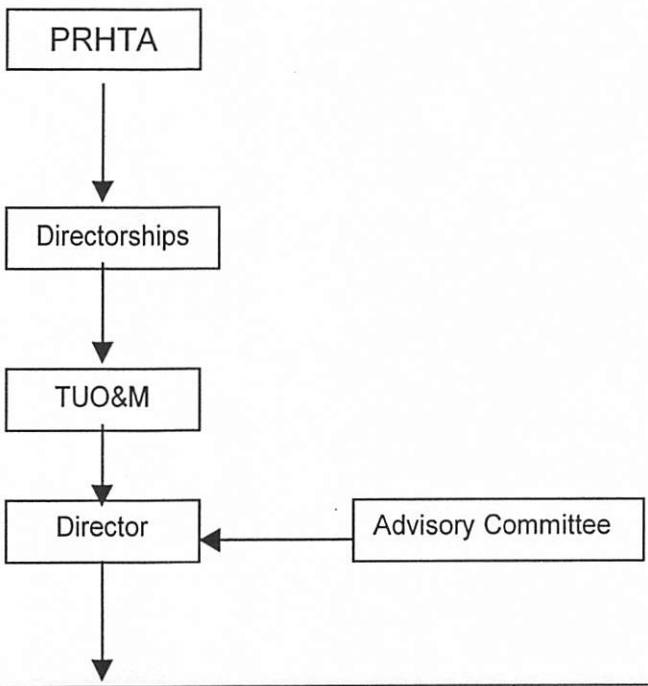
We recommend that in addition TUO&M should also have two additional units. The first, a Research and Development Unit in charge of carrying out research to improve the understanding of how Tren Urbano work and how they can be made to work better. The empirical evidence shown in the document suggests that Tren Urbano might be able to save large amounts of money from having an R&D unit within TUO&MO.

Second, an Inter Agency Coordination Unit with responsibility for approaching other agencies with competency over elements that are key for Tren Urbano's operational success such as station management, feeder service and emergency management. Further, this unit will also have responsibility for coordinating and even carrying out –together with the other agencies and stakeholders– the actual planning for these measures.

There is also an advisory committee made of experts in the several aspects of operating and maintaining a metro system. These experts can be drawn both from academia and other metro systems throughout the world. In addition it would highly desirable to have lay citizens, from users of Tren Urbano to neighbors to the line to residents who are concerned by the extensions to Tren Urbano. This committee could meet periodically, maybe twice a year initially, or whenever an extraordinary situation emerges.

Funding: Without adequate funding, the above structure will not give adequate results. Each of the proposed units within TUO&MO should have not only sufficient personnel but also sufficient funding, one, to pay competitive salaries to its workers, and, two, to acquire the resources needed to carry out its job, such as computers and software. Clearly, the fact that TUO&MO should be housed within PRHTA is an advantage for, as said above, the Authority is a wealthy organization with independent sources of funding.

E.S. Figure 1
Recommended Organizational Structure



1	2	3	4	5	6	7	8	9
R&D	Inter Agency Coor-dination	Transporta-tion and Station Operations	Systems Maintenance	Finance, Administra-tion and Support	Marketing, Communi cations, and Communit y Relations	Safety and Quality Assuran-ce	System Security	Training and Techno-logy Transfer

Units	Comment
1, 2	Units 1 and 2 we argue are essential and should exist regardless of STT's organizational structure for operations and maintenance of Tren Urbano.
3 - 9	Units 3 through 9 reflect STT's organizational structure for operations and maintenance of Tren Urbano and consequently are a flexible element in the structure. The number of units and their functions should be adapted as information and feedback become available on how the proposed organizational structure is working. PRHTA has the contractual right to order changes.

Knowledge and Training: The strategy we propose further calls for paying careful attention to the knowledge component of organizational capacity. Adequate training of the personnel that will work in TUO&MO should begin as soon as possible, because this office will be in charge of approving all of the technical procedures that STT will propose to use for operating Tren Urbano, among other key tasks. As part of this knowledge building we propose a three-pronged approach. First, the GMAEC is a capable and knowledgeable organization that can train people in the areas that TUO&MO needs. This argument is further reinforced by the fact that the GMAEC will help PRHTA during the commissioning process of Tren Urbano first stage. The commissioning process will expose trainees to most of the technical aspects involved in the actual operation of Tren Urbano.

Second, for the professionals who will be working in the Inter Agency Coordination Unit of TUO&MO we argue that they should start working as soon as possible on the planning and coordination of policies such as feeder service and emergency management. By working on the planning of these aspects, and with the help of consultants and even the GMAEC, these professionals will develop the required skills. Essential in this planning effort is that the other relevant agencies be given the opportunity to participate in a meaningful way. In the end, if feeder service or emergency planning are going to work, these agencies will have to provide resources and change some of the things they usually do.

As part of the coordination effort required to effectively implement this set of policies, the Director of PRHTA as well as the Secretary of Transportation are going to be critical actors. Indeed, their position in the Puerto Rican government opens doors and can help planners do their work in an inter agency environment.

Third, the personnel of TUO&MO should travel to existing metro systems and learn from actual experience. This will also allow them to build a network of contacts for future reference. Similarly, as part of the knowledge component we propose that PRHTA assembles an advisory committee of experts, that will meet periodically to help TUO&MO solve specific problems. This committee can also help TUO&MO evaluate

STT's work at operating and maintaining Tren Urbano, and even appraise TUO&MO's performance.

Capacity to Plan and Implement the Extension of Tren Urbano: PRHTA needs to have organizational capacity not only to oversee the O&M of Tren Urbano, but also to plan and implement the future extensions of the Tren Urbano network. The capacity to do this should continue to be in the Tren Urbano Office, aided by a GMAEC consultant. This scheme was proved with the planning, procurement and implementation of the current phase to be successful and workable. We argue that it is not desirable to bring in these responsibilities to the TUO&MO.

A note on Successful Contract Management: Analysts and experts in contract management argue that a contract were parties are "married" for a long period of tine and where the stakes are high should be managed within a win-win framework and not within an adversarial one. In a win-win contract management framework the city agency responsible for managing the contract is flexible enough to look first for solutions that solve the problems embedded in the execution of the contract, without resorting to fining the contractor or souring the relationships *as the first step*. And these solutions attempt to guarantee that the evolution of the contract will continue within the path that leads to the achievement of the objectives of the contract. In a win-win management framework, moreover, the relationship between the agency and the contractor is seen as an asset, because contingent upon this relationship is the overall evolution of the contract.

A win-win strategy is not, on the other hand, a style where the contractor can do whatever it wants. Above all, the objective is to have the contractor perform as expected and achieve the contract's objectives. Nor a win-win approach is one where the contractor is never fined if it is under performing or lawsuits are never eventually filed.

8. Conclusions

The main conclusion of this research is that for Tren Urbano to operate in the expected way –offering a high quality service, at a low cost, on well maintained trains– PRHTA,

the official owner of Tren Urbano, has to develop a minimum level of organizational capacity. This minimum capacity implies having an adequate organizational structure, funding for that organization, personnel, and knowledge and expertise. Otherwise, first, the contractor responsible for the operations and maintenance, STT, will simply not perform as expected, because it will not have the incentives for being accountable. The operations and maintenance contract is not a self-enforcing instrument and if PRHTA lacks the required capacity then it will be unable to enforce the contract's terms. Without enforcement, the contractor has few incentives for fully honoring the contract. Worse still, this situation will provide the contractor with an excuse for its own poor performance, and blame instead PRHTA for not adequately carrying out its responsibilities. Second, the contract specifically assigns PRHTA many responsibilities, such as overseeing and approving the procedures and plans that the operator uses. If PRHTA does not develop the capacity to perform the tasks that the contract assigns it, then it will be *de facto* braking the contract.

In addition to having capacity to oversee STT's performance, PRHTA needs to be able to plan and implement policies regarding feeder service, station management, and emergency management, *before* Tren Urbano opens to the public. As analyzed above, without these instruments in place, Tren Urbano will not be able to fully deliver its planned high-quality service. These policies have one special characteristic in common: They require other agencies –the main one probably being AMA– to participate both in their planning and implementation. Indeed, PRTHA will not be able to implement these policies effectively on its own. In addition, PRHTA has to have organizational capacity to carry out all the aforementioned tasks and *at the same time* continue with the planning, procurement and implementation of the next stages of the Tren Urbano project.

Finally, bearing in mind that opening date is approximately a year away we argue that PRHTA should start as soon as possible the organizational capacity building program we advocate for in this research. Indeed, if the Tren Urbano Operations and Maintenance Office (TUO&MO) is not created, or if it is created without giving its members a minimum chance to learn how metro systems work, then the plans that STT

submits for approval will not be reviewed as expected. Voluntary or involuntary mistakes made by STT's planners will not be detected. Eventually, the lack of adequate supervision of STT's job at operating and maintaining Tren Urbano will result in problems such as flat wheels, trains not running on schedule, or worse, the Metropolitan Area not having adequate transit service during an emergency. Users will notice these events and hold decision-makers accountable for these flaws. All this, of course, is avoidable if PRHTA begins now, when it still has some margin, to implement the strategy we recommend, or any other strategy for that matter, provided the end objective of building the required institutional capacity within PRHTA is achieved.

Executive Summary

COMMUNICATION, INFORMATION AND RESPONSIBILITY DISTRIBUTION STRATEGIES FOR EFFECTIVE REAL-TIME TRANSIT SERVICE MANAGEMENT

Dave Barker

Prepared for Tren Urbano, May 29, 2002

1. Purpose of research

Resolving disruptions is a continual challenge to providing quality, cost-effective transit service. A number of recovery techniques exist to recover from disruptions, but detecting a disruption, choosing a response and implementing it in a timely manner is a difficult task. Different agencies use different combinations of field supervision, centralized control, and traditional and advanced communication technology. While these different service management strategies have different results, there is no consensus on what makes a good strategy, nor a systematic method for evaluating a proposed strategy and predicting its strengths and weaknesses. The purpose of this research is to create a framework for studying bus service management strategies and draw general lessons from an application of that framework.

2. Method

This research drew from several different methodologies to develop one that is new and unique. First, the author categorized the 15 different disruptions that an agency typically faces, the different responses that can be applied, and how they correspond. He broke

down each step of choosing and implementing each response, and determined what information is needed to effectively carry out each step, as well as what instructions must be given out. (See below for an example.) The author categorized different communications technologies, and the amount of "strain" that relaying the above instructions and pieces of information takes on these different technologies.

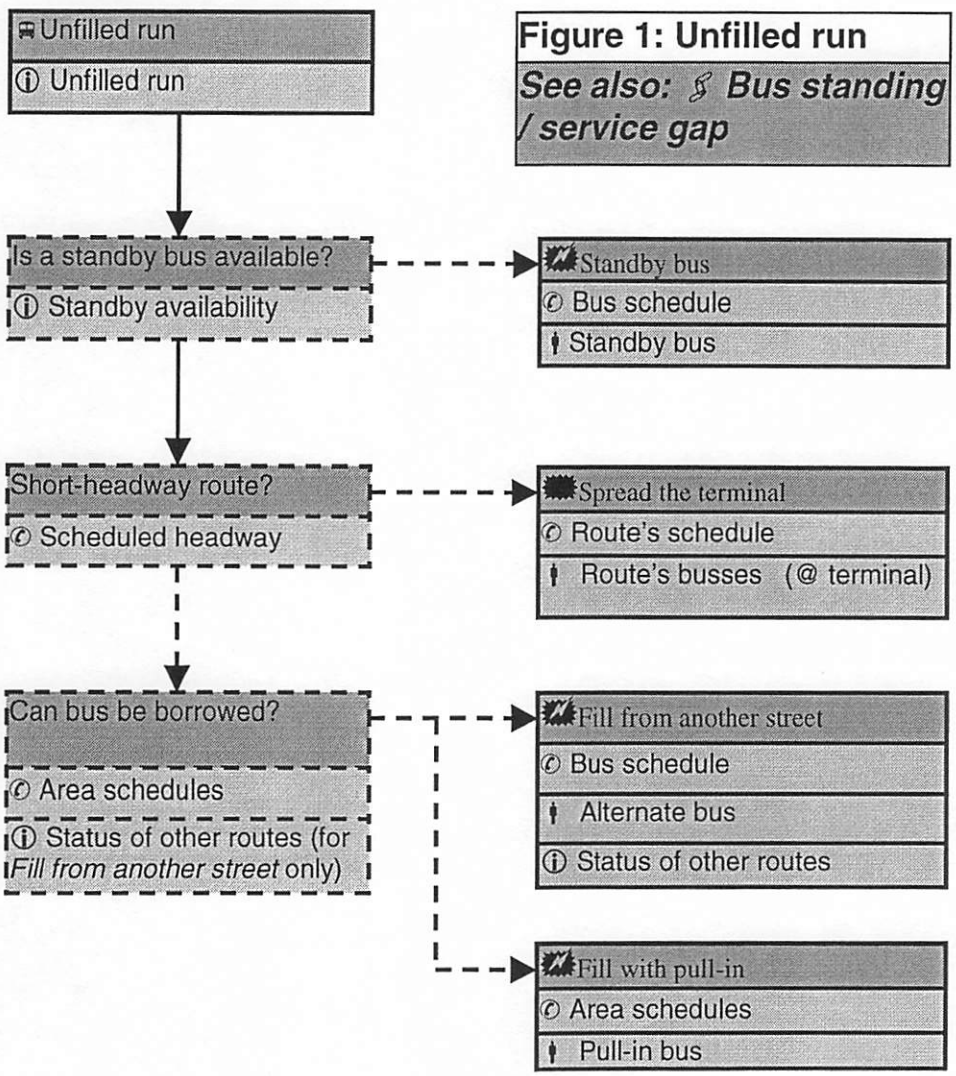
The author then created a spreadsheet model. Using knowledge of an agency's management structure, the author mapped out who performs what step, who gives instructions to whom and what communication options people in different positions have available. From this, the model derives what information needs to be communicated from the information people already have and the information each task requires. It also derives what methods of communication can be used for these messages, based on the access people have and the abilities of different communication methods. Combining this information with the number of disruptions (and hence tasks) an agency faces and the "strain" each message takes shows the use of each communication channel, and the elimination of infeasible options shows the limits of the responses available to the agency.

The author applied this model to the Chicago Transit Authority, both as it exists and as it might exist with different communications technology. The results lent themselves to conclusions about service management generally.

3. Findings of CTA Analysis

Disruptions have a predictable set of potential responses. Information is necessary to choose and implement a response.

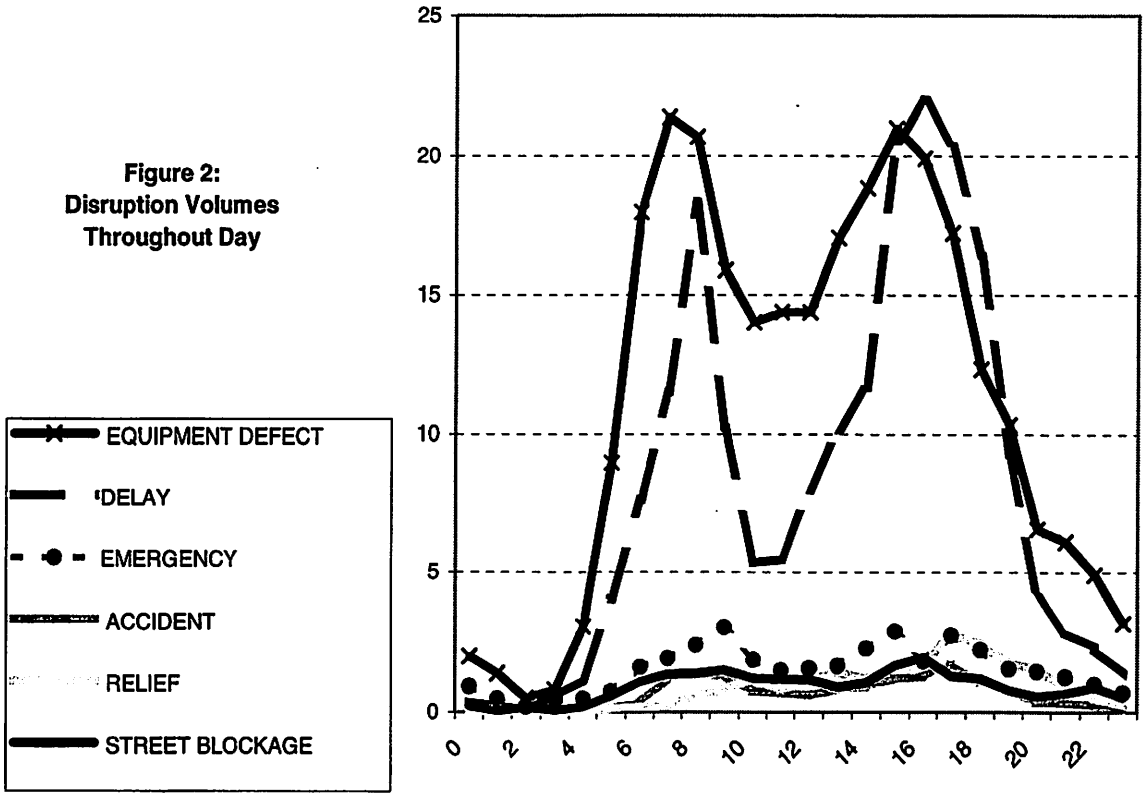
Figure 1 shows the decisions and responses that step from an unfilled run. (For an explanation of all the symbols of this diagram, see chapter 4 of the thesis.) There may be variations from one transit agency to another. Some may not have standby buses, for example. Generally, however, for a given disruption there is a set of responses that can be used, a set of information necessary to implement each response, and a set of information necessary to choose the best response.



Disruptions, though random, occur with a predictable frequency throughout the day. At CTA, delays and equipment defects experience significant peaking, while other disruptions peak only slightly.

Figure 2, reprinted from chapter 6 below, shows the frequency of various disruptions throughout the weekday at CTA. It would not be reasonable to assume that the same pattern applies at other agencies such as AMA. It would be reasonable to assume that other agencies do have patterns. Knowledge of these patterns can help an agency plan to deal with them more effectively.

Figure 2:
Disruption Volumes
Throughout Day



PDAs would allow CTA to make better restoration decisions and address schedule issues more effectively.

Tables 2 and 3, below, shows a CTA supervisor's ability to respond to a delay with and without PDAs, respectively. Supervisors would have more options and would be able to

make better decisions, resulting in more effective service restoration. In general, schedule adherence issues could be handled more effectively using digital communication, and incident management issues (such as accidents) could be handled more effectively over the radio than before, because there is less demand for the radio frequencies once schedule issues are handled digitally.

Table 2: Implied CTA Recovery Techniques to a Delay (Short Headway Route)			
Technique	Possible?	Constraints	Cost
Express down a different street	*Yes*	Not until bus reaches supervisor	Very unpredictable
Express to a later point	*Yes*	Not until bus reaches supervisor	Very unpredictable
Drop-off only	*Yes*	Not until bus reaches supervisor	Very unpredictable
Short turn	*Yes*	Not until bus reaches supervisor	Extremely unpredictable
Hold leader	*No*	N/A	N/A
Do nothing	*Yes*	None	Predictable

Table 3: CTA Recovery Techniques to a Delay (Short Headway Route) with PDAs			
Technique	Possible?	Constraints	Cost
Express down a different street	*Yes*	Not until bus reaches supervisor	Predictable
Express to a later point	*Yes*	Not until bus reaches supervisor	Predictable
Drop-off only	*Yes*	None	Predictable
Short turn	*Yes*	Not until bus reaches supervisor	Relatively predictable
Hold leader	*Yes*	None	Predictable
Do nothing	*Yes*	None	Predictable

4. Conclusions and Implications for Bus Operations

The method and model developed in this paper are a useful approach to the study of service management strategies, and are of potential

use to transit agencies seeking to change their communication systems, the responsibilities of personnel, or both.

This thesis has applied a model of communications, information and responsibility to the Chicago Transit Authority. The model produced a logical and accurate representation of CTA as it is today, and a reasonable prediction of future changes. While the precision of the model's estimation of strain on communication channels is only fair, it is effective at giving estimates that appear reasonable. The method of determining what response techniques are or are not available shows useful insights into a strategy's strengths and weaknesses, and offers a framework for comparison between different approaches.

To apply this model to another agency such as AMA, the following steps are necessary:

- The kinds of personnel must be updated, and the information and knowledge they already have must be entered.
- Communications channels must be replaced.
- The workflow must be changed. This is the most time-consuming part of the process. First one must determine what the standard operating procedures are for dealing with disruptions, and from that, what steps the agency goes through from the instance of a disruption to the execution of response techniques. Then the corresponding rows must be arranged in the model, and certain values checked to ensure that the process being entered is a feasible one. This information must be slightly modified for each proposed adjustment to the agency.
- The number of instances of each kind of disruption and each response technique during a given hour must be determined and entered.

- Finally, as AMA conducts business in a language other than English, one must listen to recordings of radio communication and mark the average time taken to relay each piece of information that the agency works with.

When planning to use new communication technology, an agency must develop new procedures simultaneously for the technology to have maximum benefit.

In studying the use of the Bus Emergency Communication System at CTA, it became clear that both its design and use suffer from a lack of understanding of the new procedures surrounding it. An example of its design suffering is that messages about equipment defects do not include some information a dispatcher needs to make a decision, while it does contain extraneous information. This means that a dispatcher must make a voice call every time he receives a digital message about an equipment defect, and the efficiency of digital messaging is lost. An example of its use suffering is that SOPs were not initially updated to reflect the use of the technology, and operators were not taught some basic facts such as which messages were for emergency use only. This means that a number of messages are sent erroneously and dispatchers must work through many emergency messages for non-emergency events. Fundamentally, failure to develop new procedures simultaneous to new communication technology will result in lost efficiencies and potentially serious problems. Better communications does not necessarily mean better operations, instead it allows for better procedures. It is those procedures that can mean better operations. If AMA, Metrobus or any other agency plan a change to digital messaging, the new procedures for handling disruptions must be developed in parallel in order to ensure benefit.

The strengths of voice communications, including ease of use and flexibility, make it well suited to communications on unpredictable service management tasks and tasks requiring collaboration.

Voice communication allows concerned parties to immediately relay whatever information they deem relevant, quickly draw others into communication, and collaborate on decisions. Digital messaging, in contrast, can send messages from a predetermined list quickly and requires typing for anything else, and removes nuances of speech that aide communication and collaboration.

The strengths of digital communications, including scalability, speed for simple messages and automation, make it well suited to communications on predictable service management tasks and tasks that peak.

Digital messaging can allow people to send the most common messages very quickly, as simply as pushing a button, and the message can be sent even if there is a lot of other communications traffic. Voice communication, by contrast, requires the user to wait for or request an available channel, get the attention of the message's recipient(s), and say the message. Some information can also be relayed without any action at all, as when a bus regularly transmits its location to a control center. If a problem is well understood, digital messaging can help people respond to the problem more quickly, and make the speed and reliability of communications more predictable and constant throughout the day. If a kind of disruption that peaks significantly is handled with communications over voice channels, those channels' availability for handling that disruption and other disruptions will lessen during peaks. If the disruption is handled with digital communications, both responses to it and responses to disruptions that are coordinated over a voice channel experience an improvement in reliability.

For digital messaging to be an effective medium for deciding on and implementing a response to a disruption, the procedures for doing so must be well understood and supported by the system of messages.

At CTA, bus drivers send digital messages with considerable detail about equipment failures, disturbances, even accidents. They are almost always followed by a voice call because information the dispatcher considers important cannot be sent digitally using CTA's system. Hypothetically almost any task can be accomplished using only digital messaging if the task is understood well enough. Chicago's 911 center handles much of its police dispatching digitally, but it does so with very sophisticated software that facilitates every aspect of the process, from the moment a call comes in and the phone number and location are entered automatically into the message that will go to the police car to the moment an officer enters the necessary information on how the problem was resolved and clears the problem from his list of tasks. So while digital messaging can potentially make a great many things easier, the level of detail necessary for complicated tasks – and the cost of learning that information and designing a digital system accordingly – can make automating them more complicated than it is worth.

The task of responding to incidents has a "natural home" in the control center.

Responding to emergencies or breakdowns requires the coordination of multiple mobile supervisors and repair trucks. To be done efficiently, this requires the coordination of different personnel to ensure even workloads and timely responses. For the mobile units to do this coordination effectively themselves would require that every person know the assignments of every other person, or that they would pause to discuss who is most appropriate for a task every time a new requirement arrives. One person can do this much more efficiently and effectively. As incidents occur randomly throughout the

service area, this person gains nothing by being on the street. He would have first-hand knowledge of only a fraction of events. A control center is the logical place for this person to be, providing him with the resources that make the job easier: a desk, a computer, and protection from distraction.

The task of making schedule adjustments has a "natural home" in the field.

A supervisor standing on a route always has information that a dispatcher might not or can not have:

- The history of bus arrivals at that location
- The traffic conditions on that portion of the route
- The load of buses as they pass that location
- The understanding of a route that can come only by observing and interacting with it for weeks

He can also talk to bus operators in person. It is possible to provide a dispatcher with more technology or communications resources than a street supervisor, and this would give him an advantage. For example, if all buses transmitted their location to the control center but the information did not reach the street supervisors, the control center would have a better picture about the line as a whole. Similarly if buses and dispatchers had radios but supervisors did not, a dispatcher would have the ability to implement some responses a supervisor could not. But putting radios or digital messaging in buses costs far more than giving it to supervisors. An average agency has on the order of 1 supervisor for every 30 buses. Equipment for supervisors is typically much cheaper than that for buses as it does not need to withstand the punishing vibrations of a bus. So the marginal cost of extending communications technology to supervisors is comparatively small.

Technologies being equal, street supervisors are better at making schedule adjustments than dispatchers can be.

Digital communication can supplement voice communication for a transit agency, but can never replace it.

There is a roughly inverse relationship between the frequency with which a disruption occurs and how well it is understood. No one can plan for every possible kind of disruption, teach everyone the procedures for handling it, and program every message into a digital message system. On September 11th, when many of Chicago's skyscrapers were evacuated, CTA had to provide unplanned service to evacuate the downtown area while watching for hints of suspicious activity so subtle that they would not usually be cause for concern. Recordings show dispatchers and supervisors working together over the radio, creating a strategy as they go along, and giving instructions to supervisors (including "find out which buildings are being evacuated") that could not possibly have been anticipated. This collaboration and instruction was all made possible with voice communication. Being restricted to digital messaging, no matter how thoroughly it was developed, would have been a substantial hindrance.

URBAN TRANSIT: RECONCILING ACCESSIBILITY, PRESERVATION AND DEVELOPMENT

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URBAN TRANSIT: RECONCILING ACCESSIBILITY, PRESERVATION AND DEVELOPMENT

I. Objective:

A. To determine the land uses between and around natural features and transportation corridors, and ensure that such uses are appropriate.

B. To ensure access to significant natural features near transit stations.

C. To discover and possibly inform the integration of the natural environment with the current and planned development of various stations in the Tren Urbano alignment.

D. To improve access and integration of the natural environment, where warranted, within the Chicago Transit system.

II. Research questions:

A. How can Tren Urbano and CTA best utilize the natural environment for economic development, or to optimize the benefits of economic development?

B. How can transit agencies and planning organizations best provide accessibility to the natural environment?

C. What implementation strategies can be applied to optimize the relationship between the natural environment and economic development?

D. What marketing tools are necessary to increase awareness of accessibility to green space?

E. How can various types of open space accessibility be used to increase ridership levels?

III. Motivation:

Take all of the possibilities of a connected city. Imagine the impressive roster of city parks in Boston, for example—places like the Public Garden, Arnold Arboretum, and Franklin Park—and link them together. Now, imagine a reconnected Boston. This will be the result of a massive transportation project, the submersion of the city's Central Artery, also referred to as the "Big Dig". As part of the Big Dig, several parks are being created where the highways elevated beams and wide parkways once dissected the city. Where once stood steel and concrete will soon lay neighbourhood and city parks. This prospect of new urban open space has sparked a debate throughout the city of whether and where to create new open space. How much? How expansive? Active recreation or passive? The prospect has also allowed

many to "imagine a reconnected Boston"[1]. This is the power of a well-planned transportation project—the power to connect and reconnect a city.

We all recognize that urban transit should facilitate access to jobs and homes, as well as to recreation, education and all aspects of life. It should make possible a life where the automobile is not necessary, where those without the option or desire to use the automobile can still lead a quality life. Because of the density of "the concrete jungle", nowhere is access to parks and open space more important than in urban areas. Due to urbanization and densification caused by capitalizating on the transportation improvements in urban areas, there tends to occur a degradation and loss of open space and access to open space. Individual developers may sometimes recognise the benefit of open space, but in the midst of hoping to maximise their immediate returns often depend on others to provide or require it. Where large-scale, single-owner developments are possible, opportunities exist to produce open space and/or protect the natural environment that would not normally exist. Tren Urbano is one such opportunity that the Junta Planificación can capitalize upon. The Chicago Transit Authority has already laid the foundation for connections, but can now improve upon direct connections between green and built environments and utilize connections as a marketing tool to increase ridership.

IV. Findings.

In some cases, transportation projects have been used as a catalyst for transforming the city and the way residents perceive it. In Bogotá, Colombia, the TransMilenio project was accompanied by reclamation of city sidewalks for pedestrians instead of cars, hundreds of kilometers of bicycle paths, and yes the creation of several city parks. In Curitiba, Brasil, the same has been true. Germany and England have both had a long-standing traditions of

[1] Gay, Jason. "Emerald Revolution?" in The Boston Phoenix April 23-29, 1998. Boston.

Berlin, Germany.

Bogotá, Colombia.

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protecting and integrating green spaces into development approvals in most cities, some more successfully accessible by public transit than others. Mexico City's parks on the other hand are typically accessible by transit. Each of these governments have used different methods to determine first what the "optimal" or minimum amount of open space is, and second what incentives and regulations are most effective to ensure development of at least the minimal amount of open space.

Many local governments have found themselves believing that they must choose between economic development and preservation or creation of open space. During interviews in Arlington County, Virginia, for example, town officials were more concerned with the need to densify the area around stations in order to increase ridership. We all know the importance of densification and increased ridership to the viability of a good transit system. However, the conflict between the economic development and preservation of the natural environment is sometimes more a factor of perception than of reality. In fact, there are many economic benefits of parks and open space. While there is a clear correlation between the two concepts, both increasing the density and increasing property values will have a positive effect—the first for ridership, the second for tax revenues.

There are varying degrees of economic benefits, depending upon the type of open space. Parks for example raise prices of residential developments due to the social benefit and resale value. This in turn raises the value of the home as well as the amount of property taxes collected by the municipality. Studies has shown that there is a 20% impact on property values as a midpoint assumption for value increases to properties fronting on passive green space[2]. In addition, hi-tech companies have listed the recreational amenities, culture and climate among the most important elements when choosing a new location and site for office

[2] Crompton, John L. "Parks and Economic Development" in the Planning Advisory Service Report Number 502. Chicago: American Planning Association, 2001.

already been identified by other cities? How are these markets approached? What information and incentives are necessary to reach these markets? How have these markets been used to build coalition and support for accessibility to green spaces, and to build ridership for public transit modes? This is an area I have only recently begun to research, yet is seems crucial to understand who target riders might be and how to entice them to use transit to access green space and other recreational attractions.

VI. Case Studies.

In beginning to choose the case studies of most relevance, I have discovered that there might be some cases that are more applicable to understand each of the various aspects of research. At this point, though, my case studies are divided according to historical examples and more recent examples. This list and/or cities' placement within the list is subject to change. Where parks near transportation corridors have already been determined, they have been included.

A. Historical.

New York City, USA: Central Park, Manhattan; Prospect Park, Brooklyn; Thompson Square Park, Lower East Side.

Boston, USA: the Emerald Necklace (Boston Common, Public Gardens, Arnold Arboretum, etc.)

Chicago, USA: Grant Park; Humboldt Park; Garfield Conservatory

Mexico City, Mexico: Bosque Chapultepec

London, England: Hyde Park

B. Recent and prospective.

Portland or **Seattle**, USA.

San Juan, USA: Parque Gándara; Parque Lineal; Jardín Botánico

Berlin, Germany.

Bogotá, Colombia.

Curitiba, Brasil.

1. **Types of Open Space.**

   Each city has had a different goal in the design of its park system. Though each city had recognized the desire for parks and open space, the ways in which these cities have addressed transportation to and through parks and open space varies greatly. As mentioned before, Curitiba's new transit system was accompanied by the creation of several hectares of parks, bicycle trails, and other improvements resulting in increased greenery. A comprehensive effort to utilize green space not just for passive or even active recreation, but for transportation as well is just one way to expand the idea of different types of open space usage. One need not have access to design elements such as tree-lined streets or grassy medians, but they should be a bare minimum of design on major transportation routes in many areas (see thesis by Frances Swtikes for more information on station area design).

2. **Design Points.**

   For the most part in many cities, traffic passes around parks and green spaces or cuts through them and forces promenading pedestrians to stop for motorized traffic, as in the case of Chicago's Grant Park. New York's Central Park, on the other hand, was designed to allow regular traffic to pass through safely, while still affording the feel of a park. Various different modes of traffic pass through the park, with intersections often at different grades to preclude traffic accidents or delay. Both designs are valid, although adopted or evolved

for different reasons, whether political, physical or simple design. Which decisions are most appropriate for connections to and through green spaces via transit: pedestrian bridges, pedestrian crosswalks, grade separation for motorized and non-motorized vehicles?

3. **Implementation strategies.**

Many cities and towns in the USA are using **transfer development rights** to prevent or protect development of sensitive areas. This policy could be utilized in San Juan during developments approved by the Junta Planificacción. Perhaps the most promising trend in regulations is the **move from open space requirements toward incentives for integration of open space** into overall design of site plans (see thesis by George Proakis for more information on integrating green space into Transit Oriented Development). German cities are quite advanced in this respect, as they both require and incentivise integrated development plans.

4. **Knowing the market.**

The TransMilenio project was so markedly different from the existing situation that large-scale changes were both warranted and desired by a significant portion of the population—particularly the **disenfranchised or underserved classes.** Understanding this is key to understanding the need for green space in the dense, urban environment. Just as in Baltimore, Maryland where the Maryland Transit Authority continued service on a struggling bus line because the target market is poor, single mothers; so too is it important to ensure accessibility to open space for those who are unable to jump in their cars for a weekend drive out to El Yunque or some other suburban, rural park.

Public transit often attempts to serve the mobility and accessibility needs of urban residents for the purpose of developing the urban environment or managing the growth of the urban environment. This attempt should facilitate access to all facets of a full life, employment, education, recreation, etc. independent of the automobile. Within this paradigm, parks, trails and open space are not simply visually pleasing; they contribute to everyday life of urban residents and are transit destinations themselves. New trends in urban development and growth initiate and expound upon the concept of balancing the relationship between economic development, urbanization and the natural environment. For San Juan the opportunity to create a more complete environment is now, before property values have risen far beyond reasonably affordable and before precedents of less green development have been set. For Chicago, the opportunity is a question of refining a system already in place, to increase awareness of the possibilities for so many. I hope that my research will help both of these agencies to establish and improve connections, as well as to improve and refine their strategies for informing the public.

EXECUTIVE SUMMARY

Improving Jitney Service Quality:
An Appropriate Governance Model for San Juan, Puerto Rico

By Cybele Chang

Motivation & Research Goal

Rapid increases in automobile travel and limited road expansion have brought unprecedented levels of traffic congestion in U.S. cities. San Juan, Puerto Rico, like many North American cities, has turned to rail lines as a solution to the mounting traffic congestion threatening the urban environment. However, a rail system must rely on other transit modes to provide feeder services in order to expand its reach and broaden its customer base. This requires intermodal integration. The success of the future San Juan transit system depends on the integration of the publicos, the jitneys of Puerto Rico. The current Secretary of Transportation anticipates that the publicos will provide the majority of feeder services to the new rail system, Tren Urbano.

For intermodal integration to succeed, publicos must offer comparable service quality. However, the service quality of publico transit is poor as a consequence of the long-term decline of the publico industry. For instance, publico vehicles typically are antiquated second hand vans that lack air conditioning and are difficult to board and exit. Also, publico service is generally infrequent and unreliable during off-peak hours. This poor quality of service has created a negative public image of publicos and the perception that publicos are a transit option for the poor. Another challenge facing the successful integration of the publicos is the unique owner operator nature of the industry. In the San Juan Metropolitan Area, there are 2,230 publico operators. Although most organize into small groups to rationalize service delivery, each operator is a unique individual with separate interests and preferences that drive their behavior. This owner operator attribute makes organizing and controlling operators very difficult. Therefore, the goal of the government is to improve publico service quality so it is comparable with the rest of the transit system, while recognizing the unique owner operator quality of the industry.

This study examines four different jitney systems in North America including San Juan, New York City, Miami, and Atlantic City. The study documents the development of the jitney

service, how different cities govern jitney operators, and what affect the governance structure has on the quality of service. The purpose of this study is to determine what kind of governance structure leads to a high quality of jitney service. The study also examines what other factors contribute to high quality service. The ultimate goal is to apply the findings to San Juan, Puerto Rico in order to define future publico reforms.

Jitney Attributes

The case studies documented in this study illustrate that jitneys provide invaluable transit services to underserved communities. Without jitney services, these typically low-income minority communities have few transit alternatives. Jitneys also generally offer a higher quality of service than conventional transit services. Passengers are guaranteed a seat on jitneys and, in places like New York and Miami, many passengers feel culturally more at ease with jitney services. In general, the total jitney trip time is shorter than conventional transit services since jitney service is more frequent and jitneys tend to stop less and for a shorter period of time.

The New York example illustrates that jitneys also can play a critical role as an unsubsidized feeder service to the subway system. The relatively short transit distance to the rail stations and the high volume of transit passengers makes rail feeder services particularly profitable for jitney operators. The small carrying capacity of jitney vehicles also makes it economically feasible for jitneys to provide service in low-density areas. Thus, jitney services extend the reach of rail lines. In addition, jitneys provide a way for underserved or inadequately served communities to access the rail system.

The Need for Governance

Despite these attributes, history has shown that, left on their own, jitney operations bring about public safety, traffic congestion, and air pollution problems. Rival operators aggressively compete for passengers, leading to accidents and unsafe conditions on the roadways. Chaotic jitney operations also lead to traffic congestion. Traffic congestion and the use of antiquated vehicles contribute to urban air pollution problems. In practice, jitney services are never left to the market. Moreover, transit history demonstrates that the laissez-faire approach is an inadequate solution to the governance of transit services. The laissez-faire approach to the omnibus industry, an early form of mass transit in the 1800's, led to chaotic conditions on the

roadways and public safety issues. In response, the government established regulations to control private omnibus operators.

On the other extreme, the collapse of private transit monopolies in the 1960s shows that government over-regulation can impair the economic viability of the industry. At the time, the regulators controlled the fare structure in order to prevent possible economic abuse by transit monopolies. However, the artificially low fares led to the financial ruin of the private sector. The advent of the jitney in the early 1900s also serves as an example of the consequences of over-regulation. The government intentionally instituted unreasonable regulations to force jitney operators out of business in order to protect the interests of streetcar companies. As a result, almost all North American jitney services ceased to exist by the 1920s. These lessons from history suggest that an appropriate governance model for jitney transit services lies between the extremes of laissez-faire and over-regulation.

In practice, North American jitney services all rely on hybrid governance models, consisting of government controls and self-regulating mechanisms. The advantage of having a hybrid governance model is that the two mechanisms complement one another. For instance, self-regulating arrangements address scheduling issues that government regulations typically do not address. The dual governance system also serves as a mechanism to force regulatory accountability. A governance model based solely on self-regulation is less accountable to passengers and the public. Whereas, a governance model based solely on command and control regulations assumes that the government will protect the public interest. When in reality, regulations are often captured by the interests of government authorities and special interest groups. Lastly, government regulations and self-regulations reinforce one another on critical issues such as vehicle and driver safety.

Case Studies

The case studies document three types of hybrid governance structure. The factor that differentiates the governance structure of the case studies is the relationship between the government regulators and the operators. San Juan is an example of a supportive governance model where the government provides incentives to operators in order to support publico operations. The San Juan regulatory agency is the only regulator studied that imposes controls

solely on individual operators. The regulations do not try to influence the behavior of drivers through the long-standing operator organizations.

In New York City and Miami, the conflict between the public transit and jitney operators created an environment where operator and government regulations function independently from one another. Generally, the government and operators do not collaborate in their efforts to regulate operators. Interestingly, the statutes in New York and Miami effectively impose a hierarchical structure where there is a company that serves as a middleman between the government and the jitney operator. The government authorizes a company to operate in a certain areas; the company then rents out the right to operate under the company to as many individuals as the permit allows. Companies have become an extension of government regulators since the regulators sanction both the company and operator when an individual operator is out of compliance; at the same time, the companies also developed self-regulations to control driver behavior.

The Atlantic City governance structure is a collaborative system where the operator organization initiates regulatory and industry changes, while the regulator supervises the efforts of the organization. Like San Juan, the jitney operators in Atlantic City spontaneously formed operator associations. Unlike San Juan, the regulations impose controls over both individual operators and the operator organization. By controlling the operator organization, the regulator has more control over the services the jitneys provide as a group.

Atlantic City produces the highest quality of service, suggesting that a collaborative governance structure leads to a high quality of service. However, service quality is not merely a function of the governance structure. The case studies indicate that the quality of service is also dependent on the profitability of the jitney industry, the strength of jitney institutions, and the context of jitney operations. In a highly profitable setting, industry actors will spontaneously mobilize and provide a high quality of service. A highly profitable market encourages operators to rationalize services through the development of strong operator organizations that are committed to providing the highest level of service to the customers. In addition, the profitability of the industry alleviates the financial burden associated with offering a higher quality of service. The institutional strength of the jitney-regulating agency also leads to the provision of a high quality of jitney service. The government regulators need to have the organizational capacity to oversee and enforce government regulations. The threat of

enforcement incites jitney operators to comply with government regulations and thus provide a higher quality of service. Lastly, jitney service quality hinges on other contextual factors such as manageable traffic conditions in the areas where jitneys operate. Severe traffic congestion such as the traffic conditions found in San Juan result in lengthy travel time on jitneys.

Recommendations for San Juan

There are three issues plaguing the publico industry. One is the poor service quality that has resulted in declining publico ridership. In light of the introduction of Tren Urbano, the poor service quality is particularly important since the success of the system depends on the quality of service on publico feeder lines. The second issue, which is in part due to the poor service quality, is the failing profitability of the industry. Rising operating costs and falling revenues from the decline in ridership threaten the very existence of the publico industry. Finally, both the self-regulating organizations and publico-regulating agency lack the organizational capacity to enforce rules and regulations. These three issues must be addressed if publicos are to continue to play a major role in transit services. The following recommendations are divided into:

- Strategies that improve the economic sustainability of the publico industry;
- Institutional changes that will help support new policies; and
- Amendments to the governance model in order to improve service quality.

Improving Profitability of Publico Industry

The profitability of the publico industry is arguably the most pressing issue confronting future publico operations. If nothing is done to improve the financial viability of the publico industry, the service will eventually cease to exist. The case studies suggest that in an unprofitable market, the government has to take the lead in developing strategies to encourage operators to improve services quality. Therefore, all the recommendations require government intervention to lead the way in publico improvements. The case studies also suggest that the more profitable the jitney service, the better the quality of service. Thus, the government should look at strategies to improve the profitability of the industry in order to save the industry from extinction and also as a way to improve the quality of publico service.

One way of improving the profitability of the publico industry is by making better use of the publico vehicle. The current regulations do not permit more than one driver to operate a

vehicle. The government should revise the regulations so that multiple drivers are allowed to operate the same vehicle. For example, two or three drivers can operate a vehicle in shifts during the day. Considering the high initial capital cost of the vehicle, more efficient use of a vehicle substantially reduces the cost of operation. The side benefit of a multiple driver strategy is that multiple shifts will result in the provision of service that is more evenly distributed throughout the day, as opposed to the current situation where operators primarily offer services in the peak morning hours. This strategy assumes that the opening of Tren Urbano will result in a surge in passenger demand that can justify a multiple driver approach.

Another way of increasing publico revenues is though user-side subsidies. For example, the user-side subsidy could take the form of a free transfer from a publico to the Tren Urbano system. User-side subsidies would entice the public to use publicos and thus boost ridership and publico revenues. A user-side subsidy would also avoid the potential drawbacks associated with supply-side subsidies. Supply-side subsidies do not guarantee that operators will provide a higher quality of service. In fact, it is likely that publico operators will accept the subsidy without making changes in their operating practices. With user-side subsidies, operators can only benefit from the program through the provision of services. User-side subsidies encourage operators to operate longer hours, to increase the supply of services, and to improve the quality of service delivery.

The government also needs to assist publico operators in reducing the cost of operations in order to increase the profitability of the industry. This strategy is particularly important for publico operators who are not impacted by Tren Urbano. It is unlikely that ridership on these routes will see a dramatic surge. Consequently, the falling profitability on these routes will eventually force operators out of business and deprive low-income riders of the only form of transit service available in many areas. Few operator organizations in San Juan are able to provide discounts to their members due to their relatively small group size. The government should make agreements with local vendors to supply discounted bulk parts, lubricants, and tires. The government should also provide reduced gasoline prices and group vehicle insurance. These measures combined could substantially lower the operating cost of publico services.

Improving Institutional Capacity

The introduction of Tren Urbano gives the Puerto Rican government an opportunity to reorganize the publico-regulating structure. The MBA and the ACT, which oversees the bus and Metrobus services, fall under the DTPW. Only the ferry services and publicos are regulated by agencies outside the DTPW. If the goal of the government is to create a well-integrated multimodal transportation network, than the creation of a centralized regulatory authority responsible for all transit modes would make coordination and implementation more efficient, leading to a higher quality of service for the entire system. A centralized regulatory authority would provide a centralized management structure, more effective oversight of transit operations, better long-term planning, and improved service coordination between modes. Under a powerful organization like the DTPW, the publico-regulating agency will also have access to an ample pool of financial and personnel resources. The current publico regulatory framework does not have the organizational capacity to enforce the regulations, resulting in the disregard of government regulations that leads to a poor level of service.

Using the additional financial and personnel resources available under a central organization, the government also needs to support a level of enforcement activities that demonstrates the government's commitment to the regulations. Sustained enforcement activities are key to service improvements. In addition, the enactment of forfeiture laws increases the enforcement power of the publico-regulating agency. Operators may see fines as merely a cost of doing business, whereas vehicle forfeiture is viewed as a real threat to operations. A sustained enforcement presence and the threat of forfeiture are necessary to demonstrate to operators that the government is serious about regulatory compliance.

Improving Service Quality (see table 1 for a summary of recommendations)

Passenger Comfort

Passenger comfort, in part, is a function of the age of the vehicle. Considering the average age of a publico is 13.6 years, the comfort of a publico ride is poor. The government could restrict the maximum age of a publico to prevent the operation of antiquated vehicles. For example, the Miami regulations do not permit drivers operate a jitney over 15 years old. This policy is easily enforced when operators renew their annual vehicle registration. If the government is going to require publico operators to purchase new vehicles, than the government must also set up a vehicle replacement program with a government-backed brokerage to cover

the cost of the vehicle. The program would provide operators with low-interest loans to purchase new vehicles. The use of an intermediate financial institution such as a brokerage shields the government from potential conflict with publico operators.

The opening of Tren Urbano will incite Americans with Disabilities Act (ADA) advocates to push for full accessibility on the entire system, including the feeder lines. Assuming the Tren Urbano feeder route publicos are considered a fixed route service, than the ADA requires that a reasonable proportion of vehicles be fully accessible. Atlantic City is the only case study that has successfully implemented an ADA compliant vehicle replacement program. The case study suggests that government funding through political lobbying efforts is needed for individual owner operators to purchase ADA compliant vehicles. In San Juan where the publico industry has experienced long-term profitability problems, the government will have to provide, at the minimum, the extra funding necessary for ADA compliant vehicles.

Service Reliability of Feeder Routes

Publico routes feeding the Tren Urbano stations should comply with strict schedules. Serving as a feeder service to a Tren Urbano station should be considered a privilege. In order to gain access to Tren Urbano stations, publico operators must follow the rules and regulations set by the government. Rules should include the following:

- Hours of publico operation that closely match those of the Tren Urbano
- Requiring publicos to leave the station at regular intervals, especially during off-peak periods
- A predetermined number of vehicles serving the route during TU operating hours
- Adherence to traffic protocols in the station areas in order to prevent traffic congestion
- Obligating drivers operate new ADA compliant vehicles with an AVL system and automated fare box.
- Periodic publico vehicle inspection to ensure minimum compliance with safety and maintenance standards

The advantage of this arrangement is that it does not coerce publico operators to comply with the new regulations. If an operator chooses to participate, operators must comply with the rules set by the government, resulting in a quality of service comparable to Tren Urbano. Otherwise,

operators can continue offering their usual service that terminates at the established publico terminals.

The success of this new system depends on the enforcement of the new station rules. The regulating agencies supervising operations in the Tren Urbano stations will need to dispatch officers to the Tren Urbano stations to monitor and enforce the rules of the station. The allocation of personnel will be particularly critical at the start of station operations. An important enforcement dilemma is how to force a group of operators to comply with the requirement to extend their hours of operation, operate according to a regular schedule during off-peak periods, and ensure the minimum number of vehicles on the route. The government cannot penalize an individual for the poor service delivery of the collective group. The government should require all operators on a certain route to join an operator organization. The government can then sanction the entire group for non-compliance of group responsibilities.

Service Reliability of Other Publico Routes

The publico routes that are not impacted by Tren Urbano are not subject to the same service quality standards as feeder routes. Nonetheless, the limited hours of operation and erratic service during off-peak hours deter individuals from patronizing the publicos. Considering many of the operators providing service on these routes may chose not to participate as a Tren Urbano feeder service, the government should not regulate the schedule of these publico routes. The government should continue to rely on self-regulating route associations, unions, and cooperatives to encourage operators to adhere to a schedule. One possibility is for the government to grant incentives to route associations for providing scheduled service. Incentives can include benefits such as health insurance, life insurance, social security benefits, government funds to improve the exterior or interior of the vehicles, etc. Only after a route association proposes a possible scheduling plan that is subject to regulatory negotiation, will the incentives be extended to the route association members. The incentives are only rescinded if the publico service does not adhere to the agreed upon schedule.

The advantage of an incentive program is that the operators have control over the schedule and how they will organize themselves in order to achieve the schedule. This idea supports the theoretical argument that industry actors are the most knowledgeable with regards to industry practices and therefore would create the most appropriate regulations. The incentive

program will also provide the government the necessary scheduling information to package the information for advertising purposes.

Safety

The regulatory arrangement most successful in achieving safety standards is a dual enforcement strategy where both the government and operator organization enforce government regulations. In the ideal case, the operator organization voluntarily enforces government safety regulation. Only a fraction of the San Juan operator organizations currently require members to comply with government regulations. As an alternative, the government can impose sanctions on both the operator and the route association when the driver is discovered to be out of compliance. The operator organization becomes legally and financially responsible for the actions of member drivers, transforming operator organizations into an extended enforcement arm of the government. In order for this arrangement to be successful, the government should require all operators join an operator organization.

The challenge in this revised system, unlike the New York and Miami models, is the operator organization is charged with enforcement responsibilities as opposed to a company president. Unless the organization is strong and well developed, the added responsibility placed on the organization may not produce any improvements in operator compliance. If the regulators and/or the operator organization do not have the capacity to enforce regulations, than the operators may ignore the sanction imposed on the organization.

In-Vehicle Time

There are two approaches that can shorten the publico in-vehicle-time: limiting congestion on the roads caused by publicos and extending special privileges so publicos can move faster through traffic. The government should reduce traffic congestion by designating publico stops, restricting operators from stopping anywhere along the route, and by maintaining terminals at publico destination areas. Publicos are subject to the same severe traffic congestion as personal vehicles. The government should establish high occupancy lanes or exclusive lanes for publicos and expand the privilege of using the counter-flow bus lanes to more publico routes. The government should also grant publicos special privileges such as head-of-line privileges and

signal pre-emption at key intersections in order to reduce the in-vehicle time and thus make the service more attractive to potential riders.

Intermodal Integration

The critical problem of the transit node reorganization is the financial burden on riders, especially low-income riders. At the same time, publico operators cannot afford relinquishing any portion of their revenue in a fare integration program due to the failing profitability of the industry. The government will need to bear the majority, if not the entire, revenue loss in a fare integration program. Joseph Barr, in his study conducted in 1997, concluded that for a trip involving both publico and public transit, the discount should be provided on the public mode. In this way, the publico operator always receives the full fare at the time the ride is given. His conclusion corresponds with the user-side subsidy strategy discussed earlier in the list of recommendations to increase the profitability of publico operations.

Timeframe of Implementation

All the strategies to improve the quality of publico services feeding Tren Urbano stations should be implemented by the opening of Tren Urbano. The public must be convinced on opening day that the entire transit system offers a high quality of service, regardless of the mode. If the publico service is still poor on opening day, but gradually improves over a course of a year, the public perception of the system from opening day will discourage individuals from using the system. On unaffected publico routes, the government should first implement the strategies that improve both the profitability and service quality. These routes will not experience an increase in ridership like those publico routes feeding into Tren Urbano stations. The government should first focus its attention on strategies that improve the service quality without further jeopardizing the economic viability of the service such as improving in-vehicle time, intermodal integration, and access to publico service information. These strategies all place the onus on the government to initiate service quality improves. Once these measure are implemented, the government should implement strategies on improving the comfort and reliability problems of publico service.

	Lessons Learned	Application to San Juan
Safety	• Dual enforcement mechanism where regulators and operator organization requires operators to comply with government regulations • Periodic inspections dependent on the age of the vehicle.	• Apply dual enforcement strategy. Sanction both operator and operator organization. • Require all operators join an operator organization.
Comfort	• Restrict age of vehicle • Only Atlantic City has replaced vehicles with ADA compliant spacious, air-conditioned vehicles	• Restrict age of vehicle • Require new vehicles serving TU stations have a/c and wheel chair lift. Government fund extra cost of ADA compliant vehicles for TU feeder routes.
Intermodal Integration	• Fares: free transfers • Scheduling: hours of operation naturally match in lucrative market • Connection: initiated by operators. Some duplication encourages intermodal connections	• Fares: Government subsidize fare integration • Scheduling: require matching hours for publico feeder lines only. • Connection: give operators the option to feed TU stations and encourage publico connections with transit-centers.
In-vehicle Time	• Reduce traffic congestion: limit the number of jitneys, control type of service, terminals and waiting areas at destination points • Special privileges: HOV lanes, exclusive lanes, counterflow bus lanes, head of line privileges, signal pre-emption	• Control type of service: establish and enforce fixed stops. • Maintain terminals • Special privileges: HOV lanes, exclusive lanes, counterflow bus lanes, head of line privileges, signal pre-emption
Scheduling	• No examples of government regulations. • A.C. regulations require certain number of vehicles to be on the road at all times. • Dependent on controls imposed by operator organizations. Usually either based on predetermined shifts or dispatching procedures.	• Different strategies depending on type of publico route • Potential feeder routes serving TU stations must adhere to strict rules. Government requires certain number of vehicles serving the route during TU operating hours. • Unaffected publico routes are given incentives to develop and adhere to a schedule
Service Information	• Atlantic City is only example of jitney advertising - both government and Association. Suggests lucrative jitney services will advertise. • A.C. Government require organization install signs • Government install signs	• Rely on the government to compile and advertise publico service information • Government should erect signage

Table 1: Summary of Service Quality Recommendations

"Financing Rail Transit Extensions Through Area Development"

Alvaro Covarrubias

May 2002

1. Motivation

Rail transit systems have had different impacts in cities around the world. In cities with high densities around stations, congestion has been reduced, and high riderships have allowed for lower operational subsidies from the governments. In the other hand, the impact of rail transit on the performance of the transportation systems of sprawled areas has been marginal.

Rail transit construction demands high investment. Financial constraints usually determine a slower pace of development of transit networks. The lack of transit promotes sprawl, which increases cost of serving new areas by transit, and reduces its potential modal share.

Although rail transit systems increase accessibility around stations, their impact on land value has been mix. Only where zoning has allowed for an increase in density, and there is available land for development or redevelopment, has land value increased.

Transit companies may create a new source of funding by capturing part of the land value increases around their stations. This may help them to finance extensions, promote transit-oriented development, and increase ridership. These objectives are especially critical for new systems like Tren Urbano in San Juan, Puerto Rico.

2. Historical Background

The financing of the construction of rail transit through land development was an important source of funding for the development of the rail systems in the US and other countries during the 19th century. Companies or individuals used to buy real estate on the fringe of cities, built rail streetcars to link them with the central business districts, and

developed the land, capturing the increase in value caused by the new transportation infrastructure.

Only few local governments or agencies tried to use land value capture in the US after World War II. This is probably because of the extensive highway construction program undertaken in this period. The government did not attempt to capture the increase in private land value, setting the precedent that the financing of transportation infrastructure investment was an exclusive responsibility of the government.

As part of my research, I will investigate why land value capture mechanisms have not been used more frequently in the US, how some agencies have tried to utilize them, and the potential to use them in the future.

3. Rail Transit and Land Value

The impact of rail transit on land value and densification has been a topic of discussion in recent years. While most studies in the US have proved that rail transit has had a positive effect on land value, this effect has been modest.

There are many reasons to explain this meager effect. In many cases, cities have not allowed further densification, which generally produces an increase in land value, because of the opposition of adjacent communities. Where densification has been allowed, many stations have seen an increase in land value, especially when they provide infrastructure for pedestrians. It is not clear whether the relaxation of zoning or the construction of rail transit has caused those land value increases, but certainly rail transit allows having higher densities without increasing congestion.

Some studies have proposed alternative explanations for the low impact of rail transit on land value in some areas. The construction of rail transit may have raised crime rates in some areas around stations (Bowes and Ihlandfeldt, 2000). In some cases, parking infrastructure and bus stops have reduced the attractiveness of the locations adjacent to the stations (Cervero, 1992). In the case of rail lines at ground level, the noise and visual pollution may be other factors explaining the low impact on land value.

In the land market, more flow-intense uses outbid others for locations with high accessibility. This explains why commercial activities rather than housing tend to develop around rail transit stations. The location of commercial services may have promoted housing development around the area that is immediately adjacent to some stations, raising land value even more than rail transit itself (Bowes and Ihlandfeldt, 2000).

Several studies have proved that land value increases around new stations depend on the overall ridership of the systems, not necessary at that station (Cervero 1992). Therefore, rail transit systems have to create a critical mass of riders in order to start having a significant impact on land value. The ridership of rail transit depend on their capacity to connect housing and jobs, as has been proved in cities like Toronto and Stockholm (Pill, 1988; Cervero, 1995). Then, the design of stations and the development of their surrounding areas should try to equilibrate these two uses.

As part of the research, I will analyze the studies that have been done on the impact of rail transit on land value in the case-study cities, and will propose several guidelines to maximize this impact, considering the effect of different types of developments (parking garages, housing, office space, commercial uses) on ridership and land value. I will also study the land market in San Juan, and try to determine the impact that Tren Urbano is currently having on its adjacent land.

As case studies, I will use San Francisco's BART (Davis, 1970; Lee, 1973; Dornbusch, 1975; Baldassare, et al. 1979), Washington D.C.'s METRO (Damm, et al. 1980; Aterkawi, 1991; Grass, 1992), Atlanta's MARTA (Bowes and Ihlandfeldt, 2000), Chicago's CTA (McDonald and Osuji, 1995) and Boston's MBTA.

4. Mechanism for Capturing Land Value Increases

Several economists, following Henry George's ideas, have proposed the usage of land value capture mechanisms as a way of financing government's budget. Their main arguments is that it is more equitable to make the beneficiaries of the public works to finance them, and that these mechanisms would be more efficient as a source of revenues than any the existing tax, as they would not produce the distortions that most taxes create.

Only few central governments have attempt to use these mechanisms, but they have been used by many local governments and transit agencies.

There are some successful examples of land value capture for rail transit. In Sweden the government has made joint development of land and rail transit from the post-war; in Boston the MBTA has sold the air-rights of some stations; in Japan JR East, one of the main rail companies, has developed suburban station's real estate, in some cases to build shopping centers; Washington D.C.'s Metro, along with Arlington County in Virginia, have coordinated the development around some stations, with significant results. Other transit agencies have rented commercial space in the stations, taking advantage of people flows.

As a part of my research, I will study these experiences in terms of their capacity to produce revenues, increase ridership and promote traffic-oriented development. I will explore the alternative of developing not only the station's real estate, but also additional land that would be acquired for this purpose before the construction of the rail transit. I will also analyze the possible conflicts, liability and terms of agreements between transit agencies and developers. I will propose a plan for implementing this mechanism, namely area development, in San Juan. I will analyze its viability in the existing real estate acquired for the construction, and in the two possible extensions to Carolina.

5. Milestones

The milestones for this research project will be:

- First Report, January 2003: The impact of transportation investment on land value.
- Final Report, June 2003: Financing rail transit investment through area development.

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Innovative Strategies for Managing Increasing Costs of Paratransit Operations Under the Americans with Disabilities Act

End of Year Report For
Chicago Transit Authority
And
Tren Urbano

By

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May 31, 2002

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Chapter 1 -- Introduction

1.1 Background

When the Americans with Disabilities Act (ADA) was passed in 1990, transit agency requirements for providing service to people with disabilities were modified. The legislation required that mainline service, such as fixed route bus and rail, be upgraded to meet accessibility standards for all persons with disabilities. This translates to fundamental infrastructure improvements throughout most systems. In addition, transit agencies were required to provide non-fixed route service, such as door-to-door paratransit, which provided comparable level of service and response time to mainline service. Viewed alone, the ADA was passed as an unfunded federal mandate that provided no funding for these improvements. In reality, through other federal legislation, funding has been earmarked for infrastructure improvements, but there is no longer federal funding for operations, including paratransit operations.

From the viewpoint of transit agencies, the major problem is how to manage the increasing costs associated with paratransit operations. Growth in costs and demand do not appear to be abating or even stabilizing, as originally expected. Projections show a sharp rise in costs and demand due to the influx of elderly, and potentially disabled, to the system. From the disabled community's viewpoint, the service itself is not fulfilling basic minimum requirements for mobility of the disabled and in some cases, is not meeting the requirements of the legislation passed in 1990. The end result is that neither major participant is satisfied with the service and both are interested in rectifying the situation.

The final result of my research will be a set of strategies that can be invoked by the Chicago Transit Authority (CTA), Tren Urbano, the Metropolitan Bus Authority, or any other transit agency in order to better manage the increasing costs of paratransit operations under the Americans with Disabilities Act (ADA). The strategies will consist of institutional and policy strategies for the reauthorization of TEA-21, various financial strategies and internal agency strategies. Along with these approaches, this thesis will deliver a thorough reasoning as to what the current issues are with regards to ADA paratransit operations and why external financial assistance should be provided for transit agencies for the operation of paratransit for the disabled. In summary, mobility for the disabled is not a matter that transit agencies could or should solve alone. Instead, it is an issue that the entire transportation system should be attempting to solve in concert.

1.2 Objectives

- Explore the past, present and future economic impacts on transit agencies (specifically Tren Urbano and the Chicago Transit Authority) of the ADA.
- Research expected growth in disabled and elderly residents Chicago and San Juan.
    - Growth of population
    - Attitudes towards mobility
    - Future needs
- Research other large US metropolitan areas (top 32 = 50% of US population) to identify their cost elements in relation to ADA and elderly paratransit
- Research federal legislation that shaped the ADA movement and highlight legislative changes that have occurred since the ADA was mandated
- Formulate strategies to reassign the fiscal responsibilities
    - Mobility of elderly and disabled – Entire transportation system problem vs. public transit problem
    - Identify emerging coalitions/constituencies who will support the outcome
- Examine the implications of the strategies to ensure that the gap between required services and funding is closed.

1.3 Work Completed

Chapters 2 and 3 below summarize the research that has been completed during the previous nine months. Chapter 2 provides a historical overview of United States legislation focused both on public transportation and the disabled and demonstrates how the agenda for mobility for the disabled has changed over time. The summary begins with the Urban Mass Transportation Act of 1964 and culminates with the recent passage of the New Freedom Initiative in 2001. It reviews the various pieces of legislation, some of which are geared toward the disabled community, mostly with respect to accessibility and transportation and highlights the continuum of legislation to help give a context to the ADA and the mobility issues of the disabled community. It also helps to sequence how mobility and accessibility became a right, as opposed to a privilege. Following the legislation review is a summary of the requirements and goals of the ADA with regards to transportation. A discussion of the existing state of ADA paratransit will be highlighted and various issues with its current condition will be brought to light. Lastly, a review of current Federal funding levels from both the Federal Transit Administration (FTA) and the Department of Health and Human Services (HHS) will be assessed.

Chapter 3 provides a summary of paratransit costs and their implications to CTA, Tren Urbano, and other transit agencies. The chapter begins by identifying what particular elements are involved in computing paratransit costs. These include labor, including drivers, maintenance workers and administrative staff, upkeep and maintenance on the vehicles themselves, fuel and insurance costs. In order to demonstrate that managing increasing paratransit costs is not only an issue felt by

Chicago and San Juan, a survey of the largest 32 metropolitan areas in the US was undertaken. The population of these areas accounts for 50.5% of the US population and therefore conclusions could be adequately made about the current state of paratransit and the long-term implications to these transit agencies and the regions. Both Chicago and San Juan were also used as a case study to highlight their main issues and attempts at resolving the increasing costs associated with the provision of paratransit.

1.4 Work Remaining

There are two aspects remaining in my research and they will be completed over the summer and during the fall of 2002 semester. The first part involves a stakeholder analysis that will identify possible coalition partners for the Chicago Transit Authority and Tren Urbano/Metropolitan Bus Authority. These coalitions can be used in order to form partnerships with which to approach the federal government on the reauthorization of TEA-21 and/or other initiatives to improve mobility for the disabled and manage the costs borne by transit agencies. The stakeholders involved include transit agencies, transit users, both disabled and nondisabled, advocates for the disabled, including the AARP, American Association of People with Disabilities, and the Community Transportation Association of America (CTAA), human service agencies and the FTA. Chapter 4 in this document provides a background on these stakeholders. A survey is in the process of being conducted to assess each stakeholder's level of responsibility towards the issue in addition to ascertaining his/her goals and objectives with regards to ADA paratransit. Once that has been completed, the coalitions will be formulated in order to understand which stakeholders can be utilized to support the strategies and also how their support can be elicited to improve the situation.

The remaining portion of Chapter 4 will discuss the likelihood of future funding avenues to manage the increasing costs of paratransit operations under the ADA and potential strategies for obtaining this funding. Within each strategy, the main payee(s), the beneficiaries and the positives and negatives of each strategy will be identified. The strategies can be divided into three types of subgroups. The first type will focus on institutional and policy strategies, such as federal and regional mobilization around mobility for the disabled and the reauthorization of TEA-21. The second type will delve into financial strategies, from obtaining federal funding, through dedicated money from the Highway Trust Fund or increasing gas taxes at a national level, to increasing state and local funding sources, through a region wide parking or sales tax. The final category can be implemented within each transit agency. This includes improved marketing of

the Taxi Assistance Program in Chicago, or the creation of a similar service in San Juan. It also includes opening ADA paratransit services to other sectors of society, including the elderly or residents of low-density areas.

Chapter 2 -- An American Legislative History of Transportation and Mobility for the Disabled

Due to increased dependence on the automobile and the continuing sprawl of urban America since the 1950s, mobility for the elderly and disabled[1] became much more of a challenge. Beginning in the 1960s, many pieces of US legislation attempted to integrate transportation and accessibility standards for the disabled. Through legislative statutes and departmental various regulations, Congress attempted to improve mobility for a segment of the population that has often been overlooked in the transportation agenda. Below is a timeline of the pieces of legislation that highlights each piece that will be discussed as well as the linear relationship among them.

[1] Originally, much of the legislation focused on elderly and handicapped, as though they had equal needs with regards to accessibility. Throughout many documents from the 60's and 70's, the industry jargon for the group was E&H. However, the elderly fought to separate themselves from the handicapped, as this title applies only to a subset of the elderly and does not sufficiently cover all of their needs. The 1970's and early 1980's subsequently referred to subjects as handicapped. From the late 1980's onward, the term handicapped was redefined as disabled, which includes both mentally and physically disabled Americans.

United States Transportation and Accessibility for Disabled Legislative Timeline

Urban Mass Transportation Act of 1964	1964
	1968 *Architectural Barriers Act*
Urban Mass Transportation Assistance Act of 1970	1970
	1973 *Federal-Aid Highway Act Rehabilitation Act Section 504*
National Mass Transportation Assistance Act	1974
	1981 *APTA v. Lewis*
Federal Public Transportation Act Surface Transportation Assistance Act	1982
	1986 *DOT/HHS Council on Human Services Transportation Formed*
Federal Mass Transportation Act	1987
	1990 Omnibus Budget Reconciliation Act *Americans with Disabilities Act*
ISTEA Title I Surface Transportation ISTEA Title III Federal Transit Act Amendments	1991
	1993 Omnibus Budget Reconciliation Act
ISTEA extended through 1998	1997
	1998 TEA-21 Title III Federal Transit Act
New Freedom Initiative	2001

Legislation in italics relates to accessibility for the disabled.

2.1 The 1960s

The 1960s began a period of addressing the civil rights of minorities in the United States, be it African Americans, the disabled, or the poor. It was during this decade that the initial push for recognition of equal accessibility and mobility for the disabled began.

2.1.1 Urban Mass Transportation Act of 1964

The provisions of this legislation did not specifically target the disabled or elderly communities. Instead, it did give a substantial boost to what is now commonly referred to as mass transportation, as it was one of the first pieces of legislation to specifically fund public transportation. $375 million of Federal funding was allotted to provide capital assistance to develop mass transportation systems in urban areas.[2]

2.1.2 Architectural Barriers Act – 1968

Studies and public discussion started as early as the 1950s in an attempt to mitigate the existence of physical barriers, which, even today, are one of the main impediments to full participation in society by the disabled population. The legislation mainly focused on the architectural modification of public buildings so that the disabled community could access them.

> "If the handicapped cannot enter and use public buildings, they cannot easily vote, obtain government services, conduct business or become independent and self-supporting. Efforts to enhance talents and market job skills become meaningless when the job site and the usual place of business are inaccessible."[3]

Prior to this act, there was no federal mandate requiring right of access to federally funded properties. The Architectural Barriers Act changed that and required that any building "designed, built, altered or leased with Federal funds" had to be accessible to all members of the community.[4] After much Congressional debate, 'building' was defined as any building or facility designed for public use, except privately owned residential structures not leased by the government for subsidized housing programs[5] and military facilities design for use by "able-bodied men."[6] The passage of this act provided some of the greatest buoyancy to the disabled cause.

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[2] Percy, Stephen L. Disability, Civil Rights and Public Policy, The University of Alabama Press, 1989 p. 131.
[3] American Civil Liberties Union. The Rights of Physically Handicapped People. 1979. p. 67.
[4] The Access Board, http://www.access-board.gov/about/ABA.htm
[5] Ibid.
[6] Percy, Stephen L. Disability, Civil Rights and Public Policy, The University of Alabama Press, 1989 p. 52.

2.2 The 1970s

Advocates for the disabled continued the push for equal mobility[7] and accessibility[8] during the 1970s and it was partially achieved by the Rehabilitation Act of 1973. However, the fuel crisis of 1970's broadened the agenda to focus on improving mobility for all through more fuel-efficient and cost effective modes like public transit.

2.2.1 Urban Mass Transportation Assistance Act of 1970

The Urban Mass Transportation Assistance Act of 1970 amended the Urban Mass Transportation Act of 1964 to include a section that stated that the elderly and handicapped had the same rights as the nondisabled community to use public transportation and that "special efforts shall be made in the planning and design of mass transportation facilities and services."[9] Although the bill asserted that accessibility should be a national policy, it stopped short of using any formal language to require enforcing accessibility compliance by agencies that received federal funding.[10]

Grants and loans were made accessible to states and local public agencies, which helped to facilitate the provision of these services. Section 16, which was changed to Section 5310 in the Surface Transportation Assistance Act of 1982,[11] was developed to specifically address the needs of the elderly and disabled segment. The governor of each state distributed funding for capital expenditures and state administrative costs. Capital expenses included buses, vans, communication equipment, vehicle maintenance, rehabilitation and overhaul, equipment leases and acquisition of transportation services under a contract or lease.[12] Unfortunately, the focus on funding for capital expenses led to the implementation of many capital-intensive projects, as opposed to projects that may have required less capital, but greater operating or coordinating expenses. However, not all providers of specialized transportation services were eligible for Section 5310 funding. Those that qualified were private nonprofit organizations who provided transportation services for the elderly and disabled, state-approved public bodies who coordinated services for the elderly and

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[7] Mobility is the ability to move freely among origins and destinations
[8] Accessibility is the ability to reach an origin or destination without barriers
[9] Prepared for the City of Tacoma. A Comprehensive Transportation Plan for the Elderly and Handicapped. 1977. p. 12.
[10] Percy. Stephen L. p. 132.
[11] Federal Transit Administration. General Overview of FTA C 9030.1B, "Urbanized Area Formula Program: Grant Application Instructions. http://www.fta.dot.gov/library/policy/9030_1B/9030CH1.htm
[12] Federal Transit Administration. Section 5310 Program Circular, Chapter II. http://www.fta.dot.gov/library/policy/circ9070/chapter2.html p 2-3.

disabled, or public bodies who certified that no non-profit was able to provide such services in the area.[13]

2.2.2 Federal-Aid Highway Act – 1973

The majority of the Federal Highway Act did not pertain directly to the disabled; however, it did present financial progress for public transportation in general. The legislation had two main features with regards to public transportation, (1) the federally funded portion of public transportation capital projects increased from 66.6% to 80% and (2) both the Federal-Aid Highway Systems highway funds and the Interstate Highway transfers were made available for public transportation projects. These changes and increased financial assets ultimately led to improvements for public transportation, which includes services for the disabled.[14]

As part of the legislation, funds were provided for the design and construction of Metro, Washington DC's subway, to specifically to enhance accessibility and mobility for the disabled. Lastly, provisions were made for non-profit organizations to receive grant or loan money to provide paratransit services to the elderly and handicapped.[15]

2.2.3 Rehabilitation Act – 1973

The Rehabilitation Act of 1973 reauthorized the vocational rehabilitation programs that helped to educate and improve the employable status of disabled individuals. In retrospect, the most important portion of the statute, Section 504, was added as a small piece of the legislation after attempts to modify the Civil Rights Act of 1964 failed. It was added almost as an afterthought, so that those individuals who participated in the Rehabilitation Act programs could transcend the traditional biases of the business community and find employment. Section 504 duplicated language found in the Civil Rights Act of 1964 and prohibited discrimination against all disabled individuals by any project that received Federal funding. This included, but was not limited to employment, education, architectural accessibility, health, welfare and social services.[16] In this case, disabled individuals were defined as anyone who "has a

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[13] Congressional Research Service. Federal Transit Administration's Section 5310 Elderly and Disabled Program: Fact Sheet. October 28, 1999. p. 1.
[14] American Public Transportation Association (APTA). Public Transportation Fact Book. P. 150.
[15] Percy, Stephen L. Disability, Civil Rights and Public Policy: The Politics of Implementation. p. 132.
[16] Tucker, Bonnie Poitras. Federal Disability Law. 1994. p. 28.

physical or mental impairment that substantially limits one or more major life activities; has a record of such an impairment; or is regarded as having such an impairment."17

This legislation only focused on those projects or agencies that received federal funding, but did not help to alleviate the biases that were pervasive in the general business community. However, it was hoped that by establishing the rights of this population within the Federal government, the business community would be persuaded to follow suit. The disabled community was left to wait until the passage of the Americans with Disabilities Act in 1990 for all discrimination to be prohibited.

In addition to Section 504, the Rehabilitation Act provided other avenues for assisting the disabled. Section 501 required that Federal agencies undertake affirmative action when hiring individuals with disabilities. Section 502 formed the Architectural and Transportation Barriers Compliance Board whose purpose was to oversee compliance with the 1968 act. Lastly, Section 503 encouraged affirmative action with regards to employing disabled contractors on Federal jobs.[18]

2.2.4 National Mass Transportation Assistance Act – 1974

The National Mass Transportation Assistance Act of 1974 was created as an amendment to the Urban Mass Transportation Act of 1964 and was the first piece of legislation to provide operating subsidies for both public and private transportation providers.[19] The act was designed to entice communities to revisit their list of priorities to try to encompass the needs of the entire community, be it mainline service or supplemental services, such as demand-responsive transportation, jitneys or service for the elderly, disabled and generally transit disadvantaged.[20]

In addition, Section 9, subsequently changed to Section 5307 in the Surface Transportation Act of 1982, was created to target urban areas through a formula program. It provided funding to urban areas, with populations exceeding 50,000, for capital and operating assistance.[21] Although many stipulations apply to the recipients of

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[17] Percy, Stephen L. Disability, Civil Rights and Public Policy: The Politics of Implementation. p. 54.
[18] Ibid.
[19] Bureau of Transportation Statistics. US Department of Transportation. National Mass Transportation Assistance Act of 1974.
http://www.bts.gov/other/MFD_tmip/papers/history/utp/ch7.htm - 7.13
[20] Prepared for the City of Tacoma. p. 13.
[21] Federal Transit Administration. FTA Statistical Summaries – Grant Assistance Program http://www.fta.dot.gov/library/reference/GAP/GAP.HTM

this funding, it can be used for capital, operating or planning expenses.[22] Funding from Section 5307 is typically provided for a broader array of projects that can assist a greater segment of the population, although it was modified in 1998 to allow for 10% of funding to be used for elderly and disabled paratransit services (see TEA-21). In addition to basic capital and operating assistance, 5307 also provides for a half transit fare subsidy for the elderly (65+), individuals presenting a Medicare card and disabled during non-peak periods. This subsidy applies to "any fixed route service that operates in both the peak period and the off-peak period using or involving facilities and equipment financed with Section 5307 funds, whether provided by the grantee or by another entity that leases facilities and/or equipment from the grantee."[23]

2.3 The 1980s

For the most part, the legislation of the 1980s did not focus directly on the issues of the disabled. Instead, it broadened the opportunities for public transportation to receive federal money through fuel taxes and other appropriations. However, out of the limelight, Congressional hearings and debates continued regarding the issues of the disabled population. The difference was that the issue had been redefined to look at sociopolitical issues. Prior to the late 1970s, disability policymaking focused on medical or economic definitions. The new definition was sociopolitical in nature and emphasized "disability stems from the failure of a structured social environment to adjust to the needs and aspirations of disabled citizens rather than from the inability of a disabled individual to adapt to the demands of society." In other words, the disabled were no different than someone of a different gender or skin color.[24] The redefinition allowed the stage to be set for a piece of legislation geared toward the disabled that used the Civil Rights Act as a baseline.

2.3.1 APTA v. Lewis – 1981

In 1979, the Department of Transportation disseminated its regulations for compliance with Section 504 of the Rehabilitation Act, which required that all

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[22] Federal Transit Administration. Urbanized Area Formula Program: Grant Application Instructions. http://www.fta.dot.gov/library/policy/9030_1B/9030CH1.htm October 10, 1996.

[23] Federal Transit Administration. Information on the Half Fare Policy for Elderly, Disabled and Medicare Patients. US Department of Transportation. http://www.fta.dot.gov/office/program/gmw/14half.doc

[24] Jeon, Yongjoo and Haider-Markel, Donald P. Tracing Issue Definition and Policy Change: An Analysis of Disability Issue Images and Policy Response. Journal of Policy Studies, University of Illinois. p. 215.

transportation facilities and vehicles were to be made accessible to the disabled. They were created in conjunction with those from the Department of Health, Education and Welfare (now, Health and Human Services) and required all recipients of federal funding to make public transportation "readily accessible to and usable by handicapped persons."[25] These guidelines brought about a lawsuit by the American Public Transit Association (APTA) versus Secretary of Transportation, Andrew Lewis.[26] The litigation challenged the position of the DOT, who sided with the disabled groups and ultimately demanded full accessibility by public transportation systems. The reasoning was based on the verbiage of Section 504, which was the main reason for claiming full accessibility for transit agencies. In 1981, the U.S. Circuit Court of Appeals for the District of Columbia handed down a ruling which sided with APTA and indicated that the DOT's rules were too stringent, imposed significant burdens on local transit properties and exceeded the requirements of the statute. After reworking the guidelines, the DOT issued amendments that compelled local properties to "provide special services" for the disabled, but left the door open for how to actually implement these guidelines.[27]

In the final opinion of the court, the ruling stated that the regulations "required extensive modifications of existing systems and imposed extremely heavy financial burdens on local transit authorities."[28] This ruling significantly altered the atmosphere for the disabled community who believed that full accessibility was a right. The fragile disability coalition splintered and was forced to look for other avenues to obtain funding for disability rights. Without the constant lobbying, the federal government did not push full accessibility by transit properties. Without full accessibility, disabled citizens were left without mobility options. Ultimately, this lack of forced accessibility led to the creation and enforcement of comparable paratransit services, which was viewed by the

[25] Lewyn, Michael. Thou Shalt Not Put A Stumbling Block Before the Blind: The Americans with Disabilities Act and Public Transit for the Disabled. Hasting Law Journal, Hastings College of Law. p. 1061.
[26] Brock Adams was President Jimmy Carter's DOT Secretary; Andrew Lewis was Ronald Reagan's appointment. Secretary Adams actually passed the regulations on full accessibility and was a strong proponent of such regulations, but was out of office by the time the lawsuit came to pass. Lewis, on the other hand, given the philosophy of the Reagan administration, was more likely to scrap the regulations. (Katzmann, Robert A. Institutional Disability: The Saga of Transportation Policy for the Disabled. p.175-6.)
[27] Percey, Stephen L. p. 94, 144.
[28] Katzmann, Robert A. Institutional Disability: The Saga of Transportation Policy for the Disabled. The Brookings Institution, Washington DC. 1986. p. 174.

transit agencies as a special service that provided effective mobility for the disabled. Comparable paratransit was later mandated in the Americans with Disabilities Act.

2.3.2 Federal Public Transportation Act – 1982

The Federal Public Transportation Act of 1982 (Section III of the Surface Transportation Act of 1982) was the first piece of legislation to dedicate any money from the federal motor fuel tax to public transportation. The law set aside $.01 of a $.05/gallon increase in the Highway Trust Fund tax to be placed in a new Mass Transit Account for use on capital projects.[29] In addition, $3.13 billion was authorized for the mass transit program for each of the subsequent fiscal years (1983-1985) and to establish a new block grant program to replace current formula grants to public transportation organizations.[30]

2.3.3 Federal Mass Transportation Act – 1987

The Federal Mass Transportation Act was Title III of the Surface Transportation and Uniform Relocation Assistance Act of 1987, which affected not only mass transportation but also federal highways and safety. Although the majority of Title III was focused on fixed route public transit, it did assist the disabled community and transit properties by increasing the Federal share for projects that improve elderly and handicapped accessibility to 95%.[31]

2.4 The 1990s through the present

The 1990s began with a bang due to the passage of the Americans with Disabilities Act, which completely outlawed any discrimination towards the disabled. Other legislation later in the decade built upon the constructs of the ADA by truly involving the disabled community's needs in legislation.

2.4.1 Omnibus Budget Reconciliation Act of 1990 and 1993

These acts did not pertain directly to the disabled community. Instead, they assisted overall public transportation projects by adding a $.015 and $.02 per gallon, respectively, to the fraction of the Highway Trust Fund available for the Mass Transit

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[29] American Public Transportation Association (APTA). History and Provisions of the Federal Transit Act And Other Major Laws Affecting Public Transportation. www.apta.com/stats/fedlaw/fta.htm

[30] United States Senate. 97th Congress, Second Session. Senate Vote Record Analysis. December 21, 1982. http://www.senate.gov/~rpc/rva/972/972467.htm

[31] Urban Mass Transportation Administration (1987). Implementation of the Federal Mass Transportation Act of 1987. U.S. Department of Transportation. www.fta.dot.gov/library/legal/fr42887.html

Account. This provided an overall increase in funding available to mass transportation properties.

2.4.2 Intermodal Surface Transportation Equity Act – 1991

The overarching purpose of the Intermodal Surface Transportation Equity Act (ISTEA) was to "develop a National Intermodal Transportation System that is economically efficient, environmentally sound, provides the foundation for the Nation to compete in the global economy and will move people and goods in an energy efficient manner."[32] Therefore, unlike previous legislation that focused the majority of time and money on highway projects, ISTEA expanded the focus to all modes of surface transportation. In an effort to allow individuals states to make decisions about future transportation spending, the concept of flexible funding was introduced. Previously, legislation identified pools of funding for specific projects, be it highway, transit or trails. Instead, ISTEA allowed the pool of funding to be linked together and utilized for any type of project, which increased the amount of funding that could be used for transit projects.

With regards to the elderly and disabled, ISTEA continued to allot funds to Section 5310, modified from Section 16(b)(2) from the Urban Mass Transportation Act of 1970. For the 6-year duration of ISTEA, $428 million was reserved for specialized services for this constituency and it was left up to the each state for dispersal for capital costs or capital costs of contracting services. Only non-profits or coordinating public bodies were eligible for this money.[33] In addition, to assist in complying with the ADA's required capital improvements for accessibility, ISTEA's Section 3, Discretionary and Formula Capital Program, allowed the use of its substantial funding of $12.4 billion over 6 years.[34]

2.4.3 Transportation Equity Act of the 21st Century – 1998

The Transportation Equity Act of the 21st Century (TEA-21) used ISTEA as a building block. TEA-21 expanded on many of the appropriations started in the earlier half of the decade by ISTEA, including the transportation planning process and flexible funding. One of the main highlights of the new legislation is the guaranteed multi-year spending for highway and transit projects by Congress through FY 2003. The total that was guaranteed for the 6-year legislation was $198 billion; however, this was a spending

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[32] US Department of Transportation. Intermodal Surface Transportation Efficiency Act of 1991: A Summary. p. 5.
[33] Ibid p. 22.
[34] Bureau of Transportation Statistics. US Department of Transportation. http://ntl.bts.gov/DOCS/ste.html

floor. The actual authorization was for $218 billion of spending for various highway, transit, safety and other surface transportation projects.[35]

The distribution of funds for Section 5310, pertaining to transportation for the elderly and disabled, was revised. In particular, the characterization of appropriate uses of Urbanized Area Formula capital funds was expanded to include preventive maintenance and ADA related expenditures for all urbanized areas.[36] In addition, recipients of the Urbanized Area Formula Program (Section 5307) and the Nonurbanized Area Formula Program (Section 5311) can use up to ten percent of their annual apportionment to finance ADA paratransit operations as long as both fixed route and non fixed route services have been certified as ADA compliant by the Federal Transit Administration (FTA).[37] These changes allowed the direct transit operating subsidies to disappear, some of which were used by large metropolitan transit agencies for paratransit operations. From this point forward, transit agencies have been forced to supplement meager paratransit revenues from their own coiffeurs.

2.4.4 New Freedom Initiative – 2001

As is evident from the summaries above, there has not been a serious piece of legislation geared toward the disabled community since the ADA was passed in 1991. The New Freedom Initiative was created under the realization that there are still significant daily challenges that the disabled community face. The legislation's purpose is to increase the disabled community's access to assistive technologies, expand educational opportunities, and increase disabled Americans' integration in the workforce and other facets of daily life.38 Although this is a broad piece of legislation targeting most aspects of the disabled community, it specifically set aside $145 million for two transportation programs geared toward the disabled. $45 million was granted for funding of 10 pilot programs in urban or rural areas to help promote innovative approaches to transportation issues of the disabled community. $100 million was made available as a dollar-to-dollar matching grant program to community-based organizations

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[35] US Department of Transportation. Transportation Equity Act for the 21st Century: A Summary. http://www.fhwa.dot.gov/tea21/sumover.htm

[36] American Public Transportation Association. Federal Legislation. http://www.apta.com/stats/fedlaw/fta.htm

[37] US Department of Transportation. Federal Register, Part II: FTA Fiscal 1999 Apportionments, Allocations and Program Information; Notice. Federal Transit Administration. November 6, 1998. p. 5.

[38] US Department of Labor. Expanding Transportation Options. (Title V) Overview. http://www.dol.gov/_sec/programs/ptfead/freedom_init.htm#7

that provide alternative transportation for the disabled population. However, the caveat of these funds is that they can only be used for the purchase and operation of specialty vans, assistance with costs associated with accessible vehicles and maintenance to extend existing transportation resources.[39] Again, there is no funding specifically for operations costs associated with specialized transport, nor are the large transit organizations able to qualify for the funding.

2.5 The Americans with Disabilities Act

The Americans with Disabilities Act (ADA) was passed on July 26, 1990 as an edict to completely eliminate any discrimination toward members of the disabled community. It went a step beyond Section 504 of the Rehabilitation Act in that it barred any discrimination by any organization, private or public, regardless of funding source and it *required* specific and detailed courses of action for compliance. Its language and rationale is quite similar to that of the Civil Rights Act – to prohibit discrimination and extend comprehensive civil rights to individuals with disabilities. The main difference stems from changes that are not only philosophical, but also physical and service oriented.

It is these physical upgrades and increased service that have led to great concern throughout the public transportation sector. Because Congress, since it likened the rationale for the ADA to the Civil Rights Act, chose not to directly fund the ADA, it is often perceived to be an unfunded federal mandate, when viewed as a standalone piece of legislation. In a comparison of the Civil Rights Act of 1964 and the ADA, Senator Tom Harkin (D-IA), one of the chief sponsors of the ADA, indicated, "before the 1964 act if you were black, you couldn't sit at the lunch table, or you had to sit at the back of the bus. All businesses had to do to accommodate was to let them sit wherever they wanted. But disabled people can't even get on the bus, ... so over time, the impact is greater."[40] Perhaps with the realization that the changes that the ADA required were, in fact, much more than philosophical, the year following the ADA's passage, ISTEA was passed and provided a multitude of federal funding for physical infrastructure enhancements or upgrades. Also, at that point, operations and maintenance funding was also being provided that could be used to alleviate the cost of paratransit

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[39] The White House. New Freedom Initiative: Expanding Transportation Options (Title V) Summary of Proposals. http://www.whitehouse.gov/news/freedominitiative/freedominitiative.html

[40] U.S. Advisory Commission on Intergovernmental Relations, http://www.library.unt.edu/gpo/ACIR/mandates.html December, 1995.

operations, although it was not to the same extent as capital money. In 1998, the federal operating subsidies fell by the wayside, but the requirement to continue providing door-to-door paratransit services for the disabled remained and the costs continued to rise. Hence, with this in mind, transit agencies often consider the ADA as an unfunded federal mandate with regard to paratransit operations.

The ADA is divided into five sections: Title I addresses employment discrimination; Title II addresses discrimination in public services or private entities under contract to public entities; Title III addresses public accommodations and services provided by private entities; Title IV provides for telecommunications access for all disabled; and Title V lists administrative and miscellaneous provisions.[41] The definition of disabled in the ADA is similar to the one used previously in Section 504 of the Rehabilitation Act of 1973, although it was expanded to include persons with cognitive disabilities and those with contagious and noncontagious diseases, such as tuberculosis and HIV. The definition of disabled does not include the elderly as an entire cohort. Instead, only those elderly who have a specific disability that qualifies them as ADA eligible qualify for any of the benefits of the law. Public entities are defined as any State or local government, any department, agency, special purpose district or any other instrumentality of a State or States or local government, AMTRAK, or any commuter authority under the Rail Passenger Service Act. Lastly, accessibility is defined as (1) physical access to vehicles and facilities, (2) hardware that enables use of facilities or vehicles, (3) proper training of personnel, and (4) operation and maintenance policies that enable disabled access.[42]

As this thesis was created to focus on mobility issues with regards to the ADA, only the passages that refer to transportation will be highlighted. Title II's main purpose was to ensure that "no qualified individual with a disability shall, by reason of such disability, be excluded from participation in or be denied the benefits of the services, programs or activities of a public entity, or be subjected to discrimination by any such entity."[43] A large portion of this section was dedicated to the accessibility of public transportation. Title III expanded upon the regulations to include compliance by the

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[41] Urban Mass Transportation Administration, US Department of Transportation. ADA Paratransit Handbook: Implementing Complementary Paratransit Service Requirements of the Americans with Disabilities Act of 1990. September, 1991. p. 1.1 – 1.4.
[42] Ibid. p. 1.7 – 1.8.
[43] United States Congress. The Americans with Disabilities Act (Title II and Title III). Washington: GPO, 1990.

private sector. It focused mainly on accessibility to accommodations and facilities, but also included transportation provided by private entities. Below is a table that summarizes each section with respect to transportation regulations, the type of organization that must comply and the specific requirements for those entities that provide transportation.

Table of ADA Regulations[44]

Title and Section	Type of Entity Providing the Service	ADA Requirements	Date
II, 222	Public	All purchased or leased (new or used) vehicles used in fixed route service must be accessible	Effective: August 25, 1990
II, 222	Public	Any refurbished vehicles must include accessibility features	Effective: August 25, 1990
II, 223	Public	Comparable paratransit must be provided by any public entity providing fixed route service if a user cannot use accessible fixed route transit	Implementation Plan submitted to Sec. DOT by January 1, 1992
II, 224	Public	New or used vehicles for demand responsive services must be accessible, unless equivalent service is provided to the disabled	Effective: August 25, 1990
II, 226	Public	All new facilities must be accessible	Effective: January 1, 1992
II, 227	Public	All current transit facilities must be altered to make them accessible	Based on plan submitted to and approved by Sec. DOT
II, 227	Public	Each transit agency must identify critical rail stations and make them accessible	Deadline: July, 26, 1993 (can be extended by 30 years for expensive structural changes)
II, 228	Public	At least one car per train for both heavy and light rail must be made accessible	Deadline: July 26, 1995
III, 302	Private (**demand responsive** not subject to following 2 requirements	The system, when viewed in its entirety, must ensure a level of service to individuals with disabilities, including those in wheelchairs, equivalent to the level of service provided to individuals without disabilities.	Effective: January 1, 1992

[44] Ibid.

III, 304	Private (transportation as **primary service**)	All purchased or leased vehicles that are used on fixed routes and seat > 8 passengers (including driver) must be accessible. If vehicles seat 8 or less or are solely used in a demand responsive system, they must be accessible unless equivalent service for the disabled is demonstrated.	Effective: August 25, 1990
III, 304	Private (transportation as **secondary service**)	All purchased or leased vehicles that are used on fixed routes and seat > 16 passengers (including driver) must be accessible. If vehicles seat 16 or less (including driver), they must be accessible unless equivalent service for the disabled is demonstrated.	Effective: August 25, 1990

2.5.1 Vehicles for Fixed Route Service

In reference to fixed route service, ADA requirements refer to any new or leased vehicle that will be operated on fixed routes, such as buses, rapid rail vehicles, light rail vehicles, or any other type of vehicle that will be used on such a system. Public school transportation, aircrafts, intercity and commuter rail transportation is specifically excluded from this portion of Title II. Public entities are able to purchase used vehicles for use on fixed route systems if they can prove that they have made "good faith efforts" to purchase an accessible vehicle. Remanufactured vehicles, new, leased or refurbished in house, must also be made to be accessible "to the maximum extent possible." Public entities that operate historic vehicles for places listed on the National Register of Historic Places need only make alterations that are required of remanufactured vehicles, as long as these modifications do not significantly alter the historic character of the vehicle.[45] Lastly, in order to accelerate accessibility of public transportation for the disabled, public entities were required to have at least one accessible car on each heavy or light rail train by July 26, 1995.[46] This enabled the disabled community to begin using public transportation as soon as possible.

2.5.2 Complementary Paratransit Services

When the ADA was written, complementary paratransit was added because legislators realized that the timeframe necessary to implement fully accessible systems was lengthy. Therefore, paratransit was added as a stopgap measure to provide mobility during the years of physical infrastructure modifications. However, there was

[45] United States Congress. The Americans with Disabilities Act (Title II, Section 222). Washington: GPO, 1990.
[46] United States Congress. The Americans with Disabilities Act (Title II, Section 228). Washington: GPO, 1990.

also a minority of people who believed that, even with full system accessibility, not all disabled users would be able to use fixed route services,. Therefore, all public entities that provide fixed route service, except for commuter bus, commuter rail, intercity rail systems, and systems not open to the general public, must provide paratransit service that is comparable, in both level of service and response time, to service available to non-disabled customers.[47] As these vehicles are designated primarily for the transportation of the disabled community, all vehicles, new or leased, must be made accessible unless the system, when viewed as a whole, provides options for all disabled users. For example, if a sufficient amount of taxicabs are accessible, then, because of the flexibility of taxicab service, the entire service is considered accessible even though each taxi in its own right is not accessible.

Six separate service criteria were identified to fully define "comparable" paratransit service.

1. Service area – Any origin or destination within ¾ of a mile on each side of any fixed bus route, ¾ of a mile on each side of corridors of a fixed route system that merge together, or within a ¾ mile radius of any heavy or light rail station. (Figures 1,2,3 from ADA paratransit handbook pictorially display these service areas.)
2. Response Time – The time between a request for service and pick-up of the passenger must be accommodated if requested the previous day. However, users of the system may request trips 14 days in advance. Pick up times are negotiable within reason and taxis may be used to increase flexibility for users.
3. Fares – Fares for complementary paratransit cannot exceed twice what is paid for non-disabled fixed route service. Zone or length fares are acceptable, if they exist on fixed route service. Transfer fees and premium fixed route fares are permitted as well. Personal care attendants cannot be charged for rides.
4. Trip Purpose – All trips must be accommodated. Prioritizing trips is not permitted.
5. Hours and Days of Service – This must match the hours and days of service of fixed route service. If multiple fixed route service is in operation (i.e. bus and rail), paratransit service must match the hours of the later system in those service areas that are served by it.

[47] Urban Mass Transportation Administration, US Department of Transportation. p. 2.1-2.2.

6. Capacity Constraints – Available complementary paratransit service cannot be limited by public entities. This includes caps on the number of trips provided or waiting lists for trips that cannot be accommodated. However, trips can be denied due to an *unanticipated* rise in demand.[48]

In order to ride complementary paratransit, riders must be certified as eligible. There are various levels of eligibility – unconditional, conditional, and transitional. Appendix 1 provides actual definitions from Chicago's Regional Transportation Authority (RTA). The first category, unconditional eligibility, is for those who cannot board, ride or disembark from an accessible vehicle on fixed route service without the assistance of another individual. Persons with an inability to recognize destinations or understand and complete transfers are included in the unconditional category. The second category, transitional eligibility, is for those users who can utilize mainline service if the vehicles are accessible. Therefore, until the vehicles and routes are made accessible, those who qualify are able to continue to use paratransit. The third category, conditional eligibility, is directed to those users who have a specific impairment that *prevents* them from traveling to a fixed route station. This category is the most vague. Difficulty getting to or from fixed route stops does not qualify; instead, the condition must *prevent* access to the stop. In addition, physical barriers outside of the public entity's control (i.e. lack of curb-cuts) or environmental barriers (i.e. weather or terrain) alone do not constitute conditional eligibility. It is only when these barriers are combined with the impairment that a person can be considered conditionally eligible.

In addition, to assist public transit agencies with the scope of paratransit services and containment of costs associated with such services, the following parameters were also included.[49]

- Other service providers who supply ADA paratransit services to eligible persons can be used toward the region's total effort
- The service area need not exceed fixed route corridors
- Only those who cannot use fixed route service are eligible
- Buses on fixed routes are accessible if reservations can be made in advance for lift-equipped buses

The first parameter provides incentives for transit agencies to work with human service agencies or other organizations that provide transportation services. This

[48] Ibid. p. 5.1-5.9.
[49] Ibid. p. 2.6-2.7

increases efficiency for the agencies and improves transportation services for the disabled community. Providing parameters for the paratransit service area helps transit agencies contain the scope of their services and minimize costs. However, this restriction limits the mobility of the disabled to the area where transit currently exists, which was not the underlying purpose of the ADA. The eligibility parameter ensures that capacity on paratransit services is readily available for those in need and is not squandered on persons who are able to use mainline transit. Lastly, the ability to reserve a lift-equipped bus on a route should reduce the costs for transit agencies, as that bus can be used for a multitude of purposes and provides the disabled community with a substitute for paratransit services. One negative for this parameter is that it is only useful for those who can easily access the bus stop.

The ADA allows public entities to submit a waiver if they feel that complying with the aforementioned six service criteria will impose an undue financial burden on the organization. Waivers, however, are not granted indefinitely, nor do they permit the organization to not implement the necessary services. Instead, the waiver increases the implementation period for complementary paratransit services and allows the organization to spread the costs over a greater period of time.[50]

2.5.3 Facilities

As with vehicles, any new public transportation facility that is constructed after 1990 is required to be accessible to all disabled persons, including those in wheelchairs.[51] One of the most capital-intensive aspects to this act is that all existing facilities must be upgraded to meet new accessibility standards. These alterations include, but are not limited to, elevators, escalators and street side ramps. In addition, amenities within the facilities, such as bathrooms, telephones, and water fountains, must be made accessible, as long as these modifications are not "disproportionate to the overall alternations in terms of cost and scope." In recognition that this mandate could be financially crippling to many public entities with large heavy or light rail systems that had many stations in need of upgrades, such as New York (490 stations)[52], Boston (131

[50] Urban Mass Transportation Administration, US Department of Transportation. p. 2.1-2.7

[51] United States Congress. The Americans with Disabilities Act (Title II, Section 226). Washington: GPO, 1990.

[52] Metropolitan Transportation Authority (2002). New York City Transit: Who Are We? www.mta.nyc.ny.us/mta/network.htm#statsnyct

stations)[53] and Chicago (143 stations)[54], the ADA proposed that each organization identify key stations within the system. These key stations, usually large transfer points or stations that served heavily traveled areas, were required to be accessible within three years of the ADA's passage. The focus on key stations allowed public entities to defer the modifications of other, supposedly less important stations, and stretch the large capital costs of facility upgrades over long periods of time.[55] In addition to facilities designated for use of public transportation, all programs or activities undertaken by public entities, such as meetings or educational classes, must occur within accessible facilities.

2.5.4 Private Transportation Providers

Title III of the ADA pertains only to private enterprises, which is defined as any organization that was not previously defined as a public entity. This includes private companies and non-profit organizations. To further differentiate between these entities with regards to transportation services, the ADA identifies private entities who provide transportation as their primary responsibility and those who provide it as secondary to their primary business, such as health centers. In the case of private entities that provide fixed route or demand responsive transportation services as a primary service, all vehicles, new or leased, that seat more than 8 passengers, including the driver must be accessible, unless the entity as a whole provides a level of service for the disabled that is equivalent to that provided to the non-disabled. The same requirements apply to those entities that provide transportation services as a secondary service, except that the seating capacity of the vehicle is reduced to more than 16 persons, including the driver.

All in all, the ADA finally forced society to put the disabled population on par with the non-disabled community. However, in the decade since its passage, there have been many debates over costs and responsibilities for its implementation with regards to transportation services.

2.6 How has the ADA affected transit agencies and the disabled?

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[53] Massachusetts Bay Transportation Authority (2002). MBTA Information www.mbta.com/profile/glance/infrastructure.cfm

[54] Chicago Transit Authority (2002). CTA Overview. www.transitchicago.com/welcome/overview.html

[55] United States. Congress. The Americans with Disabilities Act (Title II, Section 227). Washington: GPO, 1990.

Requirements of the ADA can be divided into 2 categories: physical infrastructure improvements and complementary paratransit services. As discussed above, much of the legislation pre and post-ADA has been focused, both legislatively and monetarily, on capital expenditures. Before TEA-21, operating funding existed for public transit agencies, although it did not sufficiently cover paratransit costs and other mainline operating costs. Since the elimination of operating subsidies in TEA-21, what minimal appropriations for operations that exist have been reserved for private non-profit organizations. Little has been provided for public transportation organizations, which provide a lion's share of the specialized paratransit services in most urbanized areas.

In addition, most transit agencies are close to completing the necessary physical infrastructure enhancements. However, based on queries of many large transit agencies, the accessibility of fixed route services will have a limited affect on the demand for paratransit services as most users' disabilities preclude them from ever using fixed route service. For these two reasons, the remainder of this thesis will focus on paratransit services for the disabled, as opposed to physical accessibility needs for the community.

Although the ADA required paratransit, the concept was not new to transportation providers. It had been on the radar screen previously, both locally and nationally, as an opportunity to supply transportation to those segments of the population that were underserved, specifically the elderly, disabled and poor. In addition, it was viewed as a potential competitor with the automobile as it could easily serve low-density, dispersed travel patterns. It presented a viable opportunity for private operators to enter the public transit market, which presented the opening the federal government needed to avoid direct funding of the service.

2.7 Current State of Paratransit

ADA paratransit was intended to give a comparable level of service to that of a nondisabled transit rider. However, as is evident in the level of service, transit riders in the US are billed as second-class citizens when compared with the level of service provided by the automobile. Given that the American society is designed and built with the automobile at the forefront, the ADA does not completely provide the equivalent mobility status that was its basis. Nowhere in the ADA legislation does it require that

mobility for the disabled be put on par with mobility for the majority of nondisabled Americans who use the automobile with immense regularity.[56]

Concerns over the current state and future direction of paratransit services for the disabled have been increasing over the past decade. Public transportation agencies, federal human service and transportation departments, social agencies for the disabled and elderly, local officials, elderly and disabled advocates and the communities themselves have been vocalizing their dissatisfaction with the current state of paratransit. Federal agencies, public transportation agencies and local officials are concerned with the ever-growing bottom line of providing such services. Social service agencies, advocates for the elderly and disabled and the actual communities are becoming increasingly concerned with the inadequate level of service and continued limited mobility for the disabled communities.

2.8 Why is this an issue?

2.8.1 Demand

According to Census 2000, the population of Americans over the age of 65 has grown by 12% since 1990 and as the elderly census figures table[57] demonstrates, the numbers show no signs of abating. The 75-84 cohort has increased by almost 23%, and both the 85-94 cohort and 95+ cohort have increased even more dramatically, at 37.9% and 34.7% respectively. Between 2000 and 2025, the Census projects that the 65+ cohort will increase by 75% as the babyboomers reach this age group.[58] These increases can be primarily attributed to improvements in technology and medicine that allow people to live longer and healthier lives. A need for mobility goes hand and hand with living longer.

Figure __: Census 2000 Figures

Elderly Census Figures			
Age	**1990**	**2000**	**% Difference**
65+	31.2	35.0	12.0
65-74	18.1	18.4	1.6
75-84	10.0	12.4	22.9
85-94	2.8	3.9	37.9
95+	.25	.34	34.7
*all populations in millions			

Although being older than 65 does not automatically make a person eligible for paratransit services under the ADA, there is a strong correlation between age and the onset of a disability(s), even with the broad definition of disabled used by the Census Bureau. Based on information from the 2000 Census, approximately a third of people

[56] Lewyn, Michael. p. 1085.
[57] Census 2000 Figures. http://www.census.gov/
[58] Ibid.

between 65-74 have a disability and close to 50% of those 75 or older have a disability. Therefore, the conclusion can be drawn that although the elderly are not always disabled, they comprise a sizable subset of the disabled population and are often grouped together with the disabled when discussing paratransit operations. The expected growth of this part of the paratransit population will only increase the requests for services in the future, which in turn will increase the costs of paratransit services. In addition, since many of these people are currently nondisabled and are most likely quite familiar with the convenience of the private automobile or mainline public transportation, their expectations regarding mobility and accessibility will be much different than those who have been disabled since birth. This presents not only a financial and policy problem, but also a political problem, as they will most likely demand better service.

2.8.2 Service Levels

The second issue with the current paratransit system and ADA regulations is the lack of options for the majority of disabled persons who reside outside of the boundaries defined by the ADA. According to the ADA, only disabled persons within a ¾ corridor on either side of a fixed route bus service or within a ¾ radius of a rail station are eligible for paratransit service. In addition, businesses are locating far outside of public transit service areas, which mean that the jobs and resources that go along with these organizations are out of the reach of the paratransit dependent population. Therefore, this limited spatial definition forces the vast majority of disabled who don't qualify for ADA paratransit to look for other means for mobility or suffer the realities of limited social interaction.

To compensate for the lack of public paratransit service, many disabled rely on human service agencies, religious organizations or family members. Social services and religious organizations have their own fiscal realities that force them to apply their own restrictions for providing paratransit services. These restrictions usually do not incorporate routine needs such as shopping or socializing, which are as critical to the physical and mental well being of a person as basic medical care.[59] Continuously asking family members for transportation needs often feels degrading to the person in need, and is a tremendous burden on the family member as well, as they are often unable to respond to the constant and varied needs of the disabled.[60]

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[59] Stamatiadis, Nikiforos, Leinbach, Thomas R., and Watkins, John F. (1996). Travel Among Non-Urban Elderly. *Transportation Quarterly, 50*(3), 113.
[60] Ibid p. 114.

In conjunction with the disabled population outside of the ADA limits, the ADA does not incorporate the non-disabled elderly population, even though they must contend with many of the same issues as the disabled. These include inability to walk long distances, stand for long periods to wait for bus or rail service or stand during transit. Prior to the passage of the ADA, many paratransit systems incorporated transportation needs for both the elderly and disabled. But with the high costs of providing paratransit to the disabled and incorporating the other requirements of the ADA, many public entities have chosen to eliminate the non-disabled elderly from paratransit services. Although these services for the elderly make sense and could potentially enhance the efficiency of paratransit services, transit agencies are hesitant to eliminate traditional services in favor of more efficient services that may serve a larger population and provide an overall improvement of mobility needs, especially to the elderly.

Current levels of service for ADA paratransit are lacking in their ability to adequately provide quality transportation service to the disabled. One of the concepts behind paratransit is that it should be "demand-responsive", akin to a taxi service. However, the current paratransit system is quite the opposite. Users are required to call at least one day in advance to request a ride. In addition, to obtain a reservation, users are expected to begin calling the service at 6 a.m. or 7 a.m. Even with an early start, users are often placed on hold for minutes, only to find out that capacity has been exceeded for the day and they must find alternative transportation. Once a ride is scheduled, the service is often late for a pick-up, if it arrives at all and once in the vehicle, users are subjected to lengthy travel times because, in an attempt to improve efficiency, agencies try to optimize the routes for a wide variety of users. This service provides quite the opposite of what was intended by the ADA with respect to level of service and response time that occurs in fixed route transportation. Not only is this structure expensive and inefficient for the paratransit provider, but also it is a detriment to the mobility of the disabled and negatively affects their roles and interactions with society.

2.8.3 Facility Compliance

According to most transit agencies, facilities and vehicles are close to being considered fully accessible, with respect to ADA requirements. In the decade since the ADA's passage, most transit agencies have rehabilitated their vehicle fleet and added low floored or lift-equipped buses. In compliance with the ADA, transit agencies have

modified key stations and plans have been created for compliance of the secondary stations. The question remains that once these agencies complete the mandatory physical enhancements, what can be done regarding the provision of paratransit services? Based on surveys and eligibility information, paratransit demand will most likely not be dampened upon complete accessibility of a transit system. In Chicago, 82.33% of ADA eligible paratransit riders are unconditionally qualified.[61] That is, regardless of accessibility of fixed route transit, they will still continue to use paratransit on a regular basis because their needs preclude the use of fixed route transit. Therefore, paratransit designed as a stopgap measure necessary only until fixed routes are 100% accessible is a fallacy. The current alternative is the status quo, a continuation of high cost, low quality paratransit for a limited disabled community.

2.8.4 Efficiency and Expense

Providing paratransit services is not a simple or inexpensive undertaking for public transit agencies. Specialized transportation service is not the core competency of an organization whose principle goal is to provide fast, efficient service from origin to destination for a multitude of people. Door-to-door service in its current form for a small subset of the general population is simply not an efficient mode of transportation. By continuing to provide such a system, year after year, transit agencies are faced with increases in demand and costs, both of which are unsustainable for the future.

Many public transit agencies are required to meet a fare recovery ratio, which is the percentage of operating costs that are recovered by receipts from the fare box. The ratio is usually set slightly above 50%, which most transportation providers often struggle to meet. Included in the calculations are not only fixed route service operations and administrative costs, but also paratransit operations. Higher revenue services can show returns in excess of 80%, but paratransit services barely recover much of anything. This ultimately forces those higher revenue-generating (less costly) routes to cross-subsidize those routes that are more costly. In Chicago, for example, the overall fare recovery ratio was approximately 52% and the fare recovery ratio for paratransit in 2001 was a meager 6%.[62] Because paratransit is mandatory and operating subsidies were cut in the late 1990's, other routes that are equally as important, such as weekend or evening service or service to low income or low-density areas, are eliminated to meet the terms

[61] Chicago Regional Transportation Authority (RTA). Data from Anne LeFevre re: ADA eligible riders in the CTA during 2001.
[62] Chicago Transit Authority. 2001 CTA Budget and conversation on 11/14/01 with Dennis Annosike, CTA Senior VP and Treasurer.

of the fare recovery ratio. Therefore, because of the limited funding available, other transportation disadvantaged individuals are often shortchanged.

Nowhere within the ADA is it mandated that public transportation systems must provide service to an area. Instead, it dictates that wherever and whenever fixed route service exists, complementary paratransit must exist as well. In theory, systems are able to reduce paratransit costs by reducing overall public transit, either by completely eliminating routes or scaling back service hours. Although it seems a bit extreme, this measure can be undertaken in lower density areas and areas with limited community participation. Not only does this severely undermine the purpose of the ADA, but it also ignores other non-disabled customers who rely on public transportation for mobility purposes.

2.9 How did we get here?

The ADA was passed in the name of civil rights for the disabled community. The main issue with advancing the legislation from that philosophical approach is that Congress adamantly refuses to fund civil rights legislation. This was overshadowed by the existence of federal operating subsidies that could cover a good portion of paratransit operating costs. Unfortunately, they were eliminated in 1998 with TEA-21.

There has been a gradual paradigm shift to allow for some capital and operating expenses related to ADA compliance to be covered by federal funding, which has allowed transit agencies to absorb the some of the costs associated with paratransit operations. Caveats and strict regulations have been attached to most of those funding advancements. For example, the fiscal year 1999 FTA Apportionments expanded the annual formula apportionment to allow 10% of Urbanized and Nonurbanized Funds to be used for ADA complementary paratransit operations through 2003. Any agency receiving this funding must be completely compliant with ADA regulations for both fixed route and paratransit services.[63] However, these operating subsidies were eliminated in 1998 and transit agencies were left with no assistance in paying for the services.

In fiscal year 2002, approximately $6.7 billion was appropriated for all of the FTA grant programs. Of this, $84.9 million (~1%) was appropriated for Section 5310, the Elderly and Persons with Disabilities Formula Program, and an additional $32 million from the Urbanized Area Formula Program was dedicated to transit enhancements. In addition, the 10% provision of the Urbanized and Nonurbanized Funds discussed above

[63] US Department of Transportation. Federal Register, Part II: FTA Fiscal 1999 Apportionments, Allocations and Program Information; Notice. p. 5.

can contribute another $320.7 million and $22.6 million, respectively, to ADA paratransit operations at the discretion of each state's governor. Section 5310 funding can be used only for capital expenses or transportation services acquired by contract. Only private non-profits or public bodies who coordinate these services or who can certify that they are there are no non-profits in the area providing this service qualifies for Section 5310 funding. Transit enhancements include improved access for persons with disabilities, but also can be used for modifications including public art, pedestrian walkways, bus shelters, and historic preservation.[64]

The US Department of Health and Human Services also contributes funding to the transportation needs of the elderly and disabled in addition to other individuals who are transportation disadvantaged. The Administration on Aging (AoA) has set aside $357 million for supportive services some of which can be used for transportation services. The AoA estimates that it will provide 51 million rides for older Americans, some of who are considered eligible for ADA paratransit.[65] The Centers for Medicare and Medicaid Services (CMS) also provides funding for transportation services. This funding is available only when an eligible Medicaid recipient travels for non-emergency, non-ambulance transported medical services.[66] Lastly, Health and Human Services has set aside a pool of funding that is to be used for supportive services, that is services that help support the primary mission of the organization, but do not receive funding specifically identified for its purpose. Because this funding can be used for a variety of tasks, there is no definitive documentation kept for transportation services. HHS has estimated that about 5% of support services funding, or $2.7 billion, is used for transportation services.[67]

2.10 Analysis of Federal Legislation

Since the Interstate Highway Act of 1956, legislation for highway funding has typically received a relatively easy passage through Congress for a variety of reasons. First, every Congressman and Senator can easily relate to the need for highway funding

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[64] US Department of Transportation. Federal Register, Part II: FTA Fiscal 2002 Apportionments, Allocations and Program Information; Notice. Federal Transit Administration. January 2, 2002. p. 3, 7, 9.

[65] US Department of Health and Human Services. "Ensuring a Safe and Healthy America: FY 2003 Budget for HHS. February 14, 2002. p. 98.

[66] US Department of Health and Human Services. Provisions for Providing Medical Assistance Transportation" July 1, 1992. http://www.hcfa.gov/medicaid/stateplan/state%5Fdata/ny/3.1/attachments/d/a%5F001.pdf

[67] US Department of Health and Human Services. Conversation with Diane McSwain, February 25, 2002.

and can make a strong case for it in his/her home district. Second, the constituencies that feel strongly about the funding are very powerful on Capitol Hill, such as the construction, automotive, and trucking industries. Third, many in Congress believe that continued highway spending is crucial to our country's economic and defense vitality.

The assistance for transit funding cannot be so easily viewed as transit is typically only used by a minority of the population and is usually only identified with large urban areas. Because of its difficulty in standing alone, transit has had to tie itself to highway legislation in order to obtain its fair share of federal money. To a great extent, this has been successful. Not only was the Highway Trust Fund expanded to include a Mass Transit Account, but also the previous focus on transportation has been extrapolated from a single focus on highways to include all forms of surface transportation. Similarly, the elderly and disabled constituencies saw immense benefits in tying their needs for improved mobility and accessibility to the coattails of the transit lobby. This too was successful, as can be seen by the achievements of the ADA.

With regards to creating a fully accessible fixed route transit system, federal funding through capital expenditures has helped make great strides for the disabled community. Although most large rail systems are not yet fully accessible, there are plans and money allocated to complete the task and it is clear how and when the system will be fully accessible.

Based on current legislation and available federal money, paratransit, on the other hand, is lagging in its quest to provide mobility options for the disabled community. Its level of service is far from what was anticipated by the ADA. Furthermore, it does not provide equal service to what the majority of nondisabled Americans use for their mobility in society: the automobile. With the current lack of funding for paratransit operations, the disabled community will constantly be placed on a second tier as compared with nondisabled citizens, in urban, suburban or rural settings. In addition, because of federal requirements and limited money, transit providers will consistently have to choose service for the disabled over increased service for the poor, non-disabled elderly or other transportation disadvantaged groups.

We are moving towards a crossroads with regards to mobility and accessibility for the disabled. The modifications of physical infrastructure are close to completion and the demands on paratransit services show no signs of abating, therefore the level of service will inevitably continue to decline. Instead of continuing in our current direction, shouldn't we stop to look at our predicament from the point of view of those

constituencies who are truly affected by the future of mobility for the disabled, the disabled community and the transit providers? In addition, shouldn't the overall goal of mobility for the disabled be what is beyond the bus not just the ability to get on the vehicle? Society is what the disabled need to access, regardless of their mode of travel or their destination.

Chapter 3 -- Paratransit Costs and Their Implications

The process of calculating costs for the provision of ADA paratransit services varies significantly across transit agencies. Some agencies contract out services, others keep the service in-house and still others combine ADA paratransit with other specialized services for the elderly or other groups. The diversity in service structure is one of the reasons why it is so difficult to truly estimate the total nationwide costs for supplying ADA paratransit services. For this chapter, in addition to surveying Chicago and San Juan, the other top 32 metropolitan areas were examined to determine the costs and ridership levels for ADA paratransit. These areas account for approximately 50.5% of the US population, according to Census 2000, and therefore, can effectively provide an accurate view of the challenges of providing ADA paratransit services in large metropolitan areas.

3.1 What cost elements are involved?

In order to estimate the average per trip cost of providing paratransit service to the disabled, transit organizations have incorporated a host of cost elements into the equation. Because of the diverse nature of service provision, the cost elements included vary across agencies. Even among those who contract services to other providers, the cost elements they include in computing the average cost diverge.

Labor, including benefits, is one of the largest costs for transit agencies, be it mainline service or paratransit service. Drivers for specialized services must be knowledgeable about the area, as there are an infinite number of origin-destination pairs. They also must be skillful drivers and be able to assist users in accessing the vehicle. In addition, skilled labor is necessary to maintain the vehicles and extraneous equipment, such as wheelchair lifts and movable seats, which are necessary to comply with ADA regulations.

Administrative staff also comprises a portion of the labor costs. Depending on the design of the system, one or more call centers plus the 800 number(s) to access them are necessary to handle the ride requests. Often times, paratransit service call centers are separate from other centers in the agency. In addition, if agencies contract out paratransit services, each contractor may have its own call center. Once the request has been received, schedulers and dispatchers are used to make the most effective use of the vehicles. Sometimes scheduling rides is automated, but for many of the agencies, scheduling rides is a manual process. In addition, there are various overhead positions to ensure that ADA regulations are met, as well as to operate the paratransit system.

Upkeep and maintenance of the vehicles, without taking into account labor, is also a high cost for transit agencies. Wheelchair lifts, which are common on most paratransit vehicles, require a high degree of maintenance. In addition, the weight of the lifts adds a significant strain to the axles, engine and transmission of each vehicle. This leads to a greater need for constant maintenance and potential repair.

Lastly, fuel prices fluctuate depending on the cost of oil nationwide. Combined with the increase in consumption that has been experienced across paratransit services, fuel costs have been steadily increasing. Insurance, both for the driver and the automobile are also part of the cost calculation.

3.2 Paratransit Costs for Transit Agencies

3.2.1 Largest 32 Metropolitan Area Transit Agencies

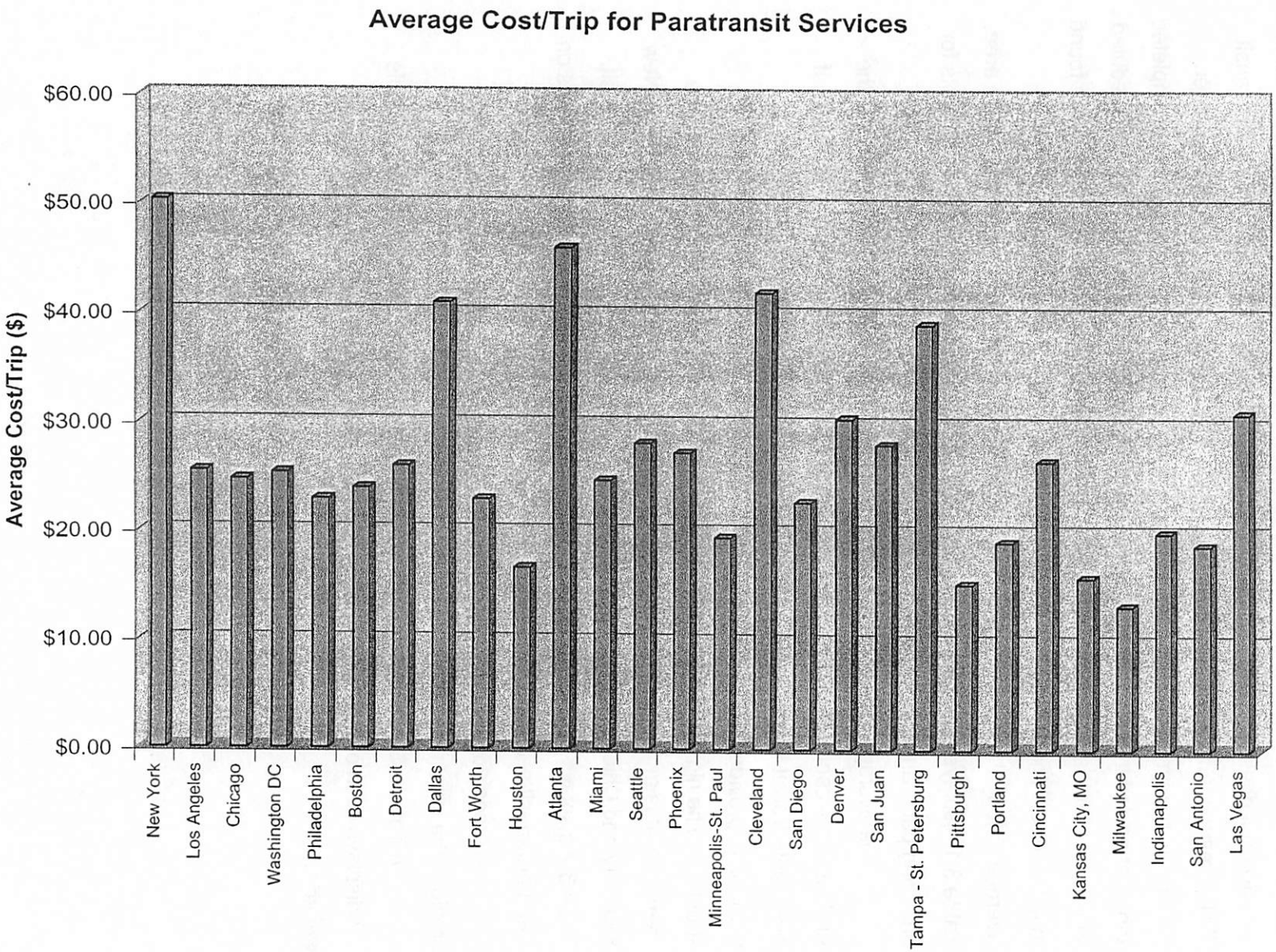
In order to obtain a broader view of paratransit costs throughout the United States, the largest metropolitan areas in the US were identified and contacted. These areas comprise 50% of the US population, which provides a comprehensive view of paratransit costs of large transit agencies across the United States. Through conversations with other paratransit providers, information was gathered about the average total cost per trip, the average fare per trip, the estimated rides per weekday, the paratransit budget for the current fiscal year and the total transit budget for the fiscal year. By gathering estimates on the first three data elements, both the subsidy for paratransit and the cost per day to provide paratransit services could be calculated. In addition, the latter two pieces of data provided an insight as to the percentage of the total transit budget that was allotted to paratransit services. Every effort was made to ensure the validity of the information contained below, but in certain cases some information was not available. In most areas, online documentation did not provide sufficient information and telephone interviews were necessary to better understand the costs associated with paratransit in each region.

Appendix 2 provides the reported costs and rides for each metropolitan area included in the survey. San Francisco, St. Louis, Sacramento, Orlando and Hampton Roads/Virginia Beach did not respond. Most of the metropolitan areas, such as Milwaukee, New York, Washington DC and San Antonio, contract their services to outside vendors. Others, such as Atlanta and St. Louis, provide paratransit services in house. In addition, other agencies, such as Cleveland, Pittsburgh and Cincinnati, combine ADA paratransit services with services for the elderly or other transportation disadvantaged groups.

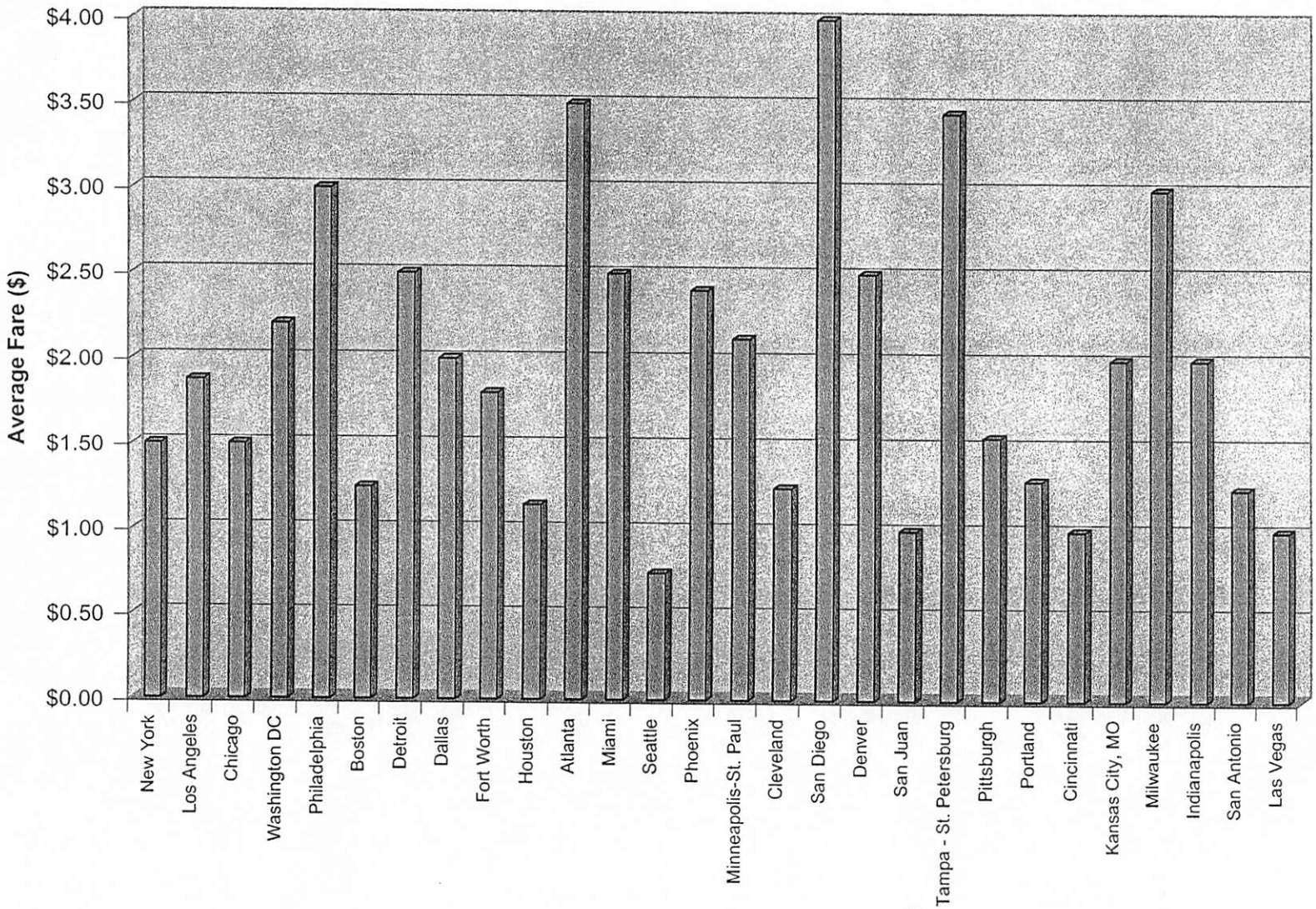
Overall, the average cost for providing paratransit services across the metropolitan areas surveyed was $26.61 per trip and the weighted average, which takes into account rides per day, was calculated to be $26.05 per trip. New York City Transit (MTA) responded with the highest cost per trip, $50.33, which includes labor, carrier, service, vehicular, and administrative costs. This amount was computed for a completed trip. Scheduled trips were slightly less expensive at $45.08, as the number of scheduled trips is greater than completed trips. The most inexpensive cost of paratransit was found in Milwaukee. The average cost was $13.27, which was calculated as a weighted average among the five paratransit vendors that provide services to the Milwaukee area. Table 3.1 displays each of the metropolitan areas and their respective average costs for providing paratransit services.

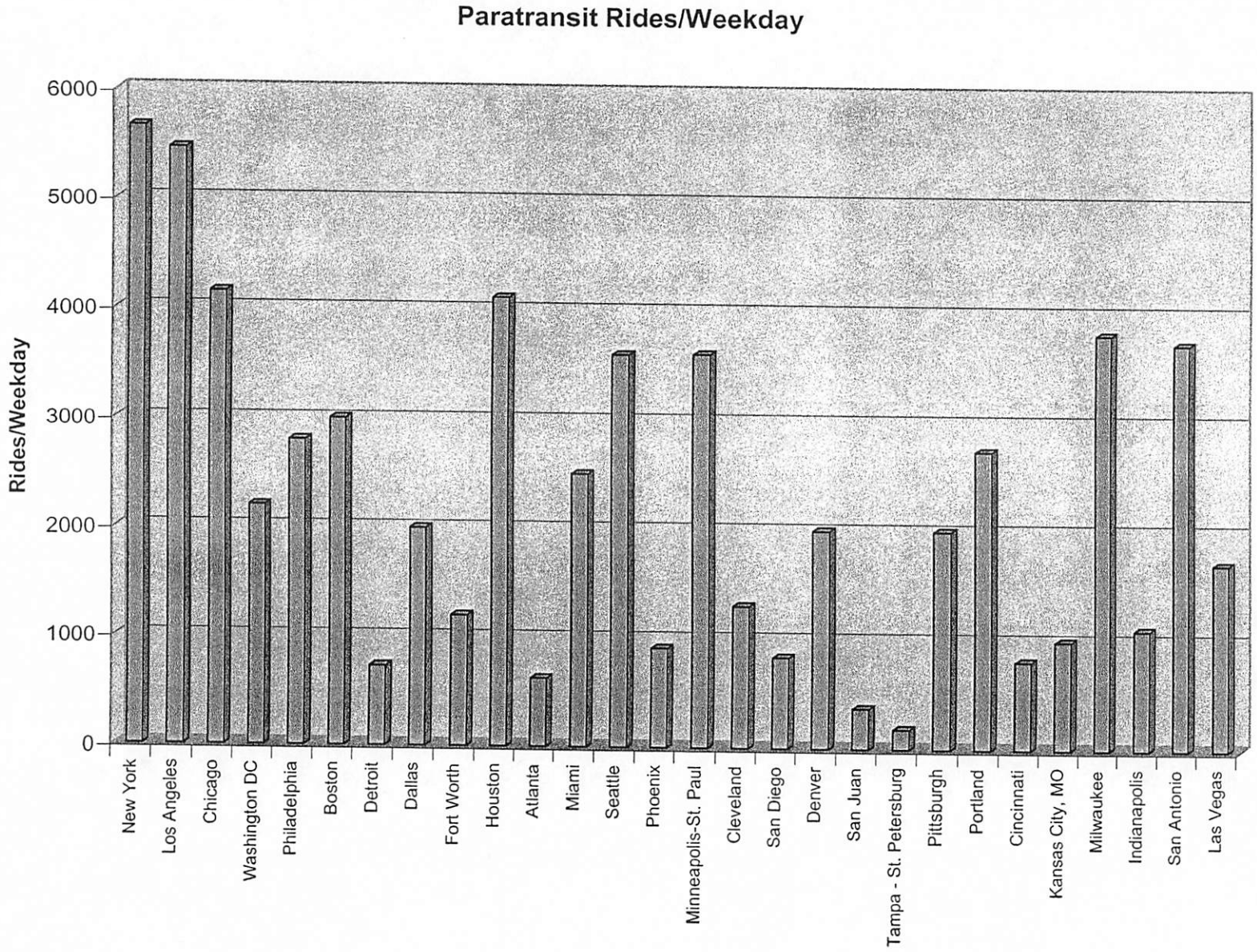
The average fare for all of the metropolitan areas is $1.98. As specified in the ADA, the fare cannot be greater than twice the fare of fixed route transit. However, if fixed route transit operates on a zone system, or does not utilize free transfers, paratransit providers may modify the fares to replicate these variations in the fare structure. The highest flat fare of $4.00 was seen in San Diego. The lowest can be seen in Seattle at $0.75. For a variety of reasons, many transit agencies, such as New York City and Chicago, have priced paratransit at the same fare as fixed route transit. Table 3.2 displays each of the metropolitan areas and their respective average fares on their paratransit services.

Average rides per weekday were found to be 2,289. New York City Transit provides the most rides per weekday at 5663 and HART-Plus, the ADA paratransit service in Tampa-St. Petersburg, provides the least at 180 riders per weekday. Table 3.3 displays each of the metropolitan areas and their average paratransit rides per weekday.


Average Cost/Trip for Paratransit Services
Average Cost/Trip ($)
$60.00
$50.00
$40.00
$30.00
$20.00
$10.00
$0.00
New York
Los Angeles
Chicago
Washington DC
Philadelphia
Boston
Detroit
Dallas
Fort Worth
Houston
Atlanta
Miami
Seattle
Phoenix
Minneapolis-St. Paul
Cleveland
San Diego
Denver
San Juan
Tampa - St. Petersburg
Pittsburgh
Portland
Cincinnati
Kansas City, MO
Milwaukee
Indianapolis
San Antonio
Las Vegas

Average Fare for Paratransit Services




Paratransit Rides/Weekday
Rides/Weekday
6000
5000
4000
3000
2000
1000
0
New York
Los Angeles
Chicago
Washington DC
Philadelphia
Boston
Detroit
Dallas
Fort Worth
Houston
Atlanta
Miami
Seattle
Phoenix
Minneapolis-St. Paul
Cleveland
San Diego
Denver
San Juan
Tampa - St. Petersburg
Pittsburgh
Portland
Cincinnati
Kansas City, MO
Milwaukee
Indianapolis
San Antonio
Las Vegas

Given these estimates, it can be observed that the majority of the transit agencies are placing a substantial amount of money into providing paratransit services for the disabled. After farebox receipts, New York City, for example, is spending approximately $277,000 per weekday to provide paratransit services. Likewise, Chicago spends slightly over $96,000 per weekday. On average, after removing the revenues from the farebox, each of the surveyed agencies spends $55,000 per weekday to provide paratransit services that comply with the ADA. Since operating subsidies have fallen by the wayside, all of the operating costs are provided by the transit agencies themselves, which presents an unsustainable method of financing mobility for the disabled.

3.2.2 Chicago Transit Authority (CTA)

The CTA has currently budgeted $34.8 million for transporting ADA qualified customers in 2002. CTA outsources its traditional ADA paratransit services (Special Services) to three providers, Art's Transportation, Cook DuPage Transportation and SCR Transportation in addition to providing service through the Taxi Assistance Program (TAP[68]).[69] Internally, CTA will use $1.26 million for labor and materials. The additional $33.5 million of the budget will be used for the purchase of paratransit services from these contractors. $31.7 million of which will go towards traditional services for the provision of 1.255 million rides at $25.23 per ride and $1.9 million will be used for TAP for .14 million rides at $13.46 per ride.[70] The CTA charges $1.50 across the board for both services and therefore, they anticipate that they will earn $2.10 million from the farebox. The remaining $32.7 million must be covered by the CTA.

Because the services are outsourced, the majority of the cost elements discussed in the previous section have been shifted to the contractor. Each vendor has negotiated a 5-year contract, all of which are set to expire at the end of 2004.[71] Labor, including drivers and maintenance employees, plus back office personnel, such as

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[68] The Taxi Assistance Program (TAP) provides certified paratransit customers reduced rate taxi rides for trips that originate within the City of Chicago. Customers pay $1.50 (the same as regular paratransit) for up to a $12.00 taxi ride.

[69] Chicago Transit Authority. CTA Paratransit Service: Customer's Guide. April 2000. p. 4.

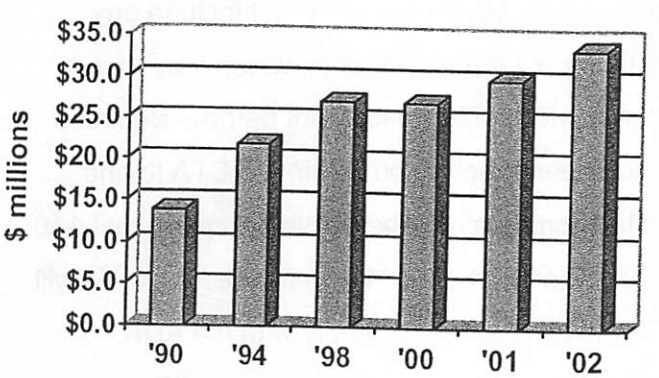
[70] Chicago Transit Authority. 2002 Annual Budget Summary. http://www.transitchicago.com/downloads/budget/2002sum.pdf

[71] Chicago Transit Authority. Conversation with Elaine McCloud, General Manager of CTA's Paratransit Operations and James Payne, Manager, Service Delivery and Contract Administration. November 15, 2001 at 120 North Racine Avenue, Chicago, IL 60607.

schedulers, call center operators, and administrative employees are the responsibility of the contractors. Maintenance, upkeep and any improvements also come under the specifics of the contract. Additionally, the contractors provide fuel and insurance. Each carrier has a voice and TTY number as well for those patrons who want to call a specific carrier directly; otherwise, CTA provides a toll free number to contact the carriers. The only other aspect of the paratransit service that the CTA provides is administrative oversight to ensure that ADA policies and practices are properly implemented and adhered to.

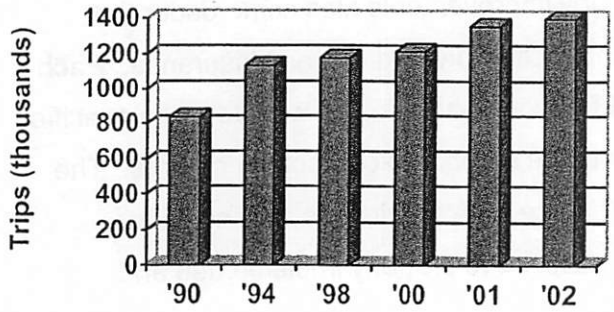
Since 1990, overall costs for paratransit services, both TAP and Special Services, have grown at a much faster rate than the costs for fixed route service. Below are three charts;[72] the first indicates the growth of the expenses associated with the purchase of paratransit services, the second shows the growth of paratransit trips, and the third indicates the average cost of paratransit services over the same period. All three charts incorporate traditional ADA paratransit services, referred to at CTA as Special Services, as well as TAP. In 1990, paratransit expenses were $13.8 million serving 838.4 thousand trips at a cost of $16.46 per trip and culminated in 2002 at $33.6 million for 1.398 million trips at a cost of $24.04 per trip.[73] This represents a 143.48% increase in paratransit expenses, a 66.7% increase in trips, and a 46% increase in average cost per trip between 1990 and 2002.

CTA Paratransit Operations

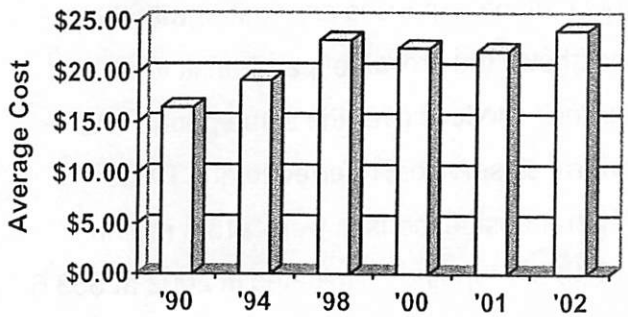


[72] Chicago Transit Authority. Paratransit Expense Chart. Received from Dennis Annosike, Treasurer of the Chicago Transit Authority.
[73] Ibid.

Paratransit Trips



Average Cost per Trip

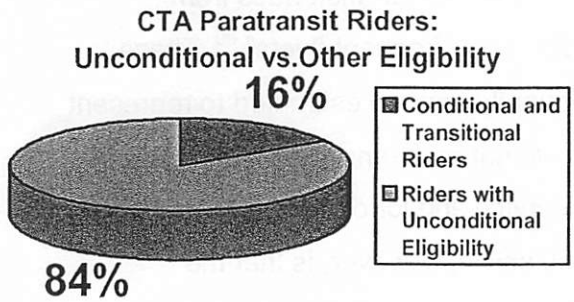


According to the CTA's financial projections, paratransit expenses area expected to grow 3.5% per annum, due to inflation, during fiscal years 2003 and 2004.[74] This does not incorporate any increases in demand, which based on historical information, has the potential to be considerable. These cost projections also do not include any additional costs that are necessary to meet other FTA requirements, which may then lead to an increase in demand due to better service, which was latent before. Because of the increase in paratransit costs, there has been much effort within the CTA to find alternative means of transporting the disabled community. They have budgeted that 119 of the 134 bus routes (89%) will have lift service and 64 of the 143 rail stations (45%) will be ADA accessible by the end of 2002.[75] Although this does comply with the ADA requirements, it also helps to foster the belief that upon mainline transit compliance, paratransit users will be able to be transitioned from special services to fixed route transit. However, this theory is not corroborated by the eligibility characteristics and the

[74] Chicago Transit Authority. 2002 Budget Summary. http://www.transitchicago.com/downloads/budget/2002sum.pdf p. 41.
[75] Ibid p. 78.

ridership information provided by CTA and their parent organization, the Regional Transportation Authority (RTA).

CTA provided data regarding the sum of trips for each ADA paratransit rider for each month during the calendar year 2001. RTA provided data for all eligible users of CTA ADA paratransit during the calendar year 2001. Their data consisted of each qualified rider, his/her eligibility category(s) and date of birth. During the eligibility process, RTA often provides more than 1 eligibility category for each rider. Also, RTA only started collecting age information in September 1999, so only those individuals who have been initially qualified or have been re-qualified since then have birth dates on file. Based on this data, there were 38,451 RTA-certified eligible riders, 15,844 of which had been qualified or re-qualified since September 1999. 10,877 qualified riders (28.3%) actually used CTA paratransit during the calendar year 2001. As demonstrated in the graph below, of those who actually rode CTA paratransit services in 2001, 9106 (83.72%) had an eligibility category of '1', which stands for unconditionally qualified. Therefore, these riders are able to use ADA paratransit at all times for any trip.



This strongly correlates to RTA's data, which lists all ADA qualified riders in CTA's service area. 82.33% of this group is unconditionally qualified. Additionally, of those riders who actually rode CTA paratransit in 2001, only 374 (4.45%) were certified as transitional. That is, a passenger can be certified as transitional if the mainline bus or train route that he/she would use is not currently accessible.[76] Similarly, 3.4% of all ADA paratransit eligible riders in the CTA service area are qualified as transitional. Therefore, based on this data, there does not seem to be much difference between those riders who are qualified to ride CTA paratransit services and those who actually use the service. More importantly, the theory that creating an accessible mainline system should significantly reduce the

[76] Chicago Transit Authority. "ADA Paratransit Certification Program: Paratransit Eligibility Categories." p. 1.

quantity of ADA paratransit services that are needed in the Chicago area does not seem to hold true, as only 3-4% apply. Even if some users move from paratransit to mainline transit, it will make it easier for unconditional paratransit users, some of whom may be latent, to request service, thereby not changing demand for service.

In an attempt to reduce the high costs of paratransit, CTA has started to heavily promote their Taxi Assistance Program (TAP). TAP provides similar service to the disabled community as traditional paratransit, but gives a higher level of service because users are able to call the day of to request service and they are not required to share rides with other paratransit users. Through a citywide ordinance that required all 18 taxicab companies assist in transporting the disabled, the number of accessible taxicabs was expanded[77] and the costs of medallions necessary to operate in the city was reduced for those who purchased an accessible vehicle. TAP rides cost CTA $13.46 per trip,[78] which is approximately 50% less than traditional paratransit services. In 2002, there are expected to be approximately 142,000 TAP rides[79] as substitutes for traditional paratransit services.

The goal at CTA is to transition 40% of the current paratransit rides from traditional paratransit to TAP, most of which will be CTA's "frequent flyers".[80] These individuals ride traditional paratransit services frequently and are estimated to represent 34.5% of all paratransit trips made by CTA.[81] Traditional paratransit services would then be used only for the neediest cases as a primary service and for others in extenuating circumstances. One of the main issues with this objective, however, is that the individuals who can suitably use TAP are only the conditional paratransit users. Transitionally qualified users are prohibited from using TAP and those who need extra assistance in embarking or disembarking from a vehicle are unable to use TAP. As stated before, conditional riders accounted for less than 12% of the entire CTA ridership during 2001 and they took less than 15% of the rides in 2001.[82]

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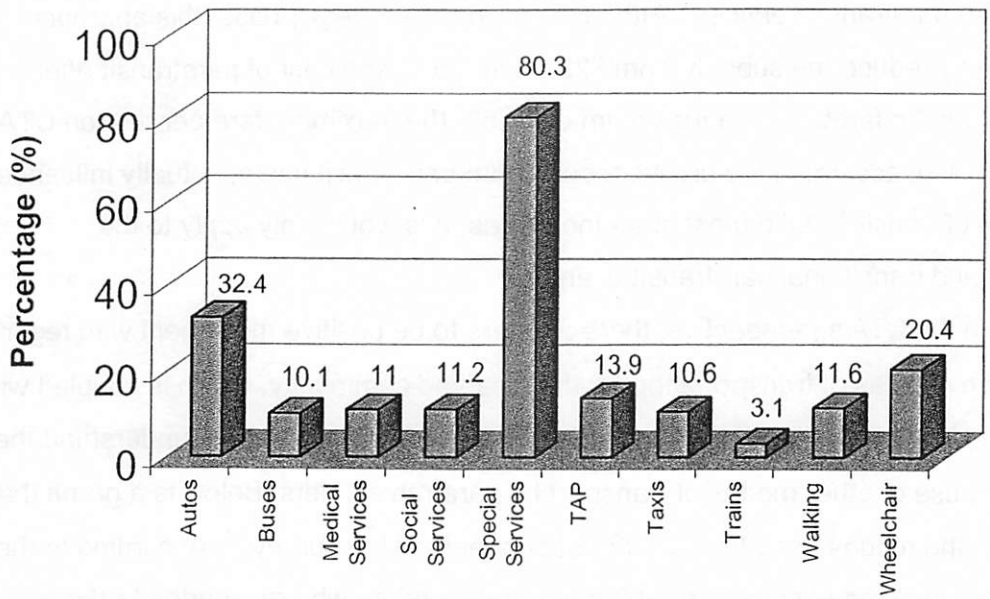
[77] Includes lift-equipped taxis as well.
[78] CTA 2002 Budget Summary. p. 78.
[79] CTA 2002 Budget Summary. p. 26.
[80] Chicago Transit Authority. Conversation with Elaine McCloud, General Manager of Paratransit Operations, and James Payne, Manager, Service Delivery and Contract Administration. November 15, 2001 Chicago, Illinois, North Racine Street offices.
[81] Chicago Transit Authority. Internal Memo re: Distribution of Number of Paratransit Trips and Trip Length. July 2000.
[82] Regional Transportation Administration and Chicago Transit Authority Data. Received from Anne LeFevre, RTA, and Lawrence Janasek, CTA.

As another incentive to ride mainline transit and ultimately reduce CTA's costs, CTA has contemplated offering free or severely discounted service to persons who currently use paratransit services. Although still in the strategy phase, this approach would not only reduce the subsidy from $22.54, the average cost of paratransit after revenues from the farebox, to a maximum of $1.50, the maximum fare per ride on CTA, but it would also, according to surveys results from paratransit users, actually influence their choice of transit.[83] Like most other incentives, this would only apply to the conditional and transitional paratransit users.

From the CTA's perspective, there appears to be positive movement with regards to alternative choices of transportation for the disabled community, which is coupled with the opportunity to reduce costs. In 1997, the CTA conducted a study to understand the extent of the use of other modes of transport by paratransit riders. Below is a graph that summarizes the modes used to travel by respondents to the survey.[84] According to the responses, approximately one-third of the paratransit riders who responded to the survey use private automobiles, vans or trucks as an alternative mode of transport. Only 10% used unsubsidized taxi service. TAP was used almost 14% of the time, perhaps because the service was not heavily marketed to paratransit users at the time. Social and medical service transportation was only used 11.2% and 11%, respectively. Most importantly, 10% and 3.1% of respondents respectively used mainline bus and rail services on a regular basis. These numbers could also be lower than actuals because of a fear of disqualification of paratransit privileges for use of mainline transit.[85]

[83] Chicago Transit Authority, Planning and Development.. Internal Memo re; Mainline Transit Service Barriers and Incentives for Paratransit Customers. November 22, 2000.
[84] Chicago Transit Authority. Internal Memo from Darwin Stuart on September 1, 2000. p. 4.
[85] Ibid.

Modes of Transport Used by CTA Paratransit Users



In an attempt to obtain a better understanding of the extent of mainline transit usage by paratransit riders, CTA asked more in-depth questions throughout the survey. The results showed that 79% of respondents who have used mainline transit indicated that it has occurred irregularly, or less than once per month. Interestingly, only 48% of those who responded felt that they were unable to ever use mainline transit due to various ailments or impediments. Lastly, approximately 25% of the respondents indicated that they could use mainline transit at least some of the time, if not all of the time.[86]

This demonstrates that although the costs and demand for paratransit are on the rise in Chicago and if previous results are indicative of future outcomes, the numbers will continue to grow, there are still options for improving mobility options for some of the disabled population in the area. TAP demand is on the rise, as well as the use of mainline transit for those who are able. However, the majority of Chicago's disabled citizens are still forced to withstand sub optimal mobility as they are left without a choice for transportation services. Their interactions with society remain at a level dictated by the service area and service level of paratransit services.

3.2.3 Metropolitan Bus Authority, San Juan

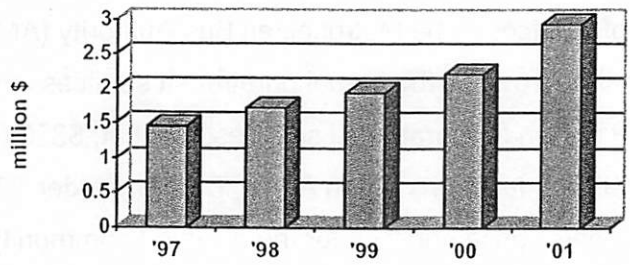
[86] Chicago Transit Authority. Summary of Paratransit Market Segments, Including High Flyers. Internal Document dated March 6, 2001.

Within the San Juan Metropolitan Area (SJMA) there are a number of public transit organizations that provide various types of transportation in addition to the more informal transportation option of publicos. The Metropolitan Bus Authority (AMA) is the only public transit organization that provides the formal paratransit services in the SJMA. Their budget for 2001 was $2.9 million for paratransit services. Of that, $320,000 will be used for administrative and overhead functions within AMA. The remainder $2.6 million will be used for the purchase of paratransit services for the disabled community in San Juan. In 2001, they provided 93,337 rides at a cost of $28.01 per ride.[87] Fares range from $.50 to $2.50, which is exactly twice the rate of mainline bus services. The variation results because transfers on mainline bus routes are not free and the ultimate fare varies within that range based on the number of transfers.[88] An average cost per trip for the disabled patrons in San Juan is estimated to be $1.00, which equates to AMA receiving approximately $94,000 from the farebox and subsidizing the remaining $2.8 million.

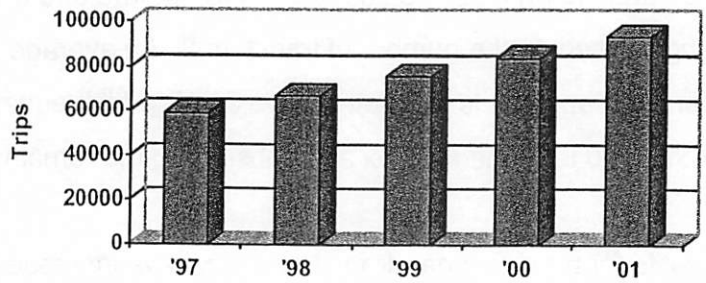
Since 1997, the costs for providing paratransit services have increased 101%, costs per trip to riders has increased by .2%, overall ridership has increased by 58% and ridership per weekday has increased by 91%. In 1997, paratransit expenses were $1.459 million serving 59.0 thousand trips at a cost of $27.95 per trip and culminated in 2001 at $2.934 million for 93.0 thousand trips at a cost of $28.01 per trip.[89] Below are four charts;[90] the first indicates the growth of the expenses associated with the purchase of paratransit services, the second shows the growth of paratransit trips, the third indicates the average cost of paratransit services over the same period and the last chart shows the growth in paratransit trips per weekday.

[87] Metropolitan Bus Authority. E-mail and fax from Omar Hernandez, Head of Budget Office, Metropolitan Bus Authority, San Juan Puerto Rico.
[88] Ibid.
[89] Ibid.
[90] Ibid.

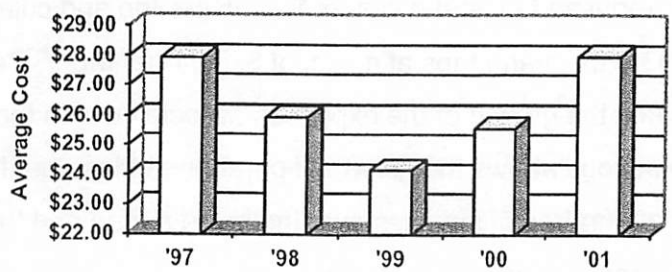
AMA Paratransit Budget



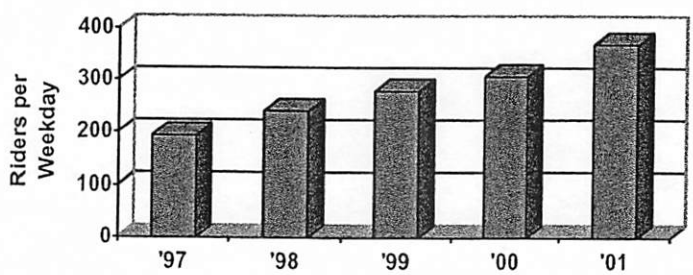
Paratransit Trips



Average Cost per Trip



Ridership per Weekday



On a smaller scale, AMA possesses many of the same problems that CTA faces. Demand and costs are increasing with little sign of dwindling and the solutions, if any, are targeted toward only a small percentage of riders. There are currently 5,175

registered paratransit riders; 2,866 of who utilize the system on a regular basis. The paratransit service area mirrors the entire AMA service area, which covers the majority of San Juan, but not the entire area. This precludes many disabled residents from utilizing AMA's paratransit services and they are otherwise forced to find alternative means of transportation or suffer in solitude. All of AMA's buses are lift equipped so those who are able can make use of mainline transit throughout the area. In addition, once Tren Urbano opens, the entire system will be fully accessible for those patrons within a viable distance from each station. These transit additions however improve mobility for a minority of the disabled population.

The main problem of accessibility and mobility of the disabled community lies with the publicos, the informal transportation service that follows a relatively fixed route, but does not have fixed stops. Most publicos are old vans with an average age of 13.6 years that have been transformed to carry up to 14-17 passengers. The fare is slightly higher than the bus, but the flexibility and consistent usage during peak periods often outweighs the cost differential. Individuals privately own the vehicles and must possess a permit, special license and registration, but are not currently held to implementing any stringent guidelines as to the maintenance or accessibility of their vehicle. Most vehicles are not air conditioned, nor are easy to ascend or descend from for nondisabled patrons, let alone disabled patrons. However, given the rising congestion and the lack of timely public transit, they are the backbone to San Juan's public transit system.

The potential problem rises in that they are not ADA accessible and there do not appear to be any plans to rectify the situation. Therefore, they are almost completely unusable for the disabled and elderly residents of San Juan. This problem will only increase as Tren Urbano, the new heavy rail system in San Juan, opens and the publicos become a potential feeder system for the train. The lack of accessibility in these vehicles will limit the usage of Tren Urbano for disabled and elderly residents, which will negatively impact the mobility of these citizens.

Both AMA and Tren Urbano have been fairly quick to embrace the ADA requirements and the accessibility and mobility needs of the disabled through mainline transit improvements. However, that only helps a small percentage of the disabled population as San Juan Metropolitan Area has the highest vehicle density per kilometer of paved road and subsequently, utilizes the private automobile to an even greater extent than the US mainland. Since the San Juan community is structured to use the automobile to access all facets of society, the disabled community is often left behind.

3.3. Future Demand

Although there is no definitive estimate of future demand for paratransit services, the ridership increases that have occurred since the ADA's inception, combined with our longer lifespan, leads to an assumption that the demand for paratransit will increase. As discussed in Chapter 2, demand for paratransit services in Chicago and San Juan has increased by 67% and 58% respectively since the early and mid 1990s. Not only has the actual number of riders requesting paratransit services increased, but as more barriers fall for the disabled community, the demand for a greater number of rides per person will increase as well. Removal of physical barriers, improved educational and work opportunities, the proliferation of social activities and the overall escalation in access to society has opened many doors to the disabled and will lend itself to an increase in demand per person.

With little argument, Americans are living longer and healthier lives, which are enabling the older generations of Americans to continue interacting with different facets of society much more frequently. This is not to say that being elderly is equivalent to being disabled. However, as one ages, the probability of being disabled rises as well. Chapter 2 provides an indication of the correlation between age and disability. Combined with the higher chance of having a disability in the higher age brackets, the Baby Boomer generation will soon reach the 65+ age range, which will increase the numbers of the 65+ cohort.

The Baby Boomer generation is comprised of 76 million Americans who were born between 1946 and 1964. According to the American Association of Retired Persons (AARP), 80% of this group plans on working, at least part time, during their retirement.[91] Often, as people age and their faculties diminish, they are less inclined to continue to utilize their private automobile for personal transportation. In addition, the penchant for living on one's own, often in single use, low density settings results in a decreased possibility of using non-motorized transport for mobility purposes. Without the automobile or other viable option, the reliance on paratransit will continue to grow, especially if older Americans do not conform to the traditional routes of retirement, continue to work outside the home and ultimately live longer.

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[91] Roper Starch Worldwide, Inc. for AARP. "Baby Boomers Envision Their Retirement: An AARP Segmentation Analysis" 1999. http://research.aarp.org/econ/boomer_seg_1.html

Many of the transit agencies surveyed provide paratransit services to the majority of their service area. Chicago, for example, provides paratransit services to all eligible patrons within the city limits. There are others, like San Juan, whose service is equivalent only to their fixed route bus service, which does not encompass the entire metro area. In these cities, the unmet demand goes unmeasured. In addition, each metro area has latent demand, which is the amount of demand that does not attempt to make a reservation because they have been discouraged in the past.[92] This demand includes certified riders who choose not to ride paratransit services or disabled residents of the region who do not even bother with certification due to previous negative experiences or stories of poor response. Because of the uncertainty of latent demand, it is also quite difficult to measure.

3.4 Paratransit Costs and Total Transit Costs

A single dollar amount does not sufficiently describe the impact that paratransit services have on public transit organizations, especially given the tendency to make comparisons among transit agencies. Instead, a contrast of each agency's paratransit costs with its total operating budget can give better insight into the plight that transit agencies currently face. The telephone survey used above also obtained the annual paratransit budget and the total operating budget of each metropolitan area. The larger transit systems, such as New York, Washington DC, and Chicago, that provide a host of transit operations utilize a small percentage of the overall transit budget for paratransit services. These agencies have other operations that can cross-subsidize paratransit expenses. They are also more densely populated and have more mixed use property within the service area, which would reduce the distance traveled per ride and increase the likelihood that more residents are either from similar origins or traveling to similar destinations. Smaller transit properties such as Indianapolis, San Antonio and Las Vegas utilize much more of their total transit budgets for paratransit services. These transit agencies do not always have the financing to cross-subsidize and therefore must spend a greater percentage of their budget on paratransit. In addition, the service area is less dense, which would require longer, more dispersed trips and lessen overall efficiency of the service. Below are the pie charts representing how the paratransit budgets measure against the total transit budget for each transit property that responded to the telephone survey.

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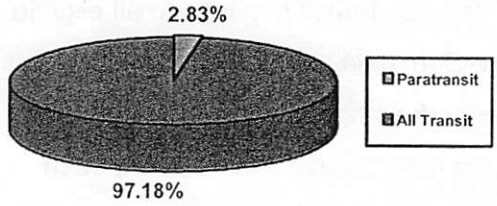
[92] Chicago Transit Authority. Internal Memo from David Czerwinski to Richard Winston re: Paratransit Demand. February 19, 2001.

New York City, New York



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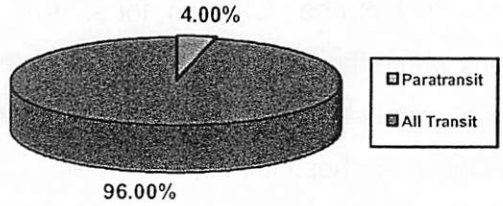

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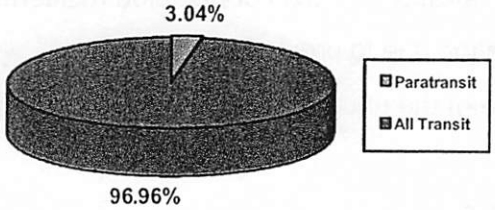

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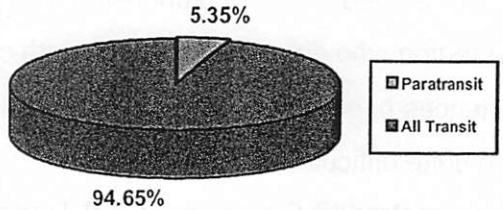

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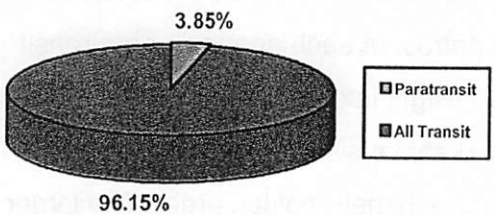

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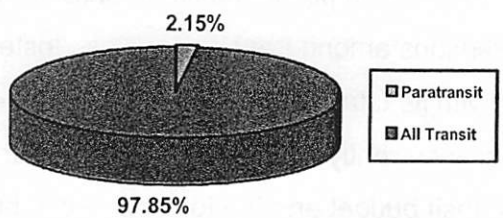

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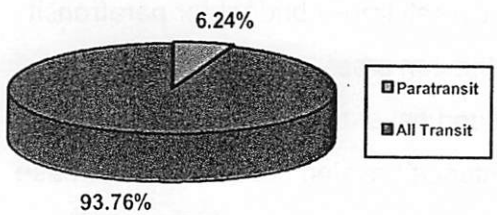

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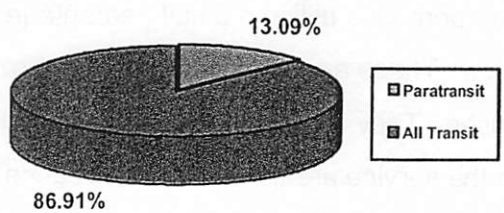

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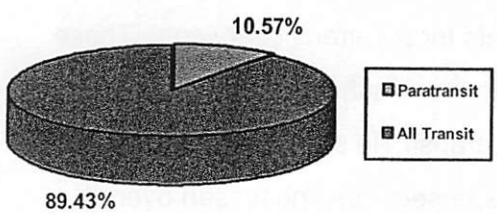

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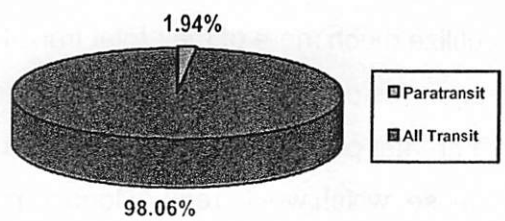

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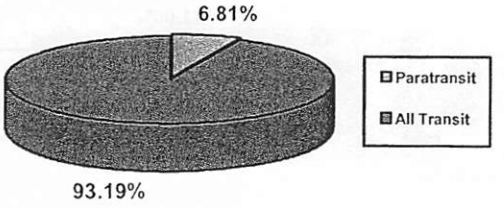

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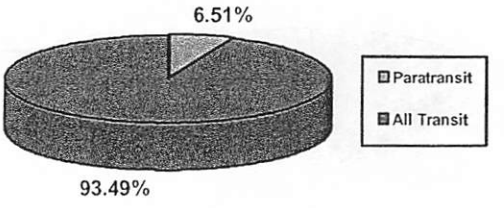

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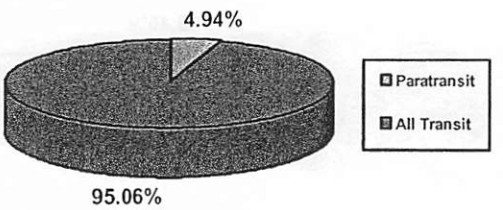

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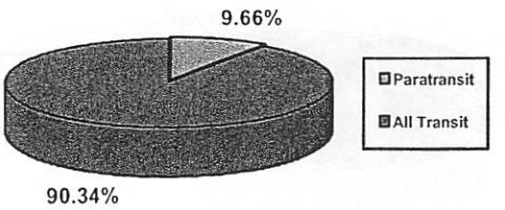

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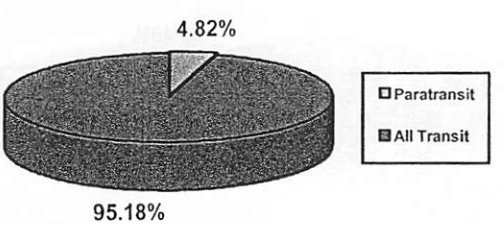

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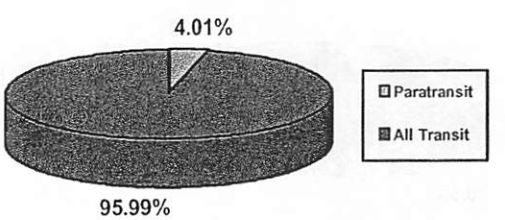

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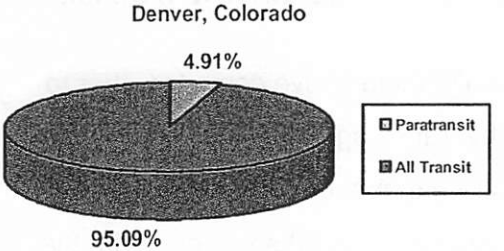

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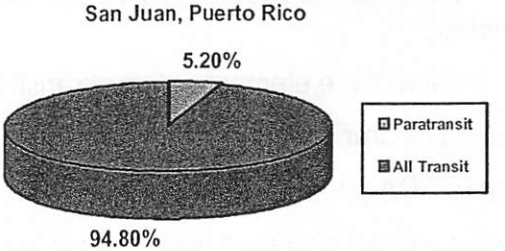

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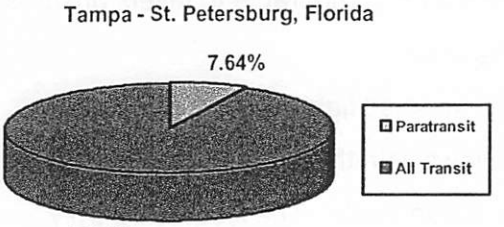

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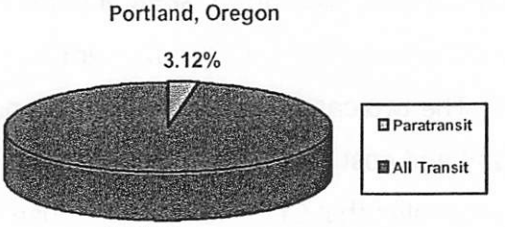

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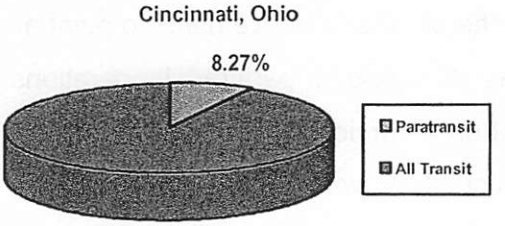

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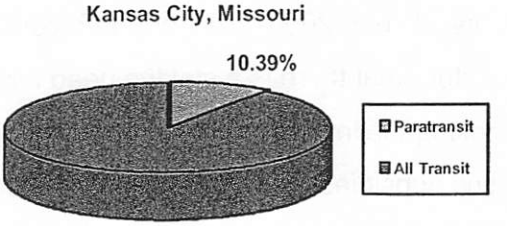

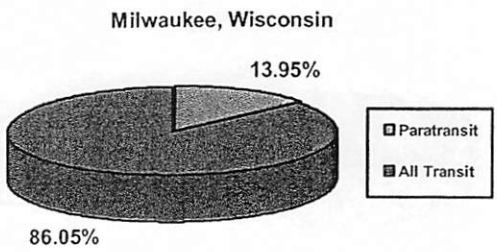

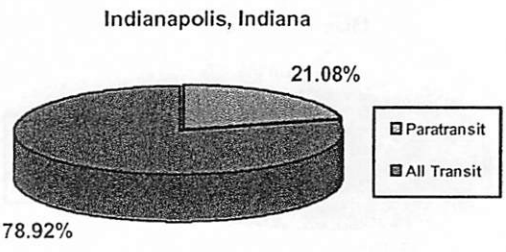

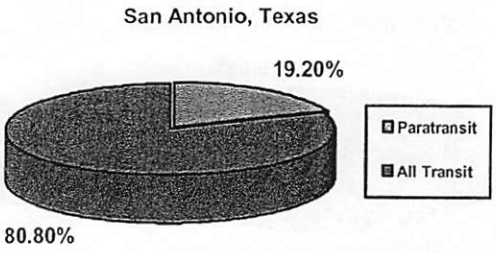

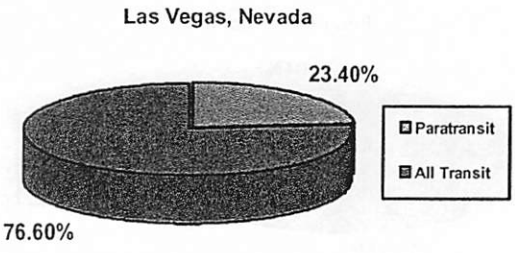

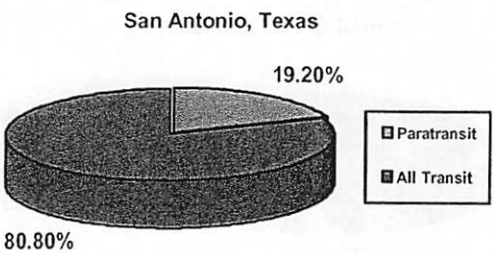

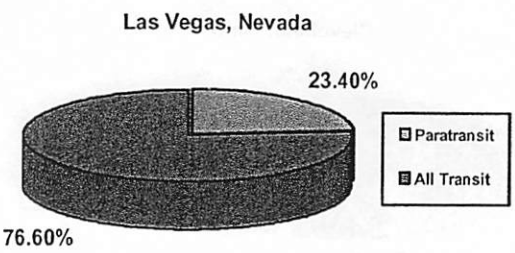

3.5 What do the results say about the current state of paratransit in transit agencies?

Each of the elements of paratransit costs highlighted above come together to present a clearer picture of financial issues faced by transit agencies nationwide with regard to ADA paratransit services. They demonstrate that each transit agency is investing a large amount of resources annually in ADA paratransit services. With the high investment, the current state of paratransit should be comparable to levels provided to nondisabled transit riders, however this is not the case.

The two case studies of Chicago and San Juan shed light on the increases of demand and cost since the ADA's inception. Interviews with the other large metropolitan areas revealed that Chicago and San Juan are not an anomaly. The issues are truly pervasive throughout the industry. Although these charts are only a snapshot of a recent fiscal year, 2000, 2001 or 2002, combining the pie charts above helps to paint a clear picture that there is a striking need for increased funding for paratransit operations. Juxtaposing the increasing costs of providing paratransit services with the elimination of operating subsidies, gives an early indication that complying with the federal mandate will become increasingly more difficult. Leveraging reasonable levels of external assistance would improve service for the disabled, as well as mitigate the need to

reduce service to the nondisabled public and relieve some of the fiscal problems that transit agencies now face. Otherwise, ADA paratransit will continue to demand greater quantities of transit agency resources, perhaps to the detriment of other transit initiatives or services.

3.6 What are the long-term implications to transit organizations and the region of these growing costs?

Based on telephone discussions with various transit agencies across the US, it is evident that concerns over providing paratransit services in the long-term are growing. Without the addition of federal funds, transit agencies will face many tough choices in the near future. Because they are required to provide paratransit services and are unable to place a cap on the provision of the service, some of these decisions may adversely affect the basic transit needs of the metro area. In order to continue to provide basic transit services, transit agencies may look to tighten the qualifications for paratransit, which only hurts their standing in the disabled community as well as limits mobility options for the disabled. Another money saving alternative is to cut or reduce service to low density or low-income areas, which negatively impacts the mobility of those residents and has the potential to pit those constituencies against the disabled community. Lastly, transit agencies could cut service entirely to an area in order to avoid providing paratransit services to that area. Not only does that reduce mobility for the disabled, but it also forces the non-disabled residents of the area to use other modes, most likely the automobile, for transportation. The negative impacts of more automobile usage in the region are plentiful and potentially more expensive than continued transit provision.

As indicated above, there are already considerable funds being spent on operating paratransit services, none of which are provided by the federal government. In the long term, the capital improvements will be completed and paratransit services will still be required, based on the needs of the disabled community. At that time, those disabled riders who are capable of using fixed route transit will be riding it and those who are unable may demand better service. The political or potential legal consequences of such a demonstration could be detrimental to the transit agencies.

From the perspective of the disabled community, the outlook for paratransit services continues to look like the status quo. Because the ADA prohibits a cap on service offerings, the disabled community is ensured of continued paratransit service.

However, the level of service will inevitably decline due higher demand and less available money for the service.

Chapter 4 -- Future Work

As my thesis is not due until December 2002, I will continue to work on this research both during the summer of 2002 and the upcoming fall semester. Below is a summary of the remaining aspects of my research.

4.1 Stakeholder Analysis

The fourth chapter of my thesis will highlight the various stakeholder groups involved in this issue and will attempt to identify possible coalition partners for both CTA and Tren Urbano to further the cause for outside funding for paratransit operations. Following is a summary of the stakeholders who will be evaluated in order to assess their strength as coalition partners and interests in improving the mobility for the disabled. Once the evaluation is complete, potential coalitions will be created with whom both Tren Urbano and CTA can join in order to sufficiently make a case to the federal government.

Before any strategies can be suggested for reassigning the fiscal responsibilities of the Americans with Disabilities Act, an analysis of applicable stakeholders must be undertaken. In order to progress and improve paratransit services, each stakeholder must "understand which organizations or groups of people are important and which relationships are most pronounced in order to develop comprehensive business and corporate strategies."[93] Although each stakeholder's vision is dynamic and they may undertake multiple roles at a time,[94] it is only with each stakeholder's input that valid recommendations can be made to help minimize the gap between the needs of the disabled community, the requirements of the legislation and the physical and financial capabilities of transit agencies.

From the viewpoint of the transit agencies, there appear to be five different groups of stakeholder, each of which is comprised of multiple organizations or groups. The first stakeholder group is the users of the transit agency's product. Within that group, the segments can be further defined as those who are disabled, both those who use ADA complementary paratransit services and those who ride mainline transit, and nondisabled transit patrons. The transit agency's competitors with respect to paratransit services are the second stakeholder group. This group is mainly comprised of human

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[93] Cummings, Jeffrey L. and Doh, Jonathan P. "Identifying Who Matters: Mapping Key Players in Multiple Environments", California Management Review. Volume 42, Number 2. Winter 2000. p. 84.

[94] Ibid.

service agencies, such as faith based or community groups, social organizations, or medical organizations. In some areas, private, for profit, organizations exist for paratransit purposes as well. The third stakeholder group consists of advocates for the elderly and disabled and for improved mobility. This includes groups such as the American Association of People with Disabilities, the American Association of Retired Persons (AARP), and the Community Transportation Association of America (CTAA). The fourth group consists of the federal, state and local governments who enacted or are required to enforce compliance with disability legislation, such as the Federal Transit Administration. Lastly, the fifth group of stakeholders is the providers of paratransit services. In the case of most transit agencies, this group consists of contract providers. Although not inclusive of all stakeholders in this debate, below is a summary that evaluates various groups of stakeholders.

4.1.1 Transit Users

4.1.1.1 Disabled Users

The value of disabled transit riders in this debate is obvious, as it is their mobility needs which is one of the focal points of the debate. Most users readily acknowledge that their mobility situation has greatly improved since the passage of the ADA.

> It is well documented that transportation is the main barrier for people with disabilities to work. But improvements in paratransit have given people with disabilities more access to employment and to other activities as well. (Kathleen Gregg, New Jersey)

> After years of staying home, I can finally get out of my house and travel. (Sally Scubin, Virginia)

> The transportation part of the ADA is changing my life. I can visit my 88-year-old Dad, swim, and go to the library, all because of transportation called for in the ADA. (Christina Keefer, California)95

However, for all of the improvements, many still feel that there is a long road ahead to put the disabled on par with the nondisabled, in terms of mobility.

> One time I was trying to ride the regular CTA bus. But the thing is... if the bus is too high, there's no such thing. I would be left there. I couldn't get in there. I couldn't climb myself up in there. And then if there is speeding or if they have to jerk, then I fall all the way back, and then I wind up getting hurt, cause there's no place to sit. So I usually ride the CDT (Cook-DuPage Transit, a contractor of paratransit services to Chicago

[95] National Council on Disability. Voices of Freedom: America Speaks Out on The ADA; A Report to the President and Congress. July 26, 1995.

> Transit Authority), Special Services. And if I can't get them – well... I just don't have a day.[96]
>
> Two or three times I tried it (riding mainline transit). And this is my experience... I was holding – I was waiting [for] two or three buses because... the lift is broke. Or [the driver said], "I['m] in a hurry, I'm sorry, I can't pick you up."[97]
>
> ... For instance, when you are in a wheelchair and you have to everyone else board first, you don't have room to get into your [space] with more people already on the bus. Also, you could be waiting first and the people fill up the bus and you are left. You can be in the subway and all of a sudden find the elevators don't [work] and there is no one to help yu. You are stranded. On the El, the operators don't always call ahead and nobody is there with the gap filler. Unless you can physically block the door from closing the train will take off before you can get off. The assistant may put the gap filler down and then when you are through the doors, the train will take off before you can get secured.[98]

Based on these comments, combined with other documentation, the disabled community desires a transportation solution that will provide them with the freedom to move between any origin and destination without impediments, just as nondisabled Americans have been doing for decades. Frequent, efficient service, the convenience of traveling on demand as opposed to planning at least 24 hours in advance, and the flexibility to access multiple destinations rather than traveling from a specific origin to a pre-arranged destination often are listed as the needs of the disabled community with regard to mobility and transportation. In addition, there is a need for courteous and competent employees who can assist users when necessary and are patient and understanding to a user's plight.

4.1.1.2 Non Disabled Mainline Transit Users

Non-disabled mainline transit users are considered latent stakeholders because the outcome of the debate on paratransit may affect their mobility needs in the future, but does not directly affect them presently. Most mainline transit riders demonstrate ambivalence or lack of knowledge with regards to paratransit services. However, due to the increasing financial needs of paratransit, the possibility of loss of mainline service reductions loom real for this group of stakeholders. In addition, because some disabilities appear only with the onset of aging, some members of this population may

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[96] The Blackstone Group. "Persons with Disabilities: Transit Mode Choice Qualitative Research: Report prepared for Chicago Transit Authority. March, 2001.
[97] Ibid.
[98] Ibid.

represent possible future paratransit demand. Currently, however, the vast majority is not concerned with paratransit because they do not understand the connection between paratransit funding and service for mainline transit.

4.1.2 Human Service Agencies

Human service agencies, such as religious, medical and social organizations, play a large role in the transport of disabled individuals for a variety of reasons. As indicated in Chapter 2 above, the Department of Health and Human Services provides funding for these organizations, some of which can be used for the transport of qualified disabled individuals. However, many of these small agencies have limited resources, such as employees and vehicles, with which to continue providing transportation services. In addition, unlike transit agencies, human service agencies are able to place parameters around their offerings, thereby specifying who can and cannot receive the service. Transit agencies in the area are left to respond to the transportation requests of individuals who do not qualify for human service agencies' transportation offerings.

4.1.3 Advocates for the Elderly and Disabled

4.1.3.1 American Association of People with Disabilities

The American Association of People with Disabilities was founded quite recently, in 1995, but in that time has become the largest non-profit, non-partisan organization focused on the disabled community. Overall, the goal of the organization is to "promote political and economic empowerment for all disabled Americans" and the organization promises to "bring about the next step in the evolution of the disability rights movement - economic clout and power through numbers - unity, leadership and impact.[99] Like AARP, the founders imagined the organization as a way for all disabled Americans to band together to work toward a common goal and also an avenue for providing services, such as insurance and other basic benefits, to the disabled community.[100]

4.1.3.2 American Association of Retired Persons

The American Association of Retired Persons, now currently referred to as AARP, has been committed to highlighting the needs and interests of Americans fifty and over since 1958. AARP's mission is to "enhance the quality of life for all by promoting independence, dignity and purpose through education, advocacy, and

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[99] American Association of People with Disabilities. http://www.aapd-dc.org/docs/info.html#about Searched on May 9, 2002.
[100] Ibid.

service."[101] AARP is considered a stakeholder in the debate on paratransit because the elderly cohorts, particularly those over 65 and 85, comprise a large portion of eligible ADA paratransit riders due to the higher probability of being afflicted by metal and physical ailments as one ages. These ailments often preclude them from utilizing America's typical means of mobility, the personal automobile, and they are reliant on alternative means of mobility, such as paratransit. Although not all members fall into this category, the quantities are great enough to warrant AARP's interest.

Based on an interview with a senior AARP staff member, AARP's view of the goal of paratransit services is simple: to "provide mobility for those who can't provide it for themselves."[102] One of AARP's main concerns about the current state of ADA paratransit is that there is insufficient funding to properly provide paratransit and mobility needs for the disabled. AARP feels that transit agencies, as well as private and human service agencies, are severely underfunded in their quest to provide equivalent mobility for the transportation disadvantaged, a group which includes the elderly, disabled and poor. Although legislation has been passed on this topic, it is for meager amounts of funding and more importantly, it has created competition for scarce resources by these various groups. This has created an environment that focuses more on who gets how much as opposed to focusing on improving mobility for those who are most in need.[103]

The current mechanism for providing transportation options in the US for the disabled community appears to be segregating, not integrating in that there is a separate but supposedly equal system for those who need it. However, the future of paratransit, according to AARP, should be a system that does not provide a wholly separate service for the disabled. Instead, a paratransit service should be open to all levels of transit users, which will undoubtedly improve the efficiency of services, from both a transit agency and individual point of view, and expand the portfolio of transportation options to the public.

4.1.3.3 Community Transportation Association of America

The Community Transportation Association of America (CTAA) is not an organization focused specifically on the disabled. Instead, their main goal is to "remove

[101] American Association of Retired Persons. Annual Report 2000. p.2.
[102] Audrey Straight, Senior Policy Advisor, AARP Public Policy Institute. Phone Conversation on May 6, 2002.
[103] Ibid.

barriers to isolation and improve mobility" for all members of society.[104] It is with this in mind that they have long been advocates for better mobility services for the disabled community.

4.1.4 Federal, State and Local Government

4.1.4.1 Federal Transit Agency

The FTA is the major federal government entity that provides financial and technical assistance to all modes of public transit. The FTA supports grant programs, like the Urbanized Area Formula Program (Section 5307) and the Elderly and Persons with Disabilities Program (Section 5310). Although they are not a lawmaking body, they will be influential in the reauthorization process of TEA-21. If there is any opportunity for convincing the federal government that there should be federal funding for paratransit operations, the FTA must be on board for it to come to fruition.

4.2 Strategies for Managing Paratransit Costs

There exist many strategies that can be used to both manage the increasing costs of paratransit operations and improve mobility for the disabled community. However, as the funding needs are so tremendous, there is not a single answer that will deliver a golden parachute. Instead, transit agencies need to pursue a variety of avenues in order to maximize the possibility of obtaining funding for paratransit operations.

4.2.1 Institutional and Policy Strategies

Institutional and policy strategies include mobilization at both the federal and regional or local levels around the reauthorization of TEA-21. In the past year, a coalition has formed with the American Association of Retired Persons (AARP), American Association of People with Disabilities, Surface Transportation Policy Project (STPP), and the Community Transportation Association of America (CTAA) as participants. STPP and AARP have been attempting to link mobility with independent living and therefore, make the case that mobility is paramount to longevity and independence. An example of regional coalitions forming to mobilize on issues of aging and mobility is the Maricopa Association of Governments (MAG). Maricopa County includes Phoenix, Arizona and its surrounding area. As a haven for retirees, this area is particularly interested in aging and mobility issues. They convened a conference in

[104] Community Transportation Association of America. http://www.ctaa.org/About/Mission Copyright 2001.

spring 2002 in an attempt to develop a national legislative agenda on aging and mobility issues for the reauthorization of TEA-21.

4.2.2 Financial Strategies

Implementing any of the following financial strategies would create a paradigm shift of mobility for the disabled as solely a transit issue to an entire transportation system issue. The following strategies would exert pressure evenly across the board, as opposed to only on transit agencies. These financial strategies that can alleviate the costs on transit agencies exist at all levels of government. The issue remains as to how to best approach each level in order to obtain the best overall response.

Approaching the issue from a federal level demonstrates a solid response and recognition of the problems at hand, however the time and resources necessary to accomplish federal funding improvements will take much longer. In addition, considerable stakeholder involvement and coalition building must occur for any action to arise from the federal level. At this level, money from the Highway Trust Fund could be explicitly dedicated to mobility for the disabled. This funding would be in addition to the transfers that already occur between the Highway Trust Fund and the Mass Transit Account. Additionally, at the federal level, a blanket gas tax could be implemented in order to shore up enough funding for paratransit operations throughout the US. Both of these options would ensure that the financial burden is shared fairly equally among all Americans.

From a state and local perspective, the outlook appears better. At this level, there is more control and more leverage with which different strategies can be implemented. Therefore, the timeline to receiving funding is much shorter in comparison to the federal level. In addition, any advancement made on a local or state level demonstrates leadership, which can be leveraged to build coalitions on a national level. Similar to the federal example above, the gas tax can be implemented from a state and regional level. Again, this would alleviate the pressure from transit riders and equally distribute it across all transportation users. A similar argument can be used in increasing the sales tax or parking tax. Increasing taxes, however, must be conscientiously undertaken so that competitive disadvantages are not observed among towns within a region.

4.2.3 Internal Agency Strategies

These strategies present the highest opportunity for implementation as all portions of the strategy are controlled internally, but unfortunately present the lowest

benefits to alleviating the financial costs of paratransit operations and improving mobility for the disabled. In Chapter 3, Chicago's Taxi Assistance Program was discussed as an additional option for able paratransit riders. The cost per ride is half of traditional paratransit services. Improved marketing for the service plus transitioning repeat users to the service will help to improve the efficiencies of paratransit services. The Metropolitan Bus Authority in San Juan could follow suit and implement a similar system in conjunction with either standard taxicabs or publicos in order to alleviate the costs of paratransit services.

Another option for improving the efficiencies of paratransit services is to open it to a larger audience, such as the elderly, non paratransit eligible disabled, or people who want a better level of service, but choose not to use a private automobile. As the law stipulates that ADA eligible riders cannot be charged more than twice the rate of non-disabled transit users, opening the service to other riders who could be charged higher fares, thereby cross subsidizing the ADA patrons. The efficiencies of such a service would be much greater in that more people would be available for rides between similar origins and destinations, which would ultimately result in an increased the economy of scale. Pittsburgh, Pennsylvania and Broward County, Florida, which includes Fort Lauderdale, have both undertaken such program fairly successfully.

There is still much work remaining to further develop the potential coalition partners and the strategies for managing the increasing costs of paratransit. What remains is discussed above in Chapter 1, Work Remaining. All of this work will be explored in greater depth during the course of the summer and the fall. The final document will be completed no later then December, 2002.

Appendix 1:

Metropolitan Areas and Paratransit Costs

Rank	City	Total Cost per Trip	Average Fare (each way)	Estimated Rides Per Weekday	Subsidization per Trip	Cost to City (Region) per Day to Provide Paratransit	Paratransit Budget	Total transit budget	Paratransit Percentage of Total Budget	Total Metro Area Population	Percent of Total US Population
1	New York	$50.33	$1.50	5663	$48.83	$276,524.29	$113,000,000	$4,000,000,000	2.83%	21,199,865	7.53%
2	Los Angeles	$25.52	$1.87	5463	$23.65	$129,199.95	$57,153,900	msg		16,373,645	5.82%
3	Chicago	$24.75	$1.50	4150	$23.25	$96,487.50	$34,800,000	$869,000,000	4.00%	9,157,540	3.25%
4	Washington DC	$25.34	$2.20	2200	$23.14	$50,908.00	$25,000,000	$823,000,000	3.04%	7,608,070	2.70%
5	San Francisco				$0.00	$0.00				7,039,362	2.50%
6	Philadelphia	$23.00	$3.00	2800	$20.00	$56,000.00	$44,000,000	$822,000,000	5.35%	6,188,463	2.20%
7	Boston	$24.00	$1.25	3000	$22.75	$68,250.00	$25,000,000	$650,000,000	3.85%	5,819,100	2.07%
8	Detroit	$26.00	$2.50	725	$23.50	$17,037.50	$3,700,000	$172,000,000	2.15%	5,456,428	1.94%
9	DFW Dallas	$41.00	$2.00	2000	$39.00	$78,000.00	$18,179,913	$291,543,034	6.24%		
	DFW Fort Worth	$23.00	$1.80	1200	$21.20	$25,440.00	$6,272,310	$47,903,408	13.09%	5,221,801	1.86%
10	Houston	$16.71	$1.15	4112	$15.56	$63,982.72	$24,984,583	$236,388,471	10.57%	4,669,571	1.66%
11	Atlanta	$46.00	$3.50	622	$42.50	$26,435.00	$6,600,000	$340,400,000	1.94%	4,112,198	1.46%
12	Miami	$24.70	$2.50	2508	$22.20	$55,677.60	$14,764,431	$216,792,635	6.81%	3,876,380	1.38%
13	Seattle	$28.15	$0.75	3591	$27.40	$98,393.40	$33,717,485	$518,000,000	6.51%	3,554,760	1.26%
14	Phoenix	$27.23	$2.40	905	$24.83	$22,471.15	$9,800,000	$198,500,000	4.94%	3,251,876	1.16%
15	Minneapolis-St. Paul	$19.50	$2.12	3600	$17.38	$62,568.00	$26,076,000	$270,000,000	9.66%	2,968,806	1.05%
16	Cleveland	$42.00	$1.25	1300	$40.75	$52,975.00	$11,000,000	$228,000,000	4.82%	2,945,831	1.05%
17	San Diego	$22.76	$4.00	825	$18.76	$15,477.00	$5,268,919	$131,466,539	4.01%	2,813,833	1.00%
18	St. Louis		$2.50							2,603,607	0.93%
19	Denver	$30.44	$2.50	2000	$27.94	$55,880.00	$14,000,000	$285,000,000	4.91%	2,581,506	0.92%
20	San Juan	$28.01	$1.00	369	$27.01	$9,966.69	$2,934,332	$56,455,741	5.20%	2,450,292	0.87%
21	Tampa - St. Petersburg	$39.00	$3.45	180	$35.55	$6,399.00	$2,217,000	$29,000,000	7.64%	2,395,997	0.85%
22	Pittsburgh	$15.25	$1.55	2000	$13.70	$27,400.00	$30,000,000	msg		2,358,695	0.84%
23	Portland	$19.14	$1.30	2732	$17.84	$48,738.88	$16,935,984	$542,958,411	3.12%	2,265,223	0.80%
24	Cincinnati	$26.51	$1.00	801	25.51	$20,433.51	$5,974,166	$72,207,460	8.27%	1,979,202	0.70%
25	Sacramento		$2.00							1,796,857	0.64%
26	Kansas City, MO	$15.90	$2.00	991	$13.90	$13,774.90	$5,158,697	$49,660,699	10.39%	1,776,062	0.63%
27	Milwaukee	$13.27	$3.00	3800	$10.27	$39,026.00	$18,000,000	$129,000,000	13.95%	1,689,572	0.60%
28	Orlando		$1.50							1,644,561	0.58%
29	Indianapolis	$20.00	$2.00	1100	$18.00	$19,800.00	$7,970,000	$37,800,000	21.08%	1,607,486	0.57%
30	San Antonio	$18.86	$1.25	3711	$17.61	$65,350.71	$19,196,789	$99,991,765	19.20%	1,592,383	0.57%
31	Virginia Beach and Norfolk, VA		$3.00							1,569,541	0.56%
32	Las Vegas	$30.99	$1.00	1700	$29.99	$50,983.00	$17,609,880	$75,259,543	23.40%	1,563,282	0.56%

Derek Lee June 2002

Case study of Tren Urbano Sagrado Corazon terminal

This case study analyses capacity and performance of the Tren Urbano Sagrado Corazon terminal using framework and tools developed in the attached thesis – Understanding Capacity and Performance of Urban Rail Transit Terminals.

The motivation of the case study is first described, then general characteristics of the terminal are discussed. After that simulation model is applied to analysis terminal performance under different operating conditions.

1. Motivation, objectives, and methodology

Terminal is a critical location of a rail line that could affect passenger service quality, as well as constrain capacity of a rail line. To ensure good service quality and adequate capacity for future service expansion at Tren Urbano, the new rail transit system now nearing completion in San Juan Puerto Rico, this case study analyzes the capacity and performance of the terminal under the proposed operating plan, and under alternative operating settings. The objectives of this case study are:

1) Describe general characteristics of the terminal using operations analysis framework
2) Predict performance of the terminal under proposed and alternative operating settings
3) Identify critical variable that affect capacity and performance of the terminal
4) Assess capacity of the terminal for future service expansion

To achieve the objectives, the Sagrado Corazon terminal and its proposed operating plan are first assessed in Section 2, then simulation analysis will be presented in Section 3 to find the practical capacity and sensitivity of terminal performance to critical variables.

2. The Sagrado Corazon terminal and the proposed operating plan

The Sagrado Corazon terminal is one of the 2 terminals in Phase I of the project. It is located at the north end of the line (see Figure 1 for a line schematic). It is picked for the case study because it will be running in higher train frequency if the Phase III of the rail system (east to Carolina) is constructed in the future. This section will first describes the infrastructure characteristics of the terminal, followed by its operating plan and service management characteristics.

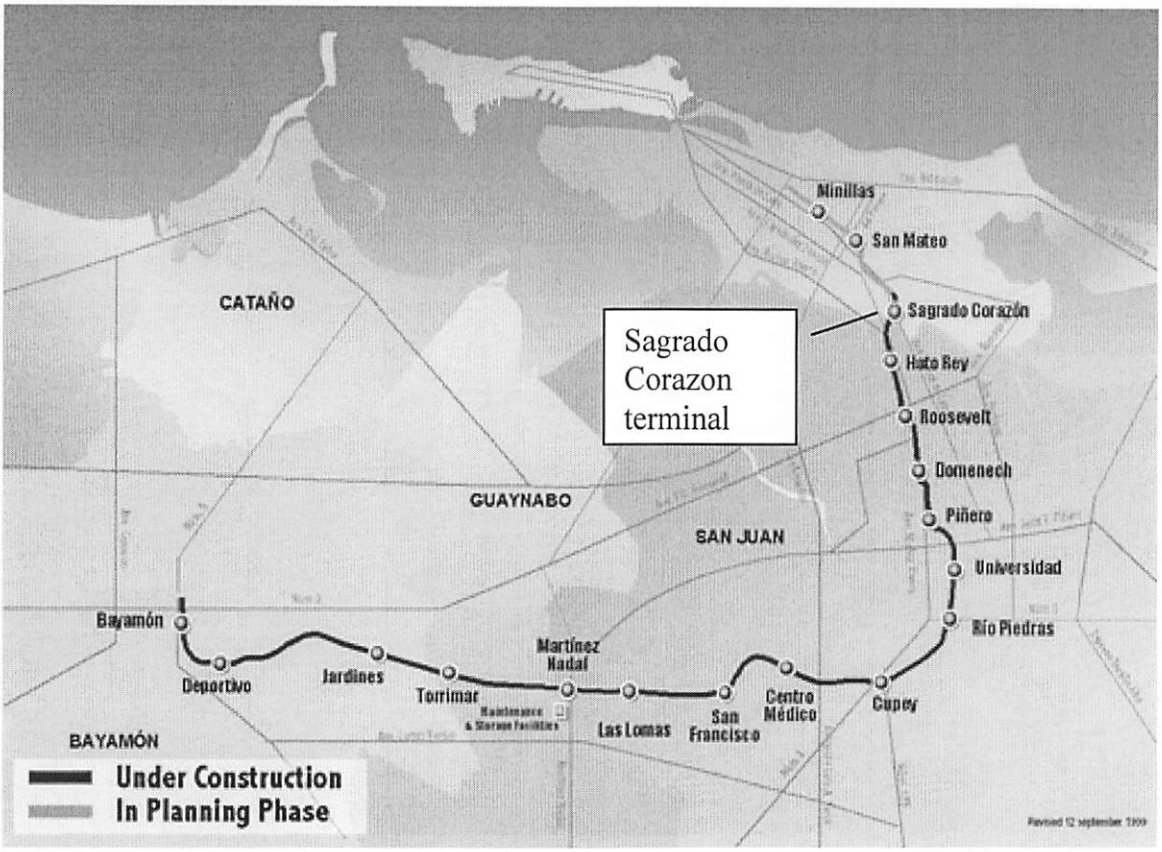


Figure 1 – Tren Urbano alignment

2.1 Line characteristics - infrastructure

Figure 2 shows the infrastructure layout for the Sagrado Corazon terminal, which includes an island platform, a crossover in front of the platform, and 2 tail tracks behind the platform where each has the capacity to store 4-car train. The crossovers are controlled by automatically by central train control system. Since there is only one crossover in front of the platform, the terminal can only be operated as a stub-end

terminal. According to the report from the prepared by the Tren Urbano signal contractor[1], the design minimum train headway allowed at Sagrado Corazon terminal is 2 minutes (a theoretical capacity of 30 trains per hour).

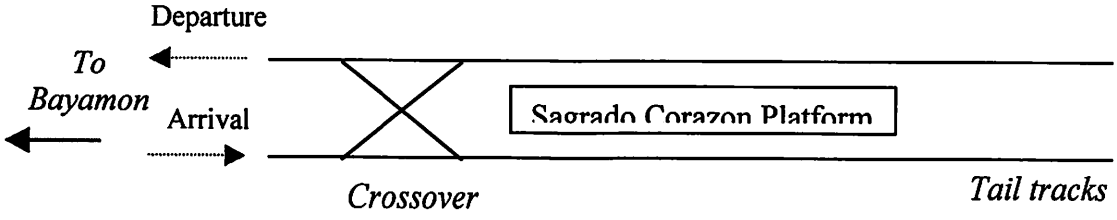


Figure 2 - Platform, track, and interlocking layout of Sagrado Corazon terminal

Operating plan characteristics

In the proposed stub-end terminal, typical train turn back movements as illustrated in Figure 3. If both platforms are empty when a train arrives at the crossover, the train would be routed to the preferred (Bayamon bound) platform so that its later departure will not interfere with the next arrival on the other platform.

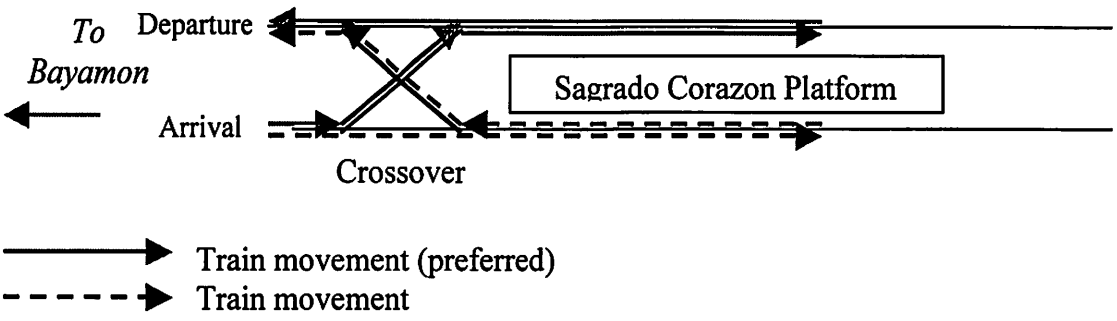


Figure 3 – Proposed stub-end operations at Sagrado Corazon terminal

Weekday service will operate from 5am to 1am, with service between 5am and 9:30pm consisting of 4-car trains, and service after 9:30pm consists of 2-car trains. According to the proposed operating plan (4th edition, November 2000), the scheduled train headways

[1] Matra Transport International (1998). *System Performance Simulation.*Tren Urbano system specification document

arriving at Sagrado Corazon terminal by time of day are as shown in Figure 4. As seen in the figure, the train headway is 4 minutes in both AM (7-9am) and PM peaks (4-7pm).

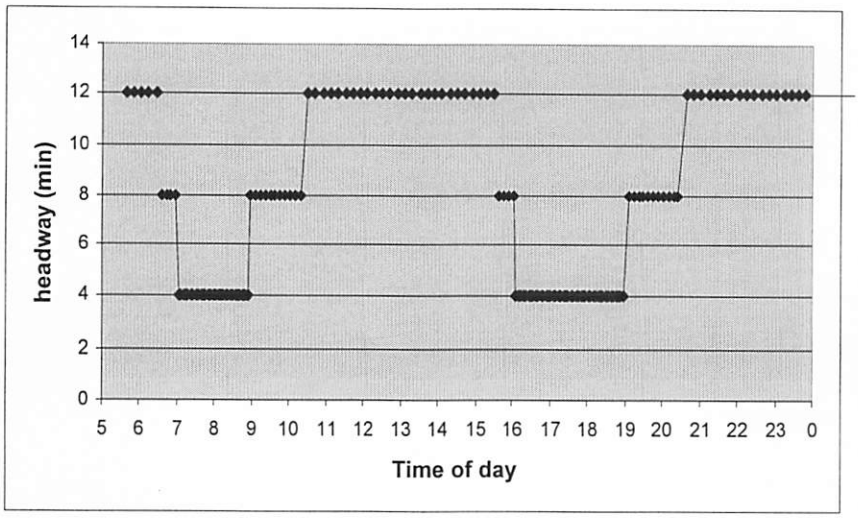


Figure 4 – Scheduled train arrival headway at Sagrado Corazon Terminal

The scheduled train recovery time at a terminal determines how long a train typically dwells at the terminal platform before its next departure. Based on the proposed operating plan, the train recovery time at Sagrado Corazon terminal by time of day is shown in Figure 5. As seen in the figure, the schedule train recovery time is set at 4 minutes in both AM and PM peak.

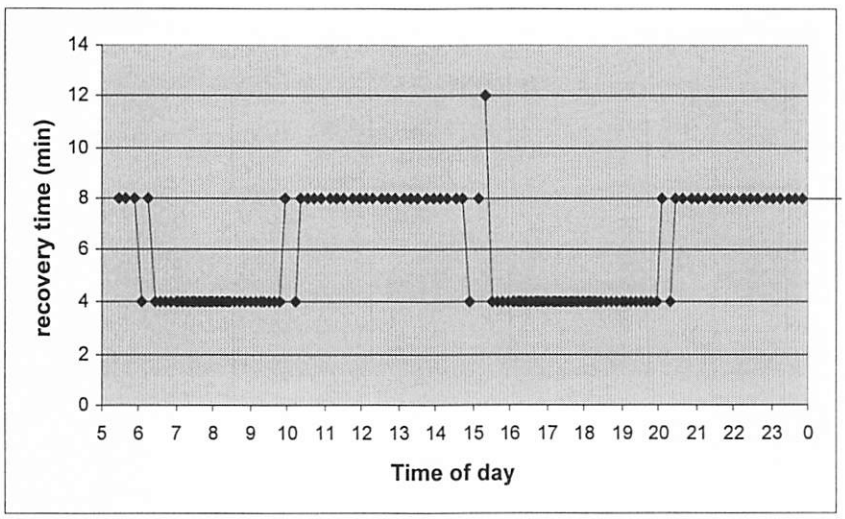


Figure 5 – Scheduled train recovery time at Sagrado Corazon Terminal

There is no discussion on crew fallback practice at terminal, so it is assumed that operators will remains at the same train when the train is turned back at the terminal.

Service management characteristics

Train routing and operations at terminal are centrally controlled in the Operations Control Center located at Martinez Nadal Station. Train routing at terminal are set up automatically by the Vehicle and Infrastructure Control and Operating System (VICOS) based on the predefined logic discussed in Figure 3.

3. Simulation analysis

So far, we only know the theoretical capacity of the Sagrado Corazon terminal through its infrastructure characteristics. However, theoretical capacity is not an appropriate indicator for terminal capacity, as it contains little buffer time for trains to recover from any delay before their next departure. More specifically, if Sagrado Corazon terminal is run under its theoretical minimum headway (2 minutes), any delay in train arrival is likely to cause delay in their next departure.

Therefore, to find the practical capacity of the terminal that allow acceptable performance, simulation model will be used in this section to illustrate how different aspects of terminal performance change with selected variables. The experimental design for the simulation analysis is presented. Then sensitivity of Sagrado Corazon performance to headway, length of peak operations, and recovery time are discussed. Finally practical capacity of Sagrado Corazon terminal is presented.

3.1 The experimental design of the simulation analysis

This section describes the design of the simulation analysis. The structure of the simulation model is first presented, then the specifications of the simulation model are stated. Finally, the outputs of the simulation model are discussed.

Structure of simulation analysis

To test the sensitivity of various aspects of terminal performance to schedule headway, length of peak, and train recovery time, a 3-layer structure is adopted, as shown in Figure 6.

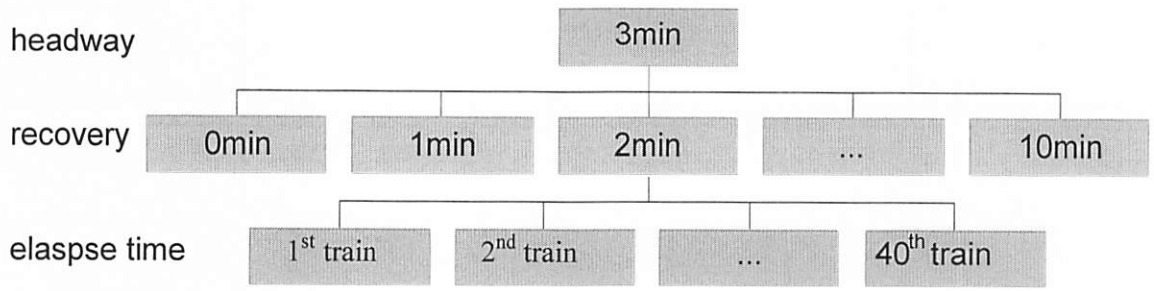


Figure 6 – Structure of simulation analysis

The three variables to be tested are structured into the three layers in Fig. 6. On the top layer is the train headway entering and departing the terminal. For the purpose of finding the minimum practical capacity of the terminal, headways ranging from 2min to 4 min (in 1min interval) were simulated with each headway having its own spreadsheet model. Under each headway, train recovery times ranging between 0 to 10 minutes were simulated. For each recovery time, three performance indicators are generated for each of 40 scheduled trains: terminal congestion and departure delay will be shown on a per-train level, whereas standard deviation of inter-departure time will be shown in a 5-train interval.

50 sets of pre-generated inputs (arrival times and platform activity time) were input to the model, which generate 50 sets of performance measures for each headway analyzed. Then average results for each of the 40 trains were obtained by averaging the results from 50 simulation runs.

Specifying the simulation model with variability

The two type of variability present in the Sagrado Corazon terminal train operations: Train arrival time variability, and platform activity time variability.

1) Train arrival times at Sagrado Corazon terminal

Schedule deviation is used to specify arrival time variability in the simulation model. Based on experience from CTA 95th terminal case study, normal distributions could be used to simulate the schedule deviation of train arrival at the terminal.

Since Tren Urbano has Automatic Train Operations, and is a shorter rail line than CTA Red Line, it is expected that train arrival variability in Sagrado Corazon terminal will be smaller that that from the CTA 95th terminal. As a preliminary assessment, this case study assumes the worst scenario for train arrival at the Sagrado Corazon terminal to be having half of the variation of that from CTA 95th terminal, based on this assumption, the following parameters are used in the arrival deviation generation process:

- Mean: 0
- Standard deviation:

Headway	2	3	4
Standard deviation	1.62	1.54	1.46

2) Platform activity time at Sagrado Corazon terminal

Based on experience in CTA 95th terminal operations (see Section 5.3.4 in attached thesis), platform activity time at can be represented by an asymmetric triangular distribution with parameter (1,1.3,2). Since there is currently no crew fallback practice adopted at the Sagrado Corazaon terminal, a walking time is needed to add to the 95th platform activity distribution to correctly reflect platform activity at Sagrado Corazon terminal. Assume crew take a deterministic value of 1 minute to change end (obtained by dividing the length of 4-car consist (~90m) by leisure walking speed of 1.5m/s), the corrected representation of platform activity time at Sagrado Corazon terminal would then be an asymmetric triangular distribution with parameter (2,2.3,3).

In additional to these two stochastic processes, running time approaching to and departing from the terminal are assumed to be deterministic. This assumption is justifiable as the Automatic Train Operations used in the Tren Urbano rail system generate minimum variation in train running times.

Outputs of the simulation model

Based on the specifications described in the previous section, the simulation model was used to generate two types of performance measure for headways between 2 and 4 minutes:

1) **Congestion** illustrates the expected amount of terminal congestion incurred by each of the 40 trains entering the terminal
2) **Departure delay** illustrates the expected amount of departure delay experienced by each of the 40 trains departing from the 95th terminal

3.2 Influence of headway, length of peak operations

Figures 7 and 8 show the influence of train headway on terminal performance. These results were generated using 4-min recovery time at the terminal (this will be shown in Section 5.3.4 to be the optimum scheduled recovery in 3-min operations, it is applied to generate performance for other headways as well for the purpose of cross-headway comparison).

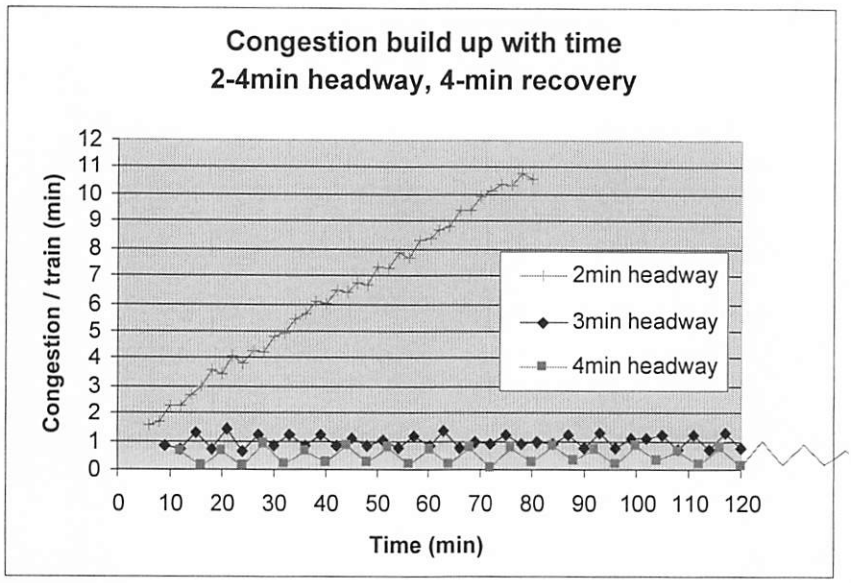


Figure 7 – Congestion build up with time

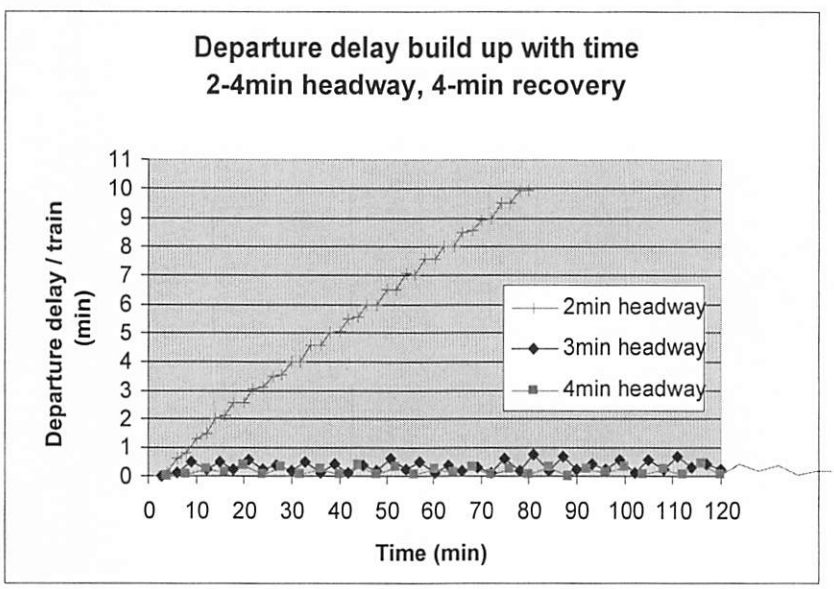


Figure 8 – Departure delay build up with time

There are three lines in Figure 7 and 8, each line contain performance outputs for one headway. In Figure 7, each dot in the figures represents the average congestion experienced by a train arriving at Sagrado Corazon terminal; whereas a dot in Figure 8 represents the amount of departure delay expected for each departure. 40 trains were simulated for each headway, which results in different simulated periods although the shortest is still 80 minutes long.

As seen from both Figures 7 and 8, train congestion and departure delay builds up linearly with time in the 2-min headway operations. For example, terminal congestion increases from 2 min per train in the beginning of the peak to over 11 minutes per train after 80 minutes. For departure delay, delay increases from 0 to 10 minutes after 80 minutes. This suggests that Sagrado Corazon terminal performance is highly sensitive to length of peak operations when it is run in 2min headway and quickly results in unacceptable train delays.

This build up of train congestion and departure delay is expected as the theoretical minimum headway Sagrado Corazon terminal can run is 2 minutes. Given the variability specified in the arrival process and platform activity time process, attempting to run 2min headway into the terminal will therefore cause train queue to develop quickly.

When headway is greater than 2min, train congestion and departure delay remains at the same level throughout the simulation period. In general, running the terminal at smaller headway generates more congestion, more departure delay, and larger variation in inter-departure time. This is reasonable as the impact of operational variability become larger when trains are running closer together.

Based on the simulation results, it is concluded that Sagrado Corazon terminal performance is sensitive to length of peak operations only when the terminal is run at 2min headway. For headway greater than or equal to 3min, larger headway would results in less congestion, and better departure service quality in terms of departure delay.

5.3.4 Influence of train recovery time

As discusses in Section 5.3.4 of the attached thesis, scheduled train recovery time at the terminal determines the tradeoff between incoming congestion and outgoing departure delay when terminal is run close to its capacity. More recovery time helps ensure on-time departures, but is likely to cause more congestion, and vice versa.

Refer again to Figure 7 and 8, since the simulated train congestion and departure delay are observed to be constant over the 40-train simulated period (except for 2-min headway), the 40-train average of the two performance measures (terminal congestion, departure delay) can be used to represent performance of the terminal for each recovery time. Based on this observation, the effect of scheduling different amount of train recovery time at Sagrado Corazon terminal to congestion and departure delay was simulated, results for 3-min headway operations are illustrated in Figure 9.

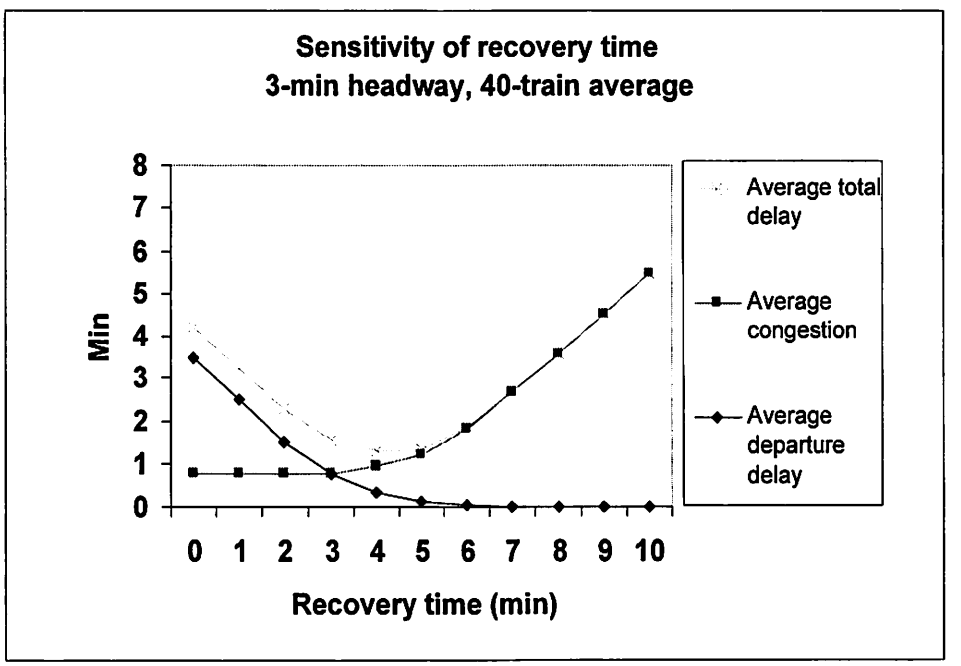


Figure 9 – Tradeoff between congestion and departure delay

As seen in Figure 9, average departure delay decreases with increasing recovery times, while average congestion increases with increasing recovery time. In this particular case, the total congestion delay is minimum (1.3min) when recovery time is 4 minutes, with an expected congestion of 0.9 min per train, and an expected departure delay of 0.3 min per train.

3.3 Practical capacity of Sagrado Corazon terminal

From Section 3.3.2 of the attached thesis, practical capacity of a terminal is defined as:

Maximum number of incoming trains a terminal can process in unit time with acceptable terminal performance

One way to find the terminal practical capacity is to use total delay per train as the terminal performance indicator, and then check for the critical headway that yields an acceptable total.

To find the practical capacity of the Sagrado Corazon terminal, total delay simulated for headways for 3 minutes and 4 minutes are shown in Figure 10. There are two lines in the figure; each line illustrates the average total delay expected as a function of recovery time for a particular headway. To determine the practical capacity, the minimum point of each line represents the best performance of the terminal under the corresponding train headway. For example, for 3-min headway, the best performance is achieved at 1.3 minutes delay per train.

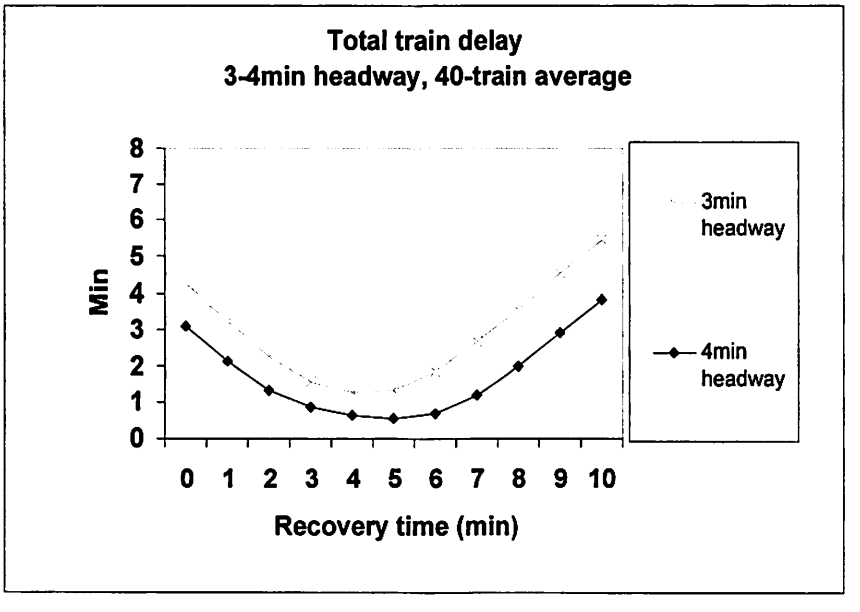


Figure 10 – Total train delay (3-4min headway)

If the acceptable total delay of Sagrado Corazon terminal is set to be 2 minutes, the practical minimum headway that terminal can run would be the minimum of all train headways that can operate with delay less than 3 minutes, in this case is: min (3,4) = 3 minutes, which yields a practical capacity of 60/3 = 20 trains per hour. If the acceptable total delay is set to 1 minute, than the practical minimum headway of the terminal would be 4 minutes, or 15 trains per hour.

4. Summary, conclusion, and future research

Recent experience from MBTA and CTA suggests that terminal could be a critical point on a rail line that affect service quality and line capacity. This case study applied the framework and model developed in the attached thesis to analyze capacity and performance of the Sagrado Corazon terminal in Tren Urbano.

Although Sagrado Corazon terminal has a theoretical capacity of 30 trains per hour (2min headway), this capacity is achievable only if there is minimal operational variability present at the terminal. In the worst train arrival scenario, simulation analysis suggests that the minimum sustainable train headway the terminal could operate is 3 minutes. Practical capacity of the terminal is 20 trains per hour (3min headway) when acceptable total delay is 2 minutes per train, and 15 trains per hour (4min headway) when acceptable total delay is 1 minute per train. The optimum scheduled train recovery time for 3min headway operations was found to be 4 minutes.

Given the current operating plan only scheduled for 4min headway operations, it is expected that there will be minimum capacity and performance problem in the Sagrado Corazon terminal. However, when future extension to Carolina is built, capacity and performance of the terminal in the north end (either Sagrado Corazon or Minillas) could become critical, because it has to handle trains from 2 lines.

Therefore, future study should be done on the north end terminal when the Carolina extension is built. In addition, attention should also be paid to other potential critical points of the rail line that might constraint capacity. The junction at Rio Piedras Station could be a location to analyze, as it represent the merging location of trains from Bayamon and Carolina branch.

DOES TRAINING MATTER?
CONSTRUCTION QUALITY FOR A NEW START TRANSIT SYSTEM: THE CASE OF TREN URBANO

By
Esther J. Lee
Thesis Advisor: Fred Salvucci
Massachusetts Institute of Technology
June 2002

EXECUTIVE SUMMARY

1.0 Introduction

As with many other large-scale infrastructure projects, the construction of a transit project is potentially vulnerable to quality failures, which can lead to completion delays and cost overruns. Especially with technologically advanced, new-start transit projects, a limitation or lack of skilled labor can exacerbate construction risks. The craftsmanship of the laborer – the ability to use new technology and materials by implementing appropriate processes and techniques – may be a significant factor in construction quality that is often ignored by managers.

This thesis examines the case of Tren Urbano in San Juan, Puerto Rico, a rapid rail transit project currently being constructed in an area with limited on-island experience in the design, construction, operation or maintenance of such a technologically sophisticated transit system. Already, a plethora of problems in the construction of Phase I have lead to multiple quality reports, such as change orders calling for rework, non conformance reports, and a 2+ year delay in systems opening and operation. Yet, according to the Tren Urbano Master Plan, five additional extensions are being considered. Already, the preliminary engineering work and environmental impact analysis for the 2km Minillas Extension (Phase 1A) has been completed by the PRHTA. Given past construction quality problems and the plans for future construction, this thesis investigates the role of training in construction quality outcomes. Particular attention is paid to the issues of knowledge transfer and the development of skills for inexperienced laborers in the construction of new transit systems.

1.1 Research Question and Objectives

The motivating question for this thesis is, does training matter for construction quality? To the degree that it does, what types of institutions and training structures can help to ensure a quality product from inexperienced construction labor?

With the general question of the role of training in construction quality on the one hand, and the specific implications of the analysis for Tren Urbano on the other hand, the objectives of this thesis are twofold:

1. To contribute to the wider discourse on training for the construction of a new transit system, presumed to be of interest to the FTA, local governments, design and engineering contractors, and international loan institutions such as the World Bank.
2. To offer specific recommendations for improved construction management and labor performance in the construction of future extensions, presumed to be of particular interest to the Puerto Rico Highway and Transit Authority. Towards that end, this thesis will also identify areas where the level of skilled labor has contributed to the construction quality outcomes of Phase 1.

The findings of this research are intended to inform Tren Urbano's overall management strategy of human resource development in both the management and implementation of construction for future extensions.

1.2 Motivation

The primary motivation of this research is to explicate lessons learned from past construction quality performances in Tren Urbano for future extensions of the project. Towards that end, assumptions of the requisite skills capacity underlying the conventional framework for construction quality are discussed. In particular, two aspects are highlighted: 1) the heavy reliance upon quality assurance/quality control (QA/QC) systems to ensure quality outcomes, which assumes that a qualified labor pool already exists and must therefore only be monitored to ensure conformity to specifications, and 2) the implications of a design-build procurement strategy on contractor responsibility for having or developing a skilled labor force to capably execute the design and construction of the project.

1.3 Methodology

The methodology for this study consists of two main features: 1) a literature review, and 2) case study analysis. First, a discussion of the construction industry and its impact on the general economy of a society is followed by an overview of a conventional and an innovative project delivery/procurement strategy, and the quality control/quality assurance systems utilized. The potential for local capacity development through training offered by existing public education systems, professional associations and labor unions is then reviewed. Second, the case study approach is used to compare the quality construction records and training experiences of the Tren Urbano Alignment Section Contract (ASC) Contractors. Information and data were collected through interviews via phone, e-mail, and in person, of project managers of the Tren Urbano/PRHTA and primary contractors, quality assurance/quality control managers, STT commissioning managers in charge of integration and interface issues, technology transfer managers and interns, international infrastructure development project consultants of World Bank, Inter-American Development Bank, and lawyers of the Tren Urbano Contracts. The contract documents for each of the ASCs was also used. The performance of each ASC Contractor is assessed based on the percentage of work completion to date, and the number of non-conformance reports per alignment section. The analysis of performance outcomes addresses three components: 1) degree of design completion; 2) explicit training programs (formal, limited and informal) and who provided it; and 3) types of training that were successful and unsuccessful.

2.0 Theoretical Context

In Chapter Two, I make a case for why knowledge-transfer can meet the profit motives of the private sector and the economic development motives of the public sector. First, I discuss the role of technology transfer in the economic development objectives of developing countries, followed by an overview of the potential economic impacts of construction industry investment. Second, I review the literature on construction project delivery systems and procurement strategies, with an evaluation of the strengths and weaknesses of design-bid-build and design-build. Third, I define and discuss the quality assurance/quality control system for monitoring and inspecting construction. Fourth, I

make the case for why the conditions of a new-start transit system require a corresponding strategy for local capacity development. Within this section, I discuss the role of general education versus specific training, as well as review the potential resources for skills training provision. Emphasis is placed on the role of labor unions and associations, and other apprenticeship types of programs. Finally, I show what the motivations for local capacity building for the public sector, private sector and labor unions are, as well as how training should be a collaborative effort.

3.0 The Puerto Rican Context

In Chapter Three, I assess the Puerto Rican context and conditions for a new-start transit system. First, I provide a general overview of the demographics, history, politics and economic indicators of Puerto Rico (Table 3.1, Figure 3.1). Second, I review the construction industry experience in Puerto Rico, including her recent experiences with design-build, and regulatory constraints placed on quality assurance/quality control. Third, I review labor conditions, including general wage rates (Table 3.3 and 3.4), structure of employment (Table 3.5 and 3.6), union activity, and the shortage of skilled labor in construction. Finally, I review the institutions available for skills development (Table 3.7, 3.8 and 3.9).

This chapter shows two major ideas. First, the Puerto Rican economy may have a role for an expanding construction sector, both for internal GDP growth and external export within the Caribbean and Latin American Region. Second, the figures describing the construction industry characteristics give mixed signals. On the one hand, the number of available skilled workers is perceived to be in short supply, while on the other hand, plentiful public sector educational and technical programs exist. One explanation for this disconnect may lie in the need for the public sector education sector to link up more tightly with the private sector projects that are currently in progress on the island.

A tight public-private partnership, or at least coordination and collaboration between the two sectors, would provide mutual benefits: jobs available for those educated within the technical skills programs, and appropriate skills that are critical and timely for the contractors currently conducting the work. This would free up the private sector from having to shoulder the entire burden of skills development and training while

at the same time meetings its objective of having a continuing stream of ready laborers. Similarly, the public sector technical education programs would be improved in its practicability of education offered, rather than being limited to skills and techniques that may be rendered moot and no longer applicable to current industry standards.

4.0 The Tren Urbano Experience – Findings

In Chapter Four, I assess the construction quality performance among the Alignment Section Contract (ASC) Contractors and training. First, I provide an overview of the Tren Urbano project, including a review of the major actors involved in project delivery (Figure 4.1). Second, I review the obligations for training and technology transfer as written within the contract documents for each of the ASC contractors (table 4.1). Third, I assess and compare the construction performance of the ASC contractors by looking briefly at percentage completion to date (Table 4.2), and analyzing the number of nonconformance reports (NCRs) (Table 4.3). Fourth, I identify three general construction challenges as gleaned from extensive interviews and analysis of other studies: design difficulties, quality control difficulties, and implementation difficulties. Finally, I review some best practice anecdotes of training conducted among the ASC contractors with particular focus on the Lord-Mass Joint Venture close partnership, Río Piedras training programs, and the ICA pre-cast bridge segment experience.

The research findings of this thesis show that the multiple prime contractors operating under similar contractual arrangements and resource conditions in San Juan exhibit variations in the quality of construction. Research findings also reveal variations in the type of training programs established by the contractors. Varied performance among the ASC contractors are indicated through lateness in delivery and the number of NCRs for each contractor. While the degree of job difficulty is one factor in comparing the performances, all the ASC contractors face the same challenges of design, quality control and implementation difficulties. The lack of final design creates an ambiguity that causes the contractor, QA/QC firms, supervisors, and laborers to be unclear about the detailed specifications and procedures for carrying them out. This problem is compounded when the QA/QC firms are not experienced in transit construction, or any other firms involved in the implementation process are unskilled.

The contractor could attempt to negotiate the acceptance of lower quality work with the client-owner by preying upon schedule slippage. In the trade-off between quality and schedule, and the constraints of political office and the desire to complete projects within an official's term in office, contractors can attempt to escape the standards of high quality construction. Within the Tren Urbano experience, such a dynamic was in play and individual contractor philosophy was a major factor in the differences. The ICA case exemplifies timely intervention by the client-owner, PRHTA, but that intervention undermines the responsibility and accountability for contractor management of the job. In the Kiewit case, the contractor accepted responsibility for training and implemented a formal program of training for construction. In the Redondo case, the contractor seems to willfully cause delay, confounding any attempt at a pre-emptive training strategy.

Alternatively, the contractor could provide training in order to construct a quality product more efficiently, resulting in quality outcomes, and improved cost and time savings. Although the contract states the need for training, beyond the technology transfer program, the ensuing training sessions conducted by ASC contractors were often reactive to problems and ad hoc. The costs incurred with retrofitting work and training sessions may have been avoided with an initial strategy for training. Moreover, the strategy for training should be carefully planned, with an assessment of the particular needs of the individuals to be trained. In the cases described above, training sessions that were conducted in a language more comfortable to the low-skilled workers, in shorter time spans over more frequent periods appeared to be more effective.

5.0 Conclusions and Recommendations

A limited conclusion can be drawn that, yes, training does matter. Training matters for the public sector, because, as the guarantor of the public good, governments are motivated to expand local capacity and skills development for economic development purposes. The principles for this reasoning were discussed in Chapter Two, while the specific Puerto Rican factors necessary for an assessment of the construction industry and educational/training opportunities were discussed in Chapter Three. General education is important for increasing the absorptive capacity of the labor pool. The resultant high-skilled labor can provide an incentive for firms to locate and spur industrial growth.

Training also matters for the private sector, because local capacity development can influence the construction quality outcome. The principles for this reasoning were discussed in Chapter Two, while the case was made for private sector interest and motivation in training in Chapter Four. Training can lead to higher quality, which, in turn, can lead to higher profits.

A framework for the proper role of training must be enlightened by the impacts of an overall project delivery plan/procurement strategy and managerial competence and experience. This thesis argues that in order to maximize the quality of construction in a new transit system, the client-owners should create an appropriate strategy which carefully assesses and matches three factors: 1) procurement strategy, whether the conventional design-bid-build or innovative design-build arrangement, 2) contractor experience and/or training capacity, and 3) the local labor skill level or training capacity.

Successful training should be tailored to pre-empt potential breakdowns of a particular procurement strategy, regardless of which procurement strategy is chosen, with emphasis on the accountability provided by a quality assurance and quality control system. Both the conventional design-bid-build and innovative design-build procurement strategies have vulnerabilities where potential breakdown may occur in project delivery. Identifying and addressing those vulnerabilities is important especially for the construction of new-start transit systems in a location with limited local labor skills.

The four stages of transit construction in Table 5.1 – design, construction, monitoring/inspection and project oversight control each identify the type of skill needed for that particular stage. The stage and skill, in turn, are broken down into the relevant actors of client-owner, contractor management and construction labor. Although the type of skills needed do not vary much, which actor possesses the expertise does vary according to the procurement strategy and the assignment of responsibility. The following summarizes the training implications of each stage in Table 5.1:

In the design stage, responsibility for design is higher for the client-owner in design-bid-build, while it is higher for the contractor in design-build. In both cases, however, the training implication for construction labor is that designers design with construction capability in mind.

Table 5.1: Procurement Strategy and Associated Skills

Stages in Transit Construction	Major Skill Needed	Actor	Procurement Strategy Level of Skill Needed: Design-Bid-Build	Design-Build
Design	Architecture/ Engineering Skill	Client-Owner	***Very High:*** Provides 100% design specifications.	***Low***: Provides <100% design specifications
		Contractor Manage-mentt	***Low:*** Not necessary; potential to change design specifications through value-engineering	***Very High***: Necessary to innovate and complete design specifications to 100%
		Construction Labor	***Training Implication:*** Need designers to design with construction capability in mind.	***Training Implication:*** Need designers to design with construction capability in mind.
Construction	Trade/Craft Skill	Client-Owner	***Moderate:*** Restrain payment schedule to match construction compliance	***Moderate:*** Restrain payment schedule to match construction compliance
		Contractor Manage-mentt	***Moderate:*** Just implement 100% design specifications	***Very High***: Necessary to innovate and complete design specifications to 100% for quality construction
		Construction Labor	***High:*** Emphasize construction supervision to implement 100% design ***Training Implication:*** Simultaneous *and* proactive inspection during construction not after.	***Very High:*** Emphasize construction supervision to implement 100% design or need to exercise judgment with incomplete design ***Training Implication:*** Simultaneous and proactive inspection during construction not after.
Monitoring/ Inspection	QA/QC Skill	Client-Owner	***Very High:*** Reliance upon on QA/QC to monitor conformity to design specifications	***Very High:*** Reliance upon on QA/QC to monitor conformity to design specifications
		Contractor Manage-mentt	***High***	***Very High***
		Construction Labor	***Training Implication:*** Need to construct with QA/QC function in mind.	***Training Implication:*** Need to construct with QA/QC function in mind.
Project Oversight Control	Management Skill	Client-Owner	***High:*** Necessary to coordinate contractors and conformity to specifications *Moderate:* Restrain payment schedule to match construction compliance	***Moderate:*** Reliance upon single contractor entity to perform coordination functions Restrain payment schedule to match construction compliance
		Contractor Manage-mentt	***Low***	***Very High:*** Necessary to coordinate all subcontractors and functions
		Construction Labor	n/a	n/a

In the construction stage, regardless of which procurement strategy is utilized, the degree of construction labor skill required is high, though higher for design-build. Implementation of designs requires strong supervision, as well as adequate design. This need is compounded when a lack of complete design requires a use of personal discretion, which may not be well-founded without past experience. Another training implication at this stage is construction with an eye forward towards creating an outcome that can pass quality inspections.

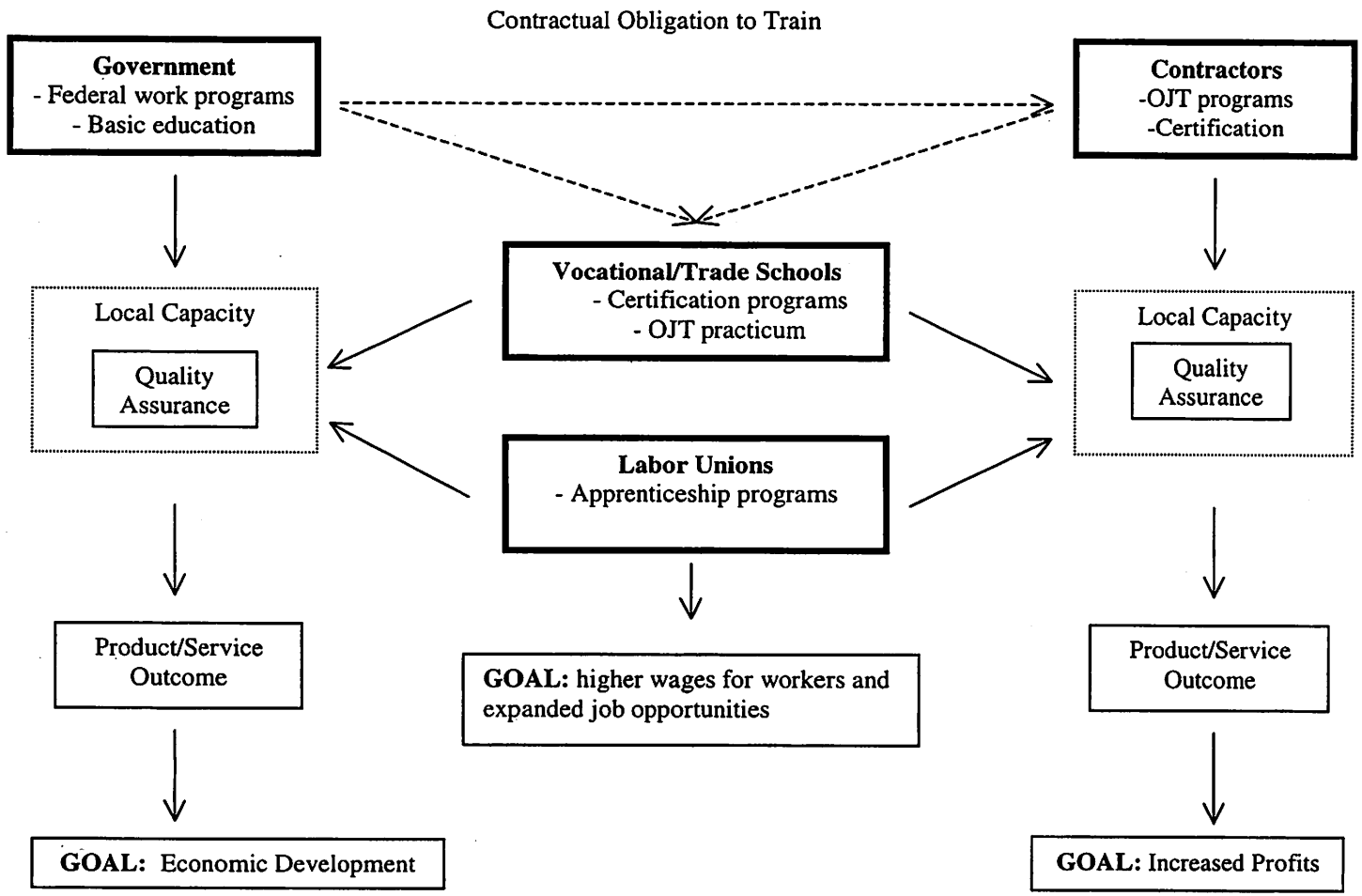
Monitoring and inspecting must be proactive and simultaneous with construction, instead of after the product has been complete. In both procurement strategies, high reliance upon the QA/QC mechanism translates into a need for high training of the QA/QC inspectors. This may be as, if not more, important than training the actual workmen who implement designs. Thus, a procurement strategy should evaluate the processes proposed by competing contractors to deal with skills training specific to quality control, including it as a basis for competition, and monitor to enforce that the winning contractor is complying with the proposed skills plan for quality control.

Project oversight control and responsibility for project delivery and management varies by procurement strategy. Although client-owner competence must be high for design-bid-build, it must be even higher, for design-build, given the added need for coordination between design and construction, and the additional potential for incomplete design or other design failures. In both cases, there is a need for the client-owner to exercise restraint in payment in order to elicit compliance with standards. Paying at a rate and schedule that is similar to the actual construction would be optimal, for paying too much ahead of time diminishes the client-owner's leverage over the contractor.

Collaborative Provision of Training

The question of necessary institutions for training, i.e., who should provide it, is addressed here. This thesis argues that training should be an intentional, collaborative effort between the public education sector, the private construction sector, and an expanded labor union presence. As seen in Figure 5.1, the government and contractor could both shape the vocational and trade school curriculum to improve the supply of relevant education and skills provided the public sector while at the same time creating a ready pool of laborers for the private sector. Similarly, the private sector could "outsource" its training to the public sector and/or labor associations with tight control over the relevance of the skills being taught and practiced.

Figure 5.3: Collaborative Provision of Local Capacity Building



A critical element of the collaboration would be to institutionalize informal means of apprenticeship by strengthening labor unions. Labor union training, such as that provided by the Carpenter's Union, would provide an invaluable source for upgrading work skills, and reducing the monopoly of workers held by local contractors. Similarly, Youth Apprenticeship programs could replenish construction labor shortages, provide access to federal funds, and provide a social service of youth investment.

Training should be demand-oriented and not supply-oriented. The program should be tailored to meet the needs, and potentially unique challenges of those needing the training. In the case of Tren Urbano effective training meant utilizing a familiar language in sessions over short, consistent times.

Recommendations

In the construction of future extensions, the conditions of local skill capacity would be different due to the previous experience in Phase 1. The labor pool and contractors are somewhat more experienced, and more aware of the challenges and impediments to construction of transit. It is important to be aware, however, that a choice awaits. On the one hand, the PRHTA could choose to continue with the same contractors for future construction due to their experience and developed skills, but exercise greater quality control and quality assurance with stronger punitive mechanisms. On the other hand, the PRHTA could choose to use similar design-build mechanisms or to shift to design-bid-build. A third alternative is to employ design-build, with more explicit attention on supervisor and worker training, and best-value contractor selection rather than low-bid. It would thus be up to the PRHTA to create a stronger requirement for training the labor workforce, in order to have the capacity to produce quality construction the first time.

Recommendation 1: Choose Best Value over Low Bid. The client-owner should take advantage of the freedom from low bid in a design build procurement strategy to pick a bid based on best-value to choose a competent and capable contractor who can manage the project better, and who may provide a more transparent bid.. Although low bids may appear low at the time of bid awards, the extra claims costs incurred due to the variety of factors described in this thesis may result in costs far exceeding a higher bid by a more

experienced and reputable firm. Additionally, in the bid selection process, the client-owner should screen the qualifications not only of the primary contractor, but also the subcontractors with particular attention paid to training problems and the experience of managers. Include an assessment of the local capacity before embarking on a project, and a strategy, accountability mechanism, and schedule to help establish the institutions and training programs necessary to produce a quality outcome.

Recommendation 2: Require 100% Final Design Acceptance Before Construction. Although in theory, lower design requirements is intended to shift risk to the contractor, in actuality, the client owner has no means of eliciting quality before the work is finished. Without clear, final design and specifications, both to direct the supervisors and workers and facilitate QA/QC, ambiguity on expectations can lead to substandard work. The requirement for 100% design acceptance establishes a pre-requisite for training to be more effective by clarifying management and construction standards. Even the most skilled and trained workers would achieve poor quality, i.e., conformance to the specified standards, without a clear and clearly communicated plan up front. An effective training program is based upon the premise that a design is created, and that the help is needed to achieve a specified standard.

Recommendation 3: Establish an Effective Quality Control Punitive Mechanism. The quality control firm must be given the real exercise of power, through the threat of a real punitive action. This may elicit greater voluntary compliance on-site if the inspector had the power to initiate and activate a "Stop Work Order". If there are no real punitive consequences for stopping shoddy or sub-par quality work, then there is little motivation for the contractor to correct inferior work. Stronger quality control establishes the accountability mechanism necessary for training to be effective. Training to do the job right is useless if a process is established where doing it the wrong way, whether intentionally or unintentionally, is accepted.

Recommendation 4: Collaboration with Labor Union and Schools. The role of the labor union and increasing prominence of a revamped vocational and trade school

provision of training would be of utmost importance to a revitalized training scheme for the construction industry in general, as well as for the Tren Urbano project in particular. Both labor unions and vocational schools have the potential to act as a go-between, drawing upon the best that the private and public sector have to offer. Access to governmental funds for education and training, as well as partnerships with private sector contractors through on-the-job apprenticeship programs would improve the public education provision of relevant training. The labor unions, also, are a vital protector and advocate for improved wages and expanded job opportunities within construction. Additionally, these two institutions may increase the professionalization of construction through a heightened certification process.

Bus Priority Treatments on Congested Arterials

A Thesis Presented

by

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to

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ABSTRACT

Increasing traffic congestion on urban roads around the world has led to the need to provide more efficient use of the limited roadway space. Heavy rail systems have proven efficient when mobilizing passengers on very dense corridors. When lower densities are to be served, other modes have been implemented, such as Light Rail Trains and Bus Rapid Transit.

This report reviews current advances and state of practice in transit priority treatments on urban arterials. A particular case was taken into consideration in order to analyze and develop strategies for improving bus service. Puerto Rico's Tren Urbano is a Heavy Rail System under construction that will supply improved mobility and reliability to the San Juan inhabitants. One of the most important corridors to be served in the future is the Avenida Regimiento 65 de Infantería, or PR-3, which runs from West to East connecting Rio Piedras (one of the most important transfer centers in Metropolitan San Juan) and Carolina, a thriving municipality. Until the Carolina extension is built, high quality bus service along PR-3 is required to carry passengers between Carolina and the Tren Urbano station at Rio Piedras and to develop a potential base of riders along this corridor.

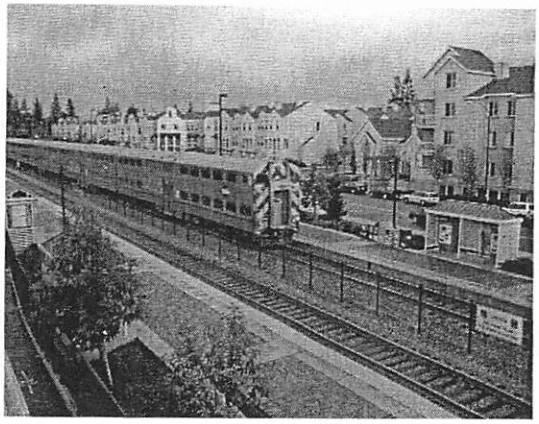
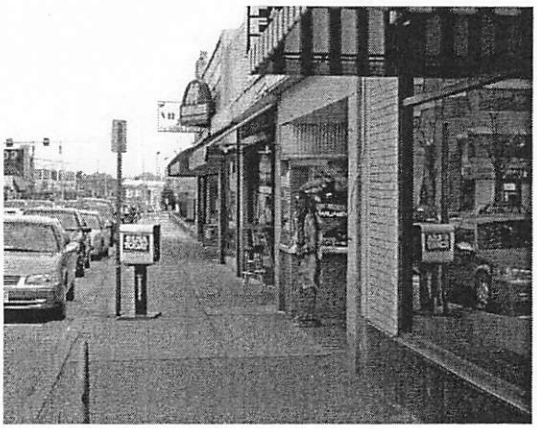
This research project aims to demonstrate the feasibility of high quality bus service along PR-3 by designing and testing, by simulation, a set of priority measures that will dramatically improve bus travel time and reliability. Priority measures will include both physical treatments such as bus lanes and temporal treatments, i.e. priority at traffic signals.

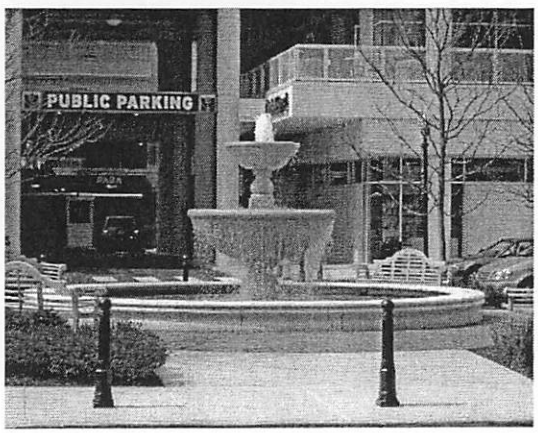
Different transit priority strategies were developed, ranging from reversible lanes to traffic responsive/bus actuated signal control. A priority treatment was designed, consisting of taking frontage roads parallel to the main arterial for bus use and making improvements in signal control in order to grant priority to buses approaching signalized intersections. Signal priority tactics included not only green extension and early green, but also complex phase switching at multi-phase intersections. A microscopic traffic simulation model was used to test the priority design during weekday A.M. peak periods.

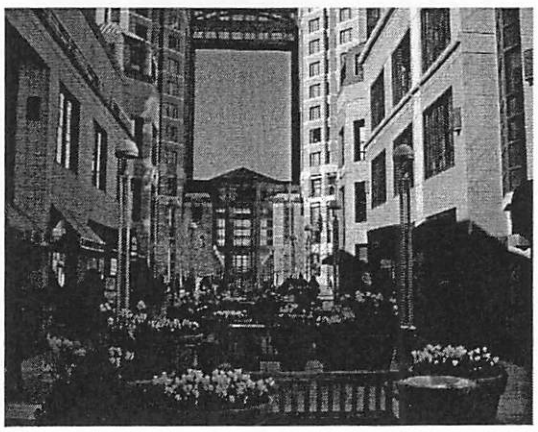
Simulation of traffic flow on PR – 3 under traffic responsive conditions as a replacement for the current time-of-day fixed time signal operation shows that substantial savings in travel time as well as significant improvements in reliability can be achieved, without significant impact on traffic level of service. Because the signal priority strategy used is responsive to general traffic as well as buses, it improves level of service for general traffic as well as for bus.

Incremental improvements were demonstrated from using actuated timing, using bus priority at the signal, and letting the bus use a frontage road as a controlled queue jumper.

STRATEGIES FOR DESIGN:
SHAPING PRIVATE DEVELOPMENT ADJACENT TO TRANSIT STATIONS
CASE STUDIES FOR TREN URBANO





EXECUTIVE SUMMARY

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May 2002

INTRODUCTION

In September of 2003, the San Juan metropolitan area will open its first high-capacity urban rail system. The Tren Urbano system will offer new opportunities to provide connections between major points in metropolitan San Juan.

The system will link 16 stations over a 17.2 kilometer route providing links between residential and commercial areas with a high population density and traffic congestion. The system will use modern electric rail transit cars with third-rail technology and a 55 mile per hour maximum speed along a fixed guideway. Most of the guideway is elevated, but some sections are at grade and underground.

Tren Urbano is more than just a rail system. It is a new way of thinking about transportation for Puerto Rico. While the first segment is only ten miles long, it can serve as the basis for a new transportation and land use arrangement in greater San Juan. Six key elements must come together for the success of the Tren Urbano system:

1. The San Juan metropolitan area economy must remain strong enough to continue to support metropolitan growth.
2. The system must use the bus and *publicos* as feeders, bringing passengers to the train to use through the most congested portion of the urban and suburban system.
3. The system must provide easy access for commuters who will drive to some of the outer stations and switch to the train to reach additional destinations.
4. The planned expansions on the system must be built, allowing for additional levels of regional accessibility to be adapted over time.
5. The system must be perceived by the public to be safe, clean and reliable.
6. The commonwealth, the municipalities, the transit authority and the private sector must focus land development efforts towards the land near the stations, building ridership demand as it builds station area developments.

While the first five elements are outside the scope of this thesis, the application of the design strategies in the thesis can be applied as a format to achieve the sixth goal. Planners from the transit agency, the Commonwealth and the local communities are looking at station areas for an opportunity to provide integrated mixed-use developments that will encourage transit use and support pedestrian activity. But, San Juan needs to answer one important question: What elements need to come together to make a station area development plan work?

Objectives

This thesis finds the combination of design elements, regulations and development incentives that encourage transit-oriented development (TOD) within walking distance of transit stations. The thesis reviews existing conditions at developments next to transit stations seeking out development that has been successful at employing elements of transit-oriented development. Successful transit-oriented development creates a comfortable pedestrian experience for users of the development and the transit station.

The interventions learned from the cases are applied to station areas on the Tren Urbano system, currently under construction, in San Juan, Puerto Rico. Recommendations include proposed policies and procedures to ensure that future development interventions and development projects are appropriate for a transit station area.

Key questions for the project include:

- What design elements work best to provide a superior pedestrian experience when developing sites near transit stations?
- What regulations, incentives and processes are necessary to make sure developers integrate these elements into their projects?
- How can these lessons be applied at 'case study' stations in San Juan?

Methodology

To define the elements, regulations, incentives and processes that lead to a successful design, one must first understand what transit-oriented development is and what elements must come together to make a successful transit-oriented development project. Through site visits and interviews, the thesis seeks to find key elements that have been brought together to make a project work, such as:

- Elements of the design that integrate the transit project with the private space.
- Incentives (funding, zoning bonuses, community support) that assisted the private developer in choosing a transit-oriented approach.
- Regulations (zoning, design codes, etc.) that led to the development of a transit-oriented approach.
- Political considerations that surrounded this process, including the role of the transit agency in the development.

This thesis builds upon the previous and current research projects completed through the Tren Urbano program. Previous thesis projects for Tren Urbano have focused on the nature of gated developments near these stations and the potential for participation of the transit agency in development decisions.

REVIEW OF CASE STUDY CONCLUSIONS

This thesis answers one important question about successful station area design: how can it be done? But, to answer the 'how' question, one must also answer the 'what' question: what is successful station-area design? The elements of success from the first two chapters are reviewed below.

A Comprehensive definition of successful TOD

The first chapter of the thesis provided a framework based upon the idea that **design matters** – and that good design is the first step to a successful transit-oriented development. But, it is also based upon the simple premise that **design is not all that matters** – and that simply designing an attractive place near a transit station is not all that needs to be done. It needs to be built, it needs to be populated and it needs to develop in a way that contributes to the greater good of the region and the society. The elements that define a successful transit-oriented private development include:

A: Elements of Design

1. Compact site design, oriented for the pedestrian
2. Buildings oriented to the transit stop but not turning their back on neighborhoods pre-dating the transit stop or on sites for future development just beyond the first ring
3. Development of open spaces and streets as an 'outdoor room', with buildings providing comfortable framing walls. A clear definition of open spaces and their uses as parks, playgrounds and/or courtyards.
4. Limitations on parking
5. Quality without a name (QWAN)[1]

[1] The term QWAN comes from Christopher Alexander's 'Timeless way of Building'. Alexander suggests that that we need to build places that increase feeling of life and wholeness.

B: Elements of Use

1. Mix of uses, including office and residential uses, over a variety of sites – although each project need not be mixed use.
2. Elements in the development that serve convenience shopping needs, while elements somewhere along the transit line should serve comparison shopping opportunities for a diversity of users.
3. Concentration of activities matches the size of the neighborhood and its market so that there is a constant level of pedestrian activity, preferably even on weekends
4. Similar uses, or at least similar densities, facing each other on opposite sides of the same street.

C: Elements of Marketability

1. Perception of safety by pedestrians using the station and the neighborhood.
2. Appealing location for retail, and density to support retail.
3. Housing that is of interest to middle and/or high income residents
4. Development of business associations, owners organizations, and/or neighborhood associations to take ownership of the area and care for public and private spaces.

D: Elements of Affordability

1. Opportunities (through offering reasonable housing costs or through a subsidy program if necessary) for lower income residents to live in the place, ensuring that captive riders have access to the transit system
2. Development of convenience retail, not just a 'boutique' environment
3. Density that allows for reduced costs

Ten Lessons for Station Area Design

The second chapter, based upon visits to 80 stations, identified ten lessons for station area design that should be incorporated into any station area plan, design review and/or zoning code for station area development. Those lessons are:

- Lesson 1: Grids of streets are very important. Keep old grids and create new ones.
- Lesson 2: Define a 'pedestrian shed' for each station, encompassing the area within a ten minute walk of each of the station exits. Inside the 'pedestrian shed', develop simple walking routes to major destinations. Make sure they are clear, safe, easy to travel and well labeled. Never separate pedestrians from vehicles on a different grade.
- Lesson 3: Avoid superblocks. When large buildings are necessary, allow them to be permeated by pedestrians.
- Lesson 4: Building design effects pedestrian amenities. Use and scale should be consistent across a single street, stepping down at points internal to the block. Loading docks and large parking garage entrances should be located to minimize impact on pedestrian access. Large commercial buildings should not turn their backs to existing or future development beyond the immediate station area.
- Lesson 5: Make open spaces into 'outdoor rooms'. Small parks and public areas can be framed by buildings of appropriate scale, use and style. High-density residential areas should provide public green-space amenities to offset for the lack of large lawns.
- Lesson 6: Security issues must be balanced with public need for access and comfort in and around the station area.
- Lesson 7: Provide convenience retail at each stop and destination retail at an accessible central point on the transit line.
- Lesson 8: Include housing at all station areas to provide for evening activity. Include office uses at all station areas to provide for daytime activity.
- Lesson 9: Plan for growth and change over time. A good plan will raise the value and perceptions of nearby real estate.
- Lesson 10: Keep the process efficient and the project finances open to ensure that costs and financial issues will be available to the public to understand tradeoffs and development time.

PLUGGING INTO THE POWER GRIDS: BRINGING THE ELEMENTS TOGETHER

After bringing together the elements and the stories of transit-oriented development in station areas across the United States, there are two clear conclusions:

- No place has created the perfect transit-oriented development in recent years although there are lessons to learn from many recent developments.
- No single element of design or regulation is capable of making transit-oriented development work. Instead it only works when a series of elements come together to create a new place.

Author and architect Christopher Alexander has been participating in the debate on transit-oriented development and New Urbanist development over many years. He has observed that planners and designers have made significant progress in understanding how to design pedestrian-oriented places around transit stations. The frustration, in Alexander's mind, is not the designs but the regulation and process that guides development. Alexander has observed that the planning community "know(s) what the appliance is." The appliance is encompassed in the design elements that can be found in the literature and the lessons from existing design, as outlined in Chapter two. What Alexander observes that we need are the "plugs to connect to the existing power grid."[2]

The elements of the power grid depend upon the role that one plays in influencing the development process. To developers who want to do a mixed-use transit-oriented project where one has not been done before, the power grids to plug into are the planners, developers, architects, engineers and community activists that dictate what our built environment looks like. To a progressive government leader, the power grids are the politicians, bankers, developers and other public officials who impact the development process.

The Power Connections

The most successful station areas involve the convergence of four elements that are necessary for high-quality station area design. When Cervero identified the three elements for TOD (density, diversity and design), he answered the question 'what is TOD'? To answer the question 'how do we build it?', we need to expand the framework. To build TOD that works, a system must plug into all the existing power grids. This requires connecting to:

- The Development Community
- The Development Process
- The Regulatory and Policy Framework
- The Public Institutional Capacity

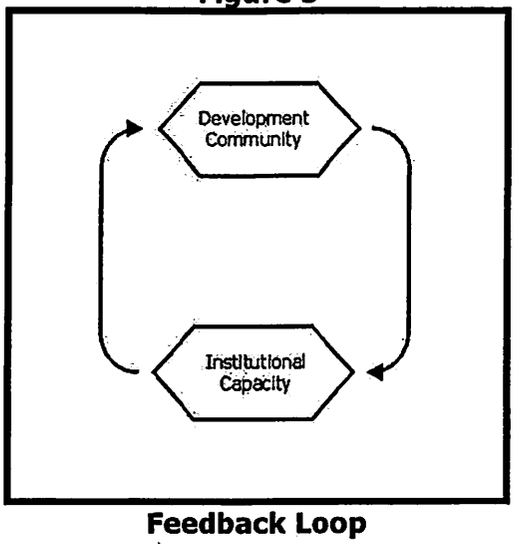
The importance of each of these elements, and the public sector tools available to influence them are explained in more detail in the next sections.

[2] Andres Duany presentation, 01/25/02

The interactions between the development community and the public institutional capacity can be seen as a feedback loop (See figure 3). In communities like Hayward, California where the local government had the institutional understanding and financial capacity to support new development it was able to entice the development community to do some early projects in the station area. As this process has spurred developer interest in Hayward and as it has brought new vibrancy into the downtown, it has built new strength in development community capacity. In Arlington, where the development community has been able to finance their own projects in most areas, the community has reacted to projects and encouraged more projects with design elements that they like while discouraging project elements that they did not like. The developments have spurred new capacity in the public institutions and the community participants.

Often the public sector must seek developers from outside the community to set the tone for future development. When the framework for station area design has been established by these early developments, the local development community will begin developing in the station areas according to community plans. The feedback loop can use joint development as a tool to bring knowledge and finance of station area projects to the development community. By reducing risk and demanding high quality design in joint-development projects, the transit agency and the local government can begin the process of transferring capacity from the local institutions to the development community.

Figure 3



Feedback Loop

FINDING THE RIGHT STATION AREA PLANNING FRAMEWORK

This section provides more detail about the regulations, investments and assistance that would be required for station area development in different types of station areas. The framework at different stations depends upon the existing station area condition. Five station area conditions are identified:

1. Station areas where significant urban development pre-dates the station.
2. Station areas in a dense urban core where development may follow transit, but significant urban real estate markets pre-existed. A natural extension of the core would propel development in this direction, therefore other factors are more primary than transit in t3he development of the area.
3. Station areas in a secondary urban grid or in a primary urban grid in an auto-oriented city. This may include any development area that, before redevelopment, included significant open sites, surface parking or under-utilized parcels.
4. Station areas in a suburban setting. The primary nearby use is residential, and the street pattern is not a standard urban grid.
5. Station areas with limited nearby uses other than parking and undeveloped land.

The thesis focuses on only the last three types of station areas. Each station area type needs a different strategy of elements to come together and provide new transit-oriented development opportunities. Table 1 identifies the needs, plans, zoning, public investments, private sector elements and public subsidies that would be needed for successful transit-oriented development to come to these different types of areas. These are also discussed in more detail below.

Table 1: Elements needed for development near transit

	All Types	Type 3: Unfinished Grid	Type 4: Suburban Model	Type 5: Open Space
PRE-EXISTING NEEDS	Market for housing, retail and offices.	Limits on growth elsewhere.		Limits on growth elsewhere.
TYPE OF PLAN	Design and density	New housing and retail, with more office.	New circulation plan. Streets to set the scale of development	New roads and infrastructure to set the scale of development.
TYPE OF ZONING	TOD Zoning Required retail on ground floor where appropriate	High FAR No setbacks Limited parking	Medium FAR Minimal setback Limited parking	Medium FAR Minimal setback Limited parking
PROP. FAR		3.0 to 10.0	1.0 to 6.0	1.0 to 6.0
PROP. HEIGHT		Scale down from station	5 – 10 stories in most cases	5 – 10 stories in most cases
PROP. SETBACKS	No superblocks Break up blocks into smaller buildings	Retail on street	Limited front yard No side yard or minimal side yards	Limited front yard No side yard or minimal side yards
PARKING LIMITS		No parking without hardship	1 per resid. unit 2 per 1000 sf off.	1 per resid. unit 2 per 1000 sf off.
PUBLIC SECTOR INVESTMENT		Streetscape Infrastructure	Street patterns	New roads and infrastructure
PUBLIC SECTOR SUBSIDIES	Programs to reduce cost of housing	Bonuses for housing	Infrastructure Incentives for TOD	Mixed-use bonuses if needed
PRIVATE SECTOR PARTICIPATION	Links to transit Pedestrian amenities		New road patterns Infrastructure	New road patterns Infrastructure

Elements Needed in All Areas

Some basic elements are needed for station areas to develop regardless of the existing landscape. First and foremost, there must be a market for the development that is desired. If there is no market for apartments or for offices in the metropolitan area, it is unlikely that the development will occur. If there is a strong market for at least one type of property, it may be possible to use bonuses, incentives and zoning requirements to push some of the more creative developers into building mixed-use projects. But, this will also scare away many developers who know only how to do single use projects. A strong plan dictates design and density, includes required density minimums, as well as a first floor retail requirement where appropriate.

As with the market for residential and office, if the retail market does not exist, or if there is not a sufficient level of pedestrian and vehicle traffic through an area, mandated first floor retail may not succeed. This requires patience, as the development of a strong design and increased density in the area may bring success to the retail element only long after it is built.

Where appropriate, the public sector may find it necessary to support affordable housing in the transit area, so that future development does not price out current residents. Furthermore, the public sector may see it as valuable to require the private developer to provide public paths and arcades to link from the development to the transit station.

Type 3: The Unfinished Grid

In the station area with the unfinished grid, there is often plenty of opportunity to fill in the grid by redeveloping existing parking lots and empty lots. There are two major challenges here. One is to ensure that there is a market for development to come and the other is to provide any necessary incentive to ensure that the development is appropriate for the transit. Often, the existing elements of the unfinished grid are inappropriate to transit – developed in the days of the urban modernist movement that put security and architecturally bold statements ahead of the people who would use the buildings and the streets. Retrofitting the existing grid and providing the public realm within the public right of way is a significant start for spurring development and renovations that will bring people back into the unfinished urban grid. Retrofitting can include supplementing the grid with additional pedestrian connections, building a smaller grid to break up large blocks, as well as re-establishing existing grids where they may have been broken apart.

The unfinished grid will benefit significantly from growth management tools that push growth away from the fringes and make downtown redevelopment more palatable for those looking for new development sites. It is likely that the risk-taking developers will be the first to return downtown, but if recent successes in many cities around the world (San Diego for example) are any sign, there will soon be plenty of opportunity for more risk averse developers and their more traditional financiers to invest. Therefore, public incentives and public participation in development may be a necessary element to tip the financial scales towards developing in the unfinished grid.

Type 4: The Suburban Model

The suburban model must break from the pattern of past development in the transit station area. If the station area is tightly surrounded by a suburban network, only the nearby joint-development sites may be available for redevelopment. Still, planning beyond this area for any empty or changing lots will ensure that the transit-oriented model permeate beyond the station and become a part of the accepted landscape.

In the suburban model, the transit-oriented model can be more suburban than in the unfinished grid, and can focus on additional housing that is higher in density than the existing grid. But it is still possible, as was done around San Antonio and Whisman stations in Mountain View to fill in the suburban model with a grid-like suburban system of housing. Or, if appropriate, the suburban model infill can come in the way of new retail or office opportunities.

Depending upon the market, the public or the private sector can be the one to provide the investment in infrastructure. Regardless of who pays, the public sector should set up the street network to set the scale of development, and all developers should be required to conform to this street network.

Type 5: Wide-open Spaces

With wide-open spaces, there are infinite possibilities for creating a new sense of place around a transit station. The plan will spur private development by setting the public sector expectations and the public infrastructure needs for the area. Depending upon the market, the public or private sector may pay for and install the infrastructure. But, the scale of development, as with the suburban case, will be set by the public sector plan. There may also be a need for developing requirements about mixing uses including housing and offices so that the area does not become a single use district.

If appropriate, a wide-open space may be an ideal location for a new destination site, like a large retail site that will draw visitors by both automobile and transit. But, the parking ratios should be limited so that this project will discourage automobile trips and encourage those who live and work by other transit stations to use the transit to access the new destination. Even a large retail site should abide by the density and design standards that are appropriate for transit-oriented development.

Often, in the wide-open space, the scale of development will be more suburban than in the unfinished grid, but a new dense grid center could also be built if it is deemed appropriate. In any case, a mix of uses is ideal. The level of public sector subsidies necessary to get a mixed-use project must be set by the particular market conditions under which the area is developing, and the speed by which the public sector feels it is necessary to see development. Often, it will be better to put a plan in place and, as long as there are growth controls in other parts of the region, the market will be there when regional growth is necessary.

THE SAN JUAN METROPOLITAN AREA

The land use and zoning regulation system in Puerto Rico provides the opportunity to institute a regional 'smart growth' style land use regulation system, if there is political will to do so. Unlike most of the states on the US mainland, the Commonwealth government controls the ability to award zoning powers to individual municipalities. The Commonwealth's overarching planning agency, the Junta de Planificación (Planning Board) grants zoning authority to municipalities only when they have a pre-approved comprehensive plan. The planning board answers directly to the office of the Governor, and is led by seven appointed members. This system allows for the planning board to ensure that municipal comprehensive plans account for regional issues.[3] Yet the ability to control and direct growth is still limited by the political pressures that may be placed on a governor and passed to that governor's planning board. There is widespread frustration with the planning board within the planning and development community. Despite their power, the board has not exercised its full political power to control development. In the words of one architect, the board could be "much more innovative". A local planner suggested that the "planning board has not planned anything since it has been created."[4]

Despite the presence of a central planning agency, standards for setbacks, densities, heights and linear frontages, all issues that would be covered through detailed zoning and design guidelines have been conspicuously absent in the development of San Juan and the metropolitan area for the past forty years. New comprehensive plans like the plan at San Juan and the new Smart Growth plan for Puerto Rico by Estudios Técnicos suggest that Puerto Rico needs such clear guidelines.[5] While there has been discussion on additional restrictions for Tren Urbano stations, such as minimizing parking and requiring minimum densities and setbacks on some lots, these have also not been codified at this time.

Despite the level of municipal independence allowed under the law, the Planning Board retains the right to take back the planning responsibilities where it deems appropriate. The planning board, at this time, intends to retain or regain control of the land within 500 meters of each of the Tren Urbano stops. The board will create new zoning and/or overlay districts for the station areas with the assistance of the Tren Urbano planning staff.

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[3] Luis García interview, 01/02
[4] Manuel Delemos and Javier Bonin interviews, 01/02
[5] Javier Bonin and Criseda Navarro interviews, 01/02

Development Community

According to Graham Castillo from Estudios Técnicos, developers in San Juan are interested in building around the train. Some land speculation is already happening in the Tren Urbano station areas. But, market issues may create challenges for development around the transit stations, particularly development of housing. Mixed use projects provide challenges to developers in Puerto Rico. The developers on the island do not have the experience to do them, and the real estate finance industry is reluctant to finance such projects unless there is a way to reduce the project risk. Most projects in Puerto Rico are financed locally. Without locally comparable projects, it is difficult to finance these unique developments.

Castillo does suggest a few opportunities that the development and lending communities may see for projects in the station areas. First, there is an underlying demand for additional government facilities and offices in the San Juan metropolitan area. These offices and service centers should be located near the stations. Public corporations such as utilities that currently have offices located in retail shopping centers could also move these offices to transit station areas. There is a need for more low-income housing, but how much should go near stations is a matter of debate. There is an opportunity to fill a small niche for market rate housing, but this niche will only work for a station areas that are developed into unique destination places.

The greatest challenges for making transit-oriented development work for the developer and finance community include:

- Finding developers who believe in mixed use projects or places
- Proving that the market exists
- Convincing the parties to participate and that they will make money
- Finding or creating developer experience in mixed use projects

Tren Urbano has already begun to look for development opportunities for land they own near the station. While reserving the right to refuse all bidders, Tren Urbano has put out a request for proposals on a number of different transit sites ranging from the development near the core and the waterfront by the northern terminus of the system to the industrial and office property that Tren Urbano has acquired by Martínez Nadal station. At this time, it is unclear what criteria Tren Urbano will use in identifying their joint development partners for these project,s but the staff is focused on the idea that this is about more than just revenue raising, and that projects must enhance the rail travel experience.

Development Process

The existing development process in Puerto Rico requires the presentation of variances to the planning board through a locational inquiry process. Personal negotiations are popular. Sometimes political or economic influences impact decisions. There is a short turnaround for the process, and many elements are often overlooked. The result is that there is no clear system of consistency for developers, and no certainty of approval or disapproval of a given idea in a given location.[6]

Design review has limited history in Puerto Rico. Most projects have no formal process. Some process of approvals for variances are in place, but they still don't require a review of building and site design. The few areas where review are required are areas of historical significance like in Old San Juan. In the old district, projects need to be reviewed by the Institute of Culture. Federal funds require additional reviews through the Historical Preservation Office. Even the City of San Juan and the tourist office will review these projects. But none of these are 'official' design review processes.[7]

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[6] Luis García interview 01/02

[7] Based on interviews with Manuel DeLemos and Andrés Mignucci, 01/02

The plan for station area project review looks more promising, although it lacks a formal design review. Yet, without a process that limits high density development in inappropriate places away from the stations, the station area planning process may not have the full effect of moving the development patterns completely into the Tren Urbano corridor area.

The new process for projects to be built in station areas is as follows:
1. Project plans will be submitted to the Planning Board
2. The board will provide a copy to the Tren Urbano office for approval
3. The board will request a presentation and/or meeting from the developer. The board can ask for a public hearing
4. The board will collect input from meetings and from hearings as well as from Tren Urbano
5. The board will have final approval, but will not approve projects without the sign-off from Tren Urbano.[8]

Public Institutional Capacity

In the San Juan area, the design and planning communities have embraced the concepts of smart growth and transit-oriented development, the regional land use framework can support such plans and the zoning enabling legislation is innovative enough to allow creative planning. Yet, it may be difficult to change habits, lifestyles and personal preferences. The niche of supporters for living and locating workplaces near stations needs to be identified.

Additional professionals who participate in government decisions must be brought into the station-area planning process. This could include road engineers, economic development agencies and leaders in any government agency that makes land-use decisions. Recently, the government insurance agency completed a building near the Cupay station that is nothing short of an environmental and urban planning disaster. The effect on station area design and on the remaining nearby natural areas is completely counterintuitive. Yet the building was proposed, designed, approved[9] and constructed. Surely, this suggests that there isn't a 100% commitment, even at the government level, for a station area planning program that respects the principles of good station area design.[10]

Residents, business leaders and other decisionmakers who understand good station area design are still few and far between. Some have decided that the train will never have an impact on urban form. The problem with this thinking is that it is a self-fulfilling prophecy. There is nothing more dangerous than a widespread belief that station area design and a compact urban form cannot work in Puerto Rico. Such defeatist ideas will not prompt confidence from developers and the finance community. Yet, the development and finance community on the island may not believe that a niche market for station area development is real. If this is the case, at least the Commonwealth should work to find developers and a finance community off the island that believes in the future advantages of building near a transit station in a metropolis with mind-boggling levels of traffic congestion.

OVERCOMING THE ISSUES FOR STATION AREA DEVELOPMENT

Political Considerations

In Puerto Rico, the current governor is very committed to high quality developments in the Tren Urbano station areas. The city of San Juan has proposed a land use plan that focuses development around the stations. The Tren Urbano staff has extensive understanding of the

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[8] Manuel DeLemos interview, 01/02 with some information from the Luis García interview 01/02

[9] Some of the approvals were after the fact, and the subject of a lawsuit that was decided against the developer. But, the building construction continued anyway.

[10] I suggest that everybody who has any participatory role in the planning of station areas be given a copy of Christopher Alexander's "A Pattern Language".

opportunities for new development around the station areas and the Planning Board is committed to participating in this process.

The greatest challenge at Tren Urbano is the fragmented form of planning and regulatory decisionmaking related to station areas. The Tren Urbano staff and the Planning Board need to establish a strategy for station area design. Chapter four outlined elements to review when developing such a strategy, based upon the case studies and the design elements that were reviewed in the thesis.

Two conclusions are most important:

- Government leaders must choose the proper balance between development process and development regulations for the station areas. This decision is often based upon the nature of the political system and the influence that it has on existing development projects.
- Government leaders need to address the condition of the development community and the institutional capacity amongst the public participants and agencies that participate in the station area development process. This assessment can formulate the basis for a strategy of increasing the feedback loop that supports additional development capacity and institutional capacity for understanding and developing station area developments.

The Tren Urbano system must be placed in the right context based on these conclusions to understand how to develop the station framework.

While the institutional players are on board at this time, the political nature of the development process as it currently works is still a concern. Private development may continue to be approved at the whim of planning board members or municipal agents who are allowed to provide variances. This system does not ensure that private developers are in conformance with a master station-area plan. Essentially, the station areas, as well as the entire metropolitan area, need to be insulated from political decisions about land use. Therefore, on the continuum from development regulation to development review, the system in Puerto Rico would benefit from a clear, stricter and more prescriptive development regulation system to require certain elements in station area design. A review process, including a review of design elements, can also be a part of the process, but this should only come after a project is in compliance with significant regulations set in place to ensure that the project meets the basic standards for good station area design.[11]

The feedback loop that connects development capacity and institutional capacity also needs to be strengthened. Currently, the capacity for understanding and implementing station area development is strongest with the planning staff at Tren Urbano. Other public sector participants also understand the need for good station area design.[12] Capacity for mixed-use pedestrian oriented development is limited within the development community in Puerto Rico. With a few notable exceptions, success in pedestrian-oriented development has been difficult to come by.[13] The feedback loop that has been successful in other cases provides insight into a strategy that should work for Tren Urbano. The capacity for good development can be transferred to the development community by creating successful joint development projects. While these projects should not be exempt from the regulations suggested above, they should also be packaged with the assistance and support of the Tren Urbano planning staff. Any support that is necessary, whether architectural, financial or moral, should be provided to any developer who wants to create projects in the joint development area within the guidelines of the station area plans.

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[11] Boston Massachusetts and Curitiba Brazil both are cities with a strong risk of political influence in the development process. In Curitiba, the government has instituted a strict regulatory system that focuses development near the transit stations. The regulations in Curitiba are enforced by a planning department that will not bend the rules. The result has been a transit-oriented development pattern as illustrated in figure 1-1. In Boston, where development relies much more on process than regulation it has been difficult to spur good station-area design projects out of the downtown core.

[12] None of the many people interviewed in PR for this thesis disputed the need for pedestrian-oriented places around stations.

[13] This is confirmed by Graham Casillo in an interview (01/02). One noted exception is the Centro Europa in Santurce. This project was developed by a local developer, and is a significant addition to the pedestrian-oriented atmosphere in the area. It will also soon be a transit-oriented development when the Tren Urbano extension reaches this area.

Developers who participate in these early projects should have their risk reduced by public support and participation. After establishing the capacity to finance, design, build and manage these projects, the developers can also work with projects on private parcels with a similar level of success. The finance community will also be more supportive when initial projects are successful.

As an example, the Commonwealth could establish a joint-development project opportunity on a station-area site in the Hato Rey corridor by:

- Committing a public-sector agency as an office tenant to reduce rent.
- Committing financial assistance and favorable lease terms in exchange for a developer commitment to develop mixed income housing as part of the project.
- Paying for public infrastructure improvements including new streets and streetscape improvements.
- Assisting the developer in recruiting retail tenants to the project.

The Commonwealth needs to have a way to seek out creative developers, creative finance opportunities and the people who can bring together those opportunities. While the Commonwealth must do what they can to keep as much investment as possible on the island, they should seek out opportunities for local interests to partner with outside developers when necessary. Station area projects are likely to need developers that have the experience with designing and building mixed-use projects, the financial backing and/or the support in the finance community to bring together the elements to make this happen. Like the economic development agencies of the past that brought a manufacturing economy to the island, the future of economic development in Puerto Rico depends upon building new centers around these stations.

A New Framework for Development

The recommendations below provide the format for Puerto Rico to adjust their strategies and ensure that the station areas develop into unique new places that become the center of activity for future development in Puerto Rico.

Regulatory and Policy Framework:

- The planning board should continue to pursue its plan to take control of station area planning, and should use the opportunity to work closely with planners who are currently working for Tren Urbano.
- The planning board and the municipalities should set specifications that will make it difficult to construct any significant level of density beyond current or future Tren Urbano station areas.
- The Commonwealth should approve as official guidelines a set of drawings and statements for station-area development created by Tren Urbano. These guidelines should be provided to all landowners in the station areas and all developers responding to joint-development RFPs. The elements of design outlined in chapter 2 should be integrated into the design guidelines.
- Specific station area plans should be finalized. There has already been a significant set of discussions on the vision for each station area. The station area plans developed by Tren Urbano should be distributed to all local land-owners and developers responding to the joint-development RFPs. Station area plans should inform the zoning restrictions based on the station type zoning framework set up in chapter four. Zoning would include: height restrictions, floor area ratios (minimum and maximum), regulations for provision of public spaces, maximum parking allowed for various uses and use guidelines to ensure housing development and first floor retail. These regulations should be strictly enforced with no exceptions for joint development or private development projects.
- Public input for station-area design should be a part of the station-area planning and zoning process. This will reduce public opposition to projects in the development phase if these projects reflect the station-area plan.

Development Process:

- The development review system should be a fair public process that ensures station area design is properly reviewed and approved. It should be secondary to approval based upon the regulatory framework that is established.
- The Commonwealth should develop a formalized design review process for all projects within the station areas. There is no shortage of architects and planners in Puerto Rico who understand what good station-area planning is. These people should be appointed to a new civic design board by the governor, and the planning board should not approve any project without approval by a majority of the members of the design review board.
- Project reviews should proceed in the following order (see figure 5-5):
  1. Approval for meeting basic zoning by the Planning Board
  2. Meeting to collect input from the Design Review Board
  3. Approval by Tren Urbano
  4. Final approval by the Design Review Board
- Participants who don't hold a position of power should be allowed the opportunity to participate in planning and comment on projects to the design review board or the planning board. Each station area project should require at least one public meeting.

Public Institutional Capacity:

- The Commonwealth government should focus investment through the Community Development Block Grant funding program to provide mixed-income housing and business opportunities in the station areas.
- The governor should commit to locating all offices of the Commonwealth, its agencies and public corporations that are in the San Juan area within walking distance of Tren Urbano stations, or at least in an area with a strong bus connection to such a station. No new construction of government buildings in the San Juan metropolitan area should proceed unless they are located in station areas and meet the strict standards of design that are established in station area plans.
- The Commonwealth government should seek out funding for affordable mixed-income[14] housing and small business in new retail storefronts by looking to local banks to invigorate station areas through their commitments to the Community Reinvestment Act.
- The Commonwealth government should develop a program to create loan guarantees for financial institutions that lend money for local developers to do mixed-use projects.

Development Community:

- The Commonwealth government, Tren Urbano and the planning board should seek out mixed-use developers on and off the island for developing private and joint development sites around transit stations.
- Joint development should remain focused on creating station-area places as the primary factor for developer selection. Joint development should set the tone for other developments in the station area. The transit agency is required to select the best 'transit oriented' project,[15] and they should not sacrifice regional land use objectives for larger lease fees. Joint development projects should remain competitive processes, allowing the government to choose the best developer and best project only at the time that they feel ready to do so.

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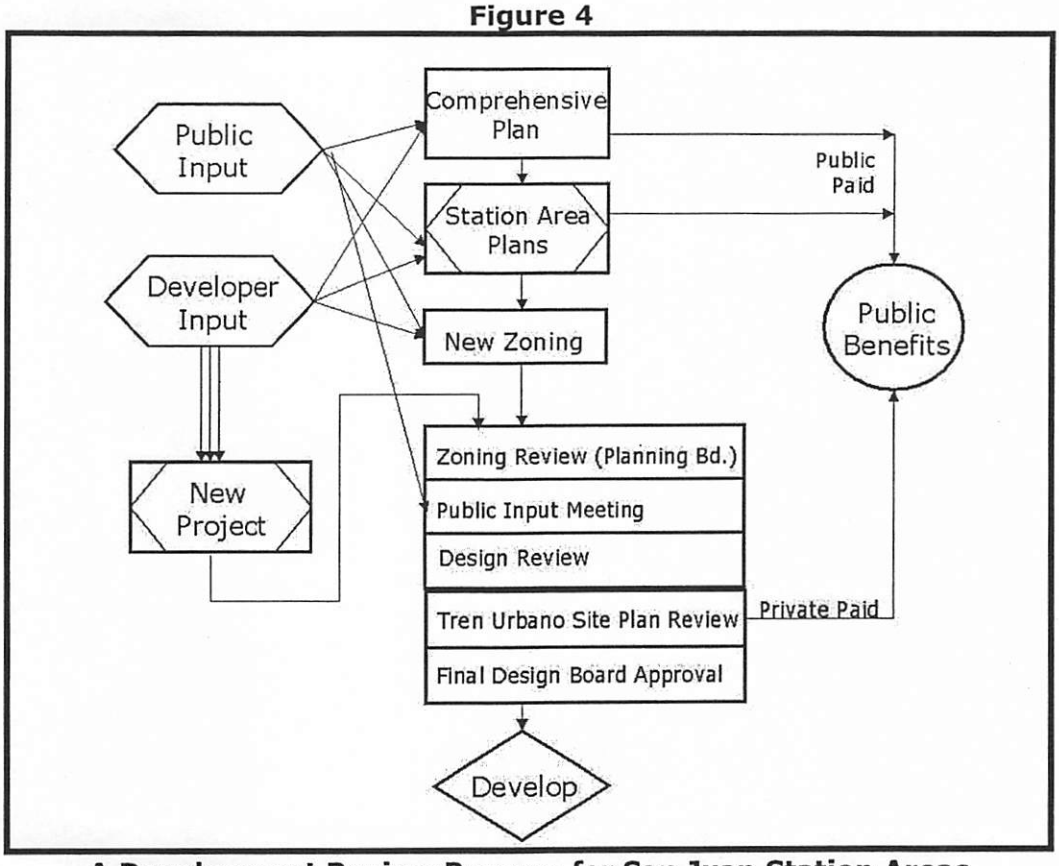
[14] While the government may be interested in affordable housing at station sites, it should proceed with caution and make sure not to cluster low income people around the station. This would lose the opportunity to mix in market income and higher income developments in the area. Ideally, incomes should be mixed, but if this is not possible, there should be the opportunity for small low income projects without pushing away other income groups from the station areas.

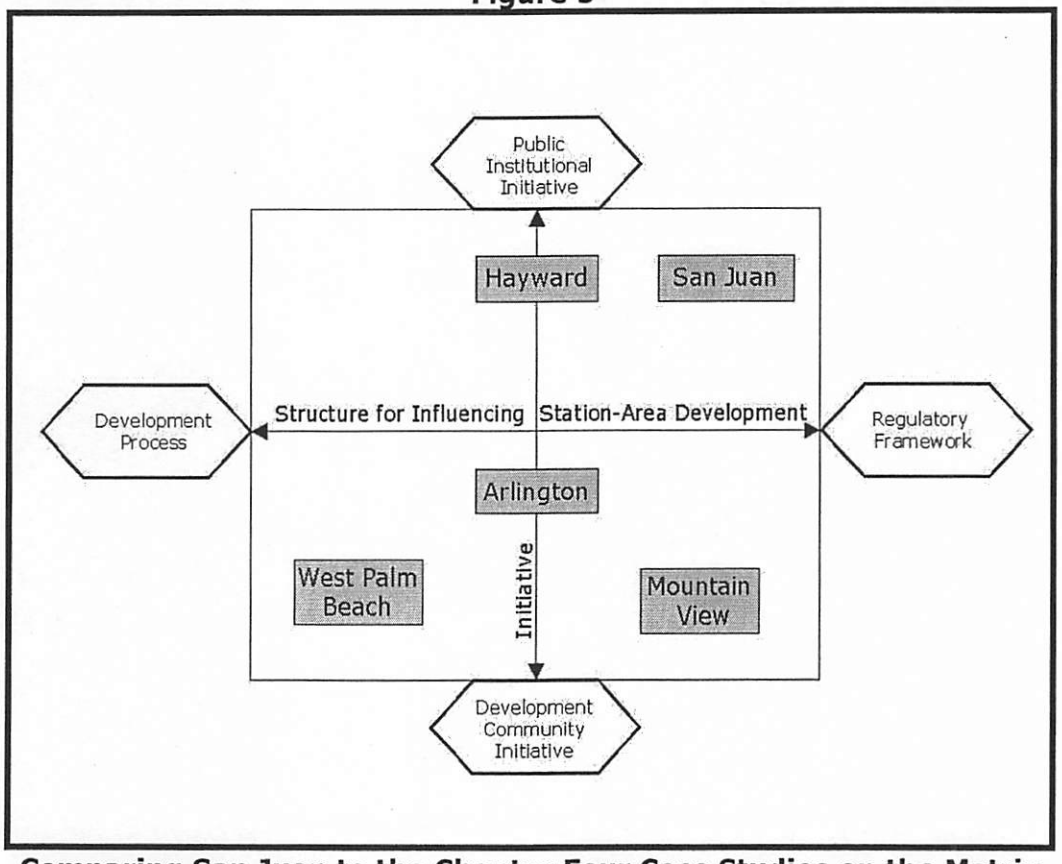
[15] Peter Albert interview, 01/02

Figure 4



A Development Review Process for San Juan Station Areas

Figure 5



Comparing San Juan to the Chapter Four Case Studies on the Matrix

CONCLUSION: THE NEW METROPOLIS

Metropolitan San Juan will continue to see growth of population, commercial and retail space as well as a continued reduction in household size. This means that there will continue to be a need for new buildings. If these buildings are constructed along the Tren Urbano rather than at peripheral locations, they can very quickly reinforce the viability of the transit and establish a desire for more transit capacity and hence more development activities. The Tren Urbano system is a new opportunity for San Juan to create a new type of metropolis out of their existing sprawling developments. The combination of the new train, the proposed extensions, the bus and *publico* feeder system, and the station area development will serve to move the public between destinations with an alternative to the private automobile.

Station area developments have been studied in many cities by many people. Even in the San Juan area, there have already been numerous proposals for public, private and joint development around the Tren Urbano stations. Projects have looked to identify the goals, the design elements and the realistic market projections that will allow Tren Urbano to find what is possible and likely to be done in converting the metropolitan fabric from an auto-oriented style to a pedestrian and transit-oriented design. This thesis contributes two elements to that debate. First, it analyzed the of elements of design that help and hurt pedestrian activity in a transit station area. Second, it focuses on the zoning and redevelopment process that has guided developments as they have been proposed, permitted and built.

This thesis has provided a number of suggestions on how Tren Urbano can bring together the forces that create station area plans and developments into a new process for planning and project review. It also has provided proposals for how this concept can be applied at three station areas on the Tren Urbano system. Most important is the idea that the government must form a set of development regulations to be applied in the station areas to ensure that development is of value. Furthermore, the government should use the regulatory tools available to them and the joint-development process as opportunities to build developer capacity for achieving successful transit-oriented projects in the station areas.

Tren Urbano may or may not accept all of the specific station area recommendations provided in this thesis. If only two elements are taken from this thesis project by the Tren Urbano staff and the planning board, it should be these:

- Successful station area development will depend upon government agency leadership, cooperation, consistency and control of station area development decisions through establishment of a strong development regulatory system and a companion development review and design review process.
- Successful station area development in the San Juan metropolitan area depends upon an institutional capacity to understand pedestrian-oriented design at the agency level and transfer that understanding to the development community. Joint development projects will provide this opportunity. The government would be best off building nothing on the joint development sites rather than settle for a mediocre project that will set a bad tone in the station area for the development community.

Tren Urbano, to be successful, must invent its own future. It must develop its own ridership. It must provide the opportunity for choice transit riders to use the Tren Urbano and its feeder systems because they provide an attractive alternative to automobile trips. To do so, the Tren Urbano must be more than a transportation system, it must be a whole new way of thinking about transportation, about the urban form and about the new economic development opportunities for the future of the San Juan metropolitan area. This will become possible when Tren Urbano links transit, land use and economic development through a station area development process that answers both the what question 'what do we want here?' and the how question 'how do we get it?'. Planning offers the opportunity to invent a new future, a new metropolis in a place where a different paradigm existed before. Inventing one version of this new metropolis can allow for the example to be copied by others.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CENTER FOR TRANSPORTATION STUDIES

Research Executive Summary

Implementation of Policies for Transit Systems Preferential Treatment

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Revised: May 29, 2002

Introduction

Why At-Grade Transit and Not Metro?

When one wants to deal with public urban transportation, it is often found that subway is a very robust alternative. Indeed, heavy rail transit system, through a higher capital investment, brings more capacity and is much more appealing! Why do we want to focus on at-grade transit system?

The following graph (figure 1) represents the distribution of traffic volume (passenger-kilometers per capita) between bus and metro, in major metropolitan area enjoying a heavy rail system.

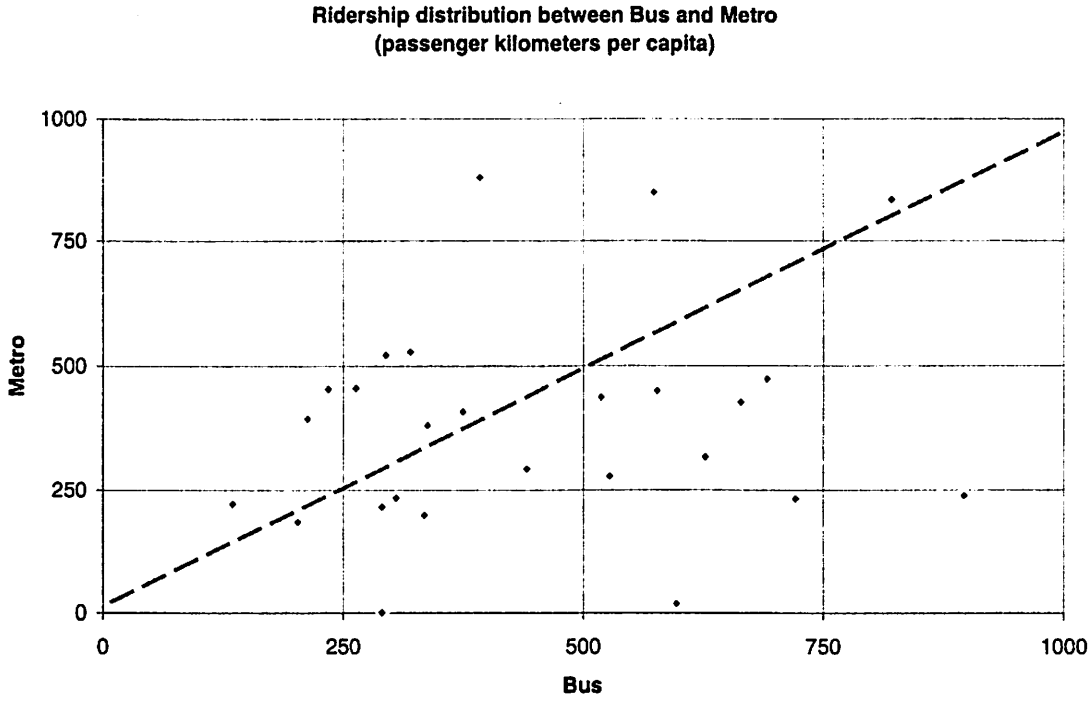

Figure 1: Distribution of Ridership between Bus and Metro [1]

15 of the 26 cities represented (58%) are located under the first bisector; this is to say that their bus system is carrying more traffic than their heavy rail system. Above the first bisector, the cities are still relying on the bus system, proving that a metro system cannot be self-sufficient.

Why Preferential Treatment Is Not More Common?

The question following the importance of bus (in a broader aspect at-grade transit) is why a better treatment is provided to the backbone of most of the transit system. Preferential treatment, as it would be defined later, has been successfully implemented in several cities in both developed and developing countries. There are not technical barriers that

[1] Source: Millennium database. The following cities have been used: Brussels, Lyon, Marseille, Paris, Frankfurt, Hamburg, Munich, Athens, Milan, Amsterdam, Oslo, Barcelona, Madrid, Stockholm, Glasgow, London, Newcastle, Montreal, Toronto, Vancouver, Atlanta, Chicago, Los Angeles, New York, San Francisco, Washington

can compromise the implementation, as the technology is widely available. But is the technology the only factor?

Objectives

This research will aim at analyzing the processes behind the different public policies that have led to the implementation of preferential treatment for transit systems, ranging from exclusive right-or-way (ROW) to other measures (i.e. Traffic signals, queue jumps...). The main basis of this research will be the analysis of different experiences on the development and implementation of such policies all around the globe.

Preferential treatment aim is to improve the schedule adherent and to increase commercial speeds. When implemented successfully, preferential treatment attracts new riders; the transit capacity and the quality of service increase. Preferential treatment includes a wide range of measure: from the queue jump to the Light Rail Transit. However, it can be divided in three categories:

- Operational improvements
- Bus Rapid Transit
- Light Rail Transit

A Quantitative Approach

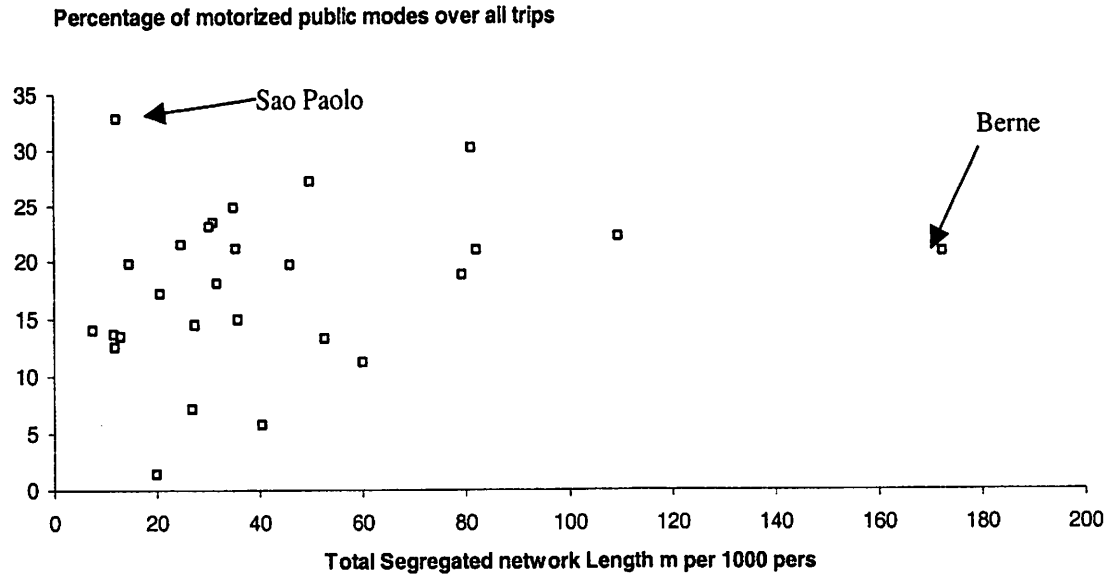

Figure 2

In Figure 2, we represent the percentage of motorized public modes over all trips in function of the total segregated network length per 1000 persons. A relation cannot be drawn from those results. However, the correlation coefficient is low (0.240). It seems that Sao Paolo and Berne have peculiar situations; nevertheless the correlation coefficient remains low (0.394) if we do not consider these two cities.

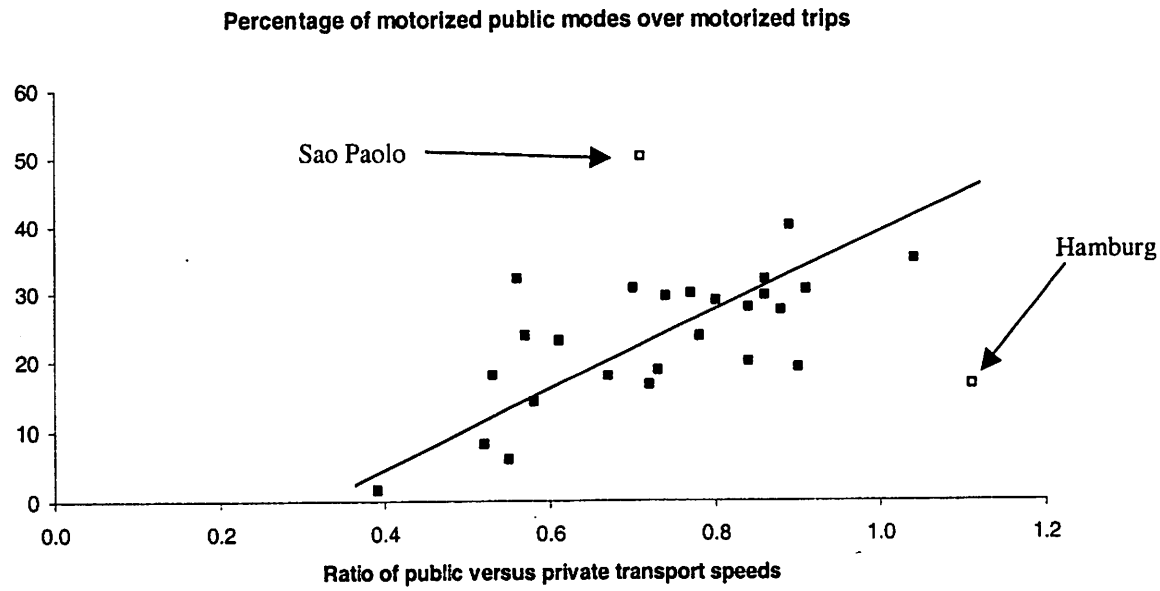

Figure 3

When one looks at the distribution of motorized trips in function of the speed ratio, the correlation is important (0.467 and without Sao Paolo and Hamburg 0.599). Building an infrastructure is not a guaranty for ridership, but insuring a high speed for the transit network seems to.

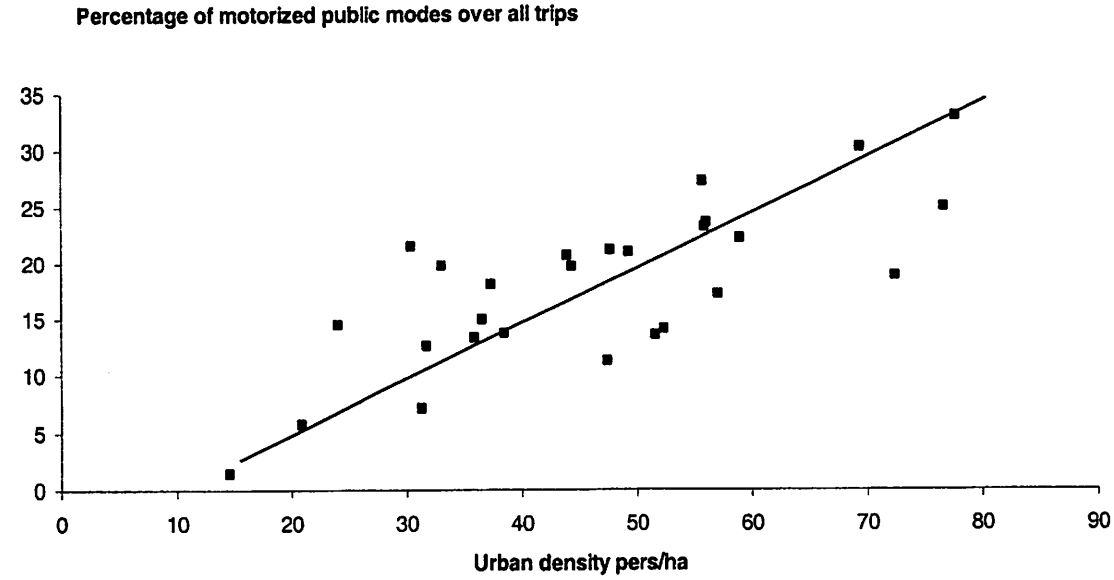

Figure 4

Figure 4 shows us that there is a strong correlation between the urban density and the public transportation use. This fact has already been described in the Millennium database Report. The relation remains true in the sample of cities with segregated at-grade transit. The coefficient of correlation is high with a value of 0.760.

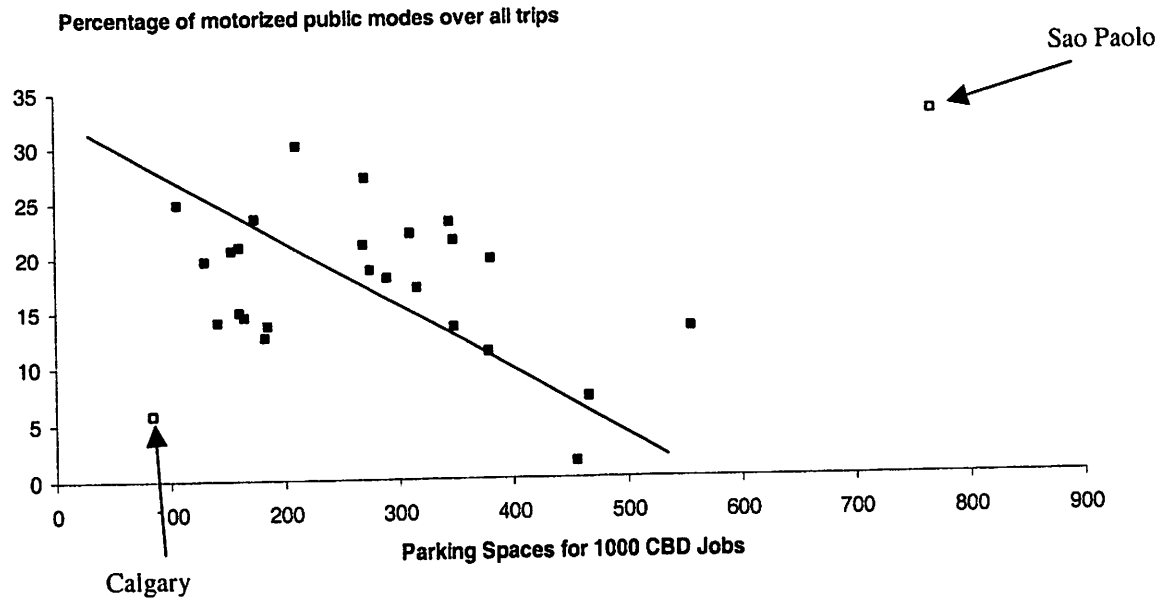

Figure 5

The indicator that we try to determine is the parking supply. The Figure 5 seems to show a correlation in the sample but the correlation coefficient is only 0.065. However, we notice that Calgary and Sao Paolo present some peculiarities. Without these two cities, the coefficient is –0.432, showing that less parking spaces in the downtown area make transportation systems more attractive.

The case studies

Curitiba: The Visionary Leadership

Curitiba has incrementally built its transit system over the last 30 years. In 1974, the first 20 kilometers of bus exclusive lanes were implemented and rapidly grew. In 1979, the concept of Integrated Transit Network was developed and the radial transit system was structured and reinforced by interdistrict lines. In the 80's, the system reached its capacity. First, the city upgraded its system by putting into service bi articulated buses and tube stations, then implemented in 1991 the Direct Line service (express service buses). The city was designed on the "Trinary Road System"

In 1943, the Agache plan, the first plan establishing Curitiba's priorities, pointed out the problem raised by motorization growth. It suggested creating arterial highways in order to accommodate the future traffic. Right-of-ways were bought by the city but the works never started and the plans remains on the shelf due to a lack of resources.
In 1965, the Plano Diretor de Curitiba (Master plan) was created to tackle the traffic problems. However, it adopted the completely opposite solution of the Agache plan: building the city around the transportation network through the strict control of the urban development along designated corridor.
In 1971, Lerner was elected/appointed at the head of the city. One of his first decisions was to transfer power to the Plan Committee to start the implementation of the Master

Plan. At this point, Lerner launched the implementation with strong commitment, describing it as an emergency, like in times of war. The aims were clear:

- Control the urban growth
- Integrate urban functions
- Give full priority to transit
- Limit traffic and pollution

One of the main factors in Curitiba's process is definitively the political leadership. Indeed, political leaders including Jaime Lerner had pushed to make things happened. Cervero's description of Lerner is pretty clear: Lerner acted as an army leader, persuaded in his mission. Also, Curitiba had started the planning process long ago The efficiency in the planning exercise is also a major factor, also we must emphasize that planning was not being only a pure intellectual process but was implemented fast. One of the main difficulties in planning – especially long term planning – is in which extent the plan is actually feasible.
The planning exercise has always integrated land use and transportation as part of a local dynamism. The planning process clearly stated to build the city around the transportation system, a city that would push people toward transit. Most of the cities tried to do the opposite, adapting the transportation system to a urban context build on the automobile mode.

The Curitiba's success is hardly replicable due to different aspects. When Curitiba implemented its transit system, the city was at an early stage of its development both in motorization and land use prospective. At this time, the car was fare from being an alternative for everyone. So confrontation with actual and deeply established patterns was not an issue. Leaders were not lacking of support to give preferential treatment to transit, as the majority of the population were transit-dependant. On this other hand, the urban growth was starting: to have any influence on the land use pattern, policy during the development of the city is obviously more efficient than during the time where the city is already build. Eventually, we have to point out that the political context Brazil at that time favored initiatives as they were coming from the top. Indeed, it would be interesting to analyze in which extent the national context inhibited the opposed stakeholders (drivers, communities, social groups) to act. It appears that locally communities were highly involved in the city management.

Ottawa, The Success of Planning

In 1969, the Canadian Parliament established the Regional Municipality of Ottawa-Carletton (RMOC) in order to control the urban sprawl. The major roles attributed to the RMOC were planning, infrastructure investments and providing regional service. In 1972, the RMOC created OC Transpo (Ottawa-Carletton Regional Transit Commission) to exclusively operate public transportation in its perimeter. Planned in the early 70, 31 kilometers of Transitway were achieved in 1996, completing the existing bus network.

organized, referendum in which politicians suggest and citizens decide. The following text is part of the referendum on transportation issues. The political class opted for an increase in highway capacity to release congestion and suggested a rejection of the transit solution. The population rejected the proposition and opted for a full priority to transit!

Finance

Financing infrastructure is the main point to understand the decision-making process that occurred in Zurich. The referendum was rejected because the financial burden. Joost[5] explains the contradiction between the citizens and their elected officials that, according to him, is due to the misrepresentation of the population. Elected officials are generally men over 40, a market predominantly dominated by the automobile mode; therefore they tend to be biased when they opt for a solution to solve transportation. Definitely, Zurich's citizens understood that the problem of the city could not be resolved in increasing capacity; it was more a matter of better management of the current assets.

If the politicians, first, disagreed with their bases, they did not wait long to back the new plan for the city. We must remember that giving transit priority was not an easy task at that time. The transit system in place in Zurich has been built in early 1900's, in a time when automobile was not a competitor. Giving back the full priority needed a complete development in terms of technology. The city overcame the barrier in investing massively in a traffic signal center to control most of the city traffic light, in order to speed up transit.

Speeding up transit was not the only measure to make public transportation more attractive. The city implemented a capacity management program for parking and road capacity.[6] They also drastically reduced the parking places. On the other hand, they froze the city road capacity: any new additional road capacity has to be removed and transfer to transit in another parts of the city. In addition, the city imposed automobile restrictions by traffic calming in residential neighborhoods. Eventually, the city reorganized public transportation to achieve a fully-integrated system. The creation of the ZVV in 1990 was aiming at coordinating the different transit operators and limiting transfer between the different parts of the system.

In Zurich, the environment is considered to be the main trigger in the whole process. We would argue that it is more the quality of life in a broader sense. Environment is part of it, as well as urban patterns, congestion. Zurich citizens were aware that automobiles were destructuring their way of life through sprawl and dependency and imposing heavy external cost to the society. The debate crystallized around environment because it is the most tangible argument.

Bogotá, Fast and Cheap to Convince

In December 2000, Transmilenio, a Bus Rapid Transit, started operating in Bogotá. Initiated by the Mayor Enrique Peñalosa at the beginning of its mandate in 1998, the city and private operators built and organized the transit system. Three sections have been completed in less than three years.

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[5] Ernst Joost

[6] Cervero

The Subway

Bogotá has discussed the construction of transit system for a long time. Building a subway to provide heavy capacity transportation was already on the public agenda in the 40's. More recently, several attempts have been made to implement the subway solution[7] but all failed. In 1998, the newly elected mayor Enrique Peñalosa Londoño created two offices in charge to plan the potential subway construction or the possible bus system. Rapidly, the first office concluded that the metro was not feasible for financial reasons. Therefore, the administration focused on the bus solution by setting a planning team and designing the system.

Peñalosa: a visionary

Bogotá is the one of the recent example and we should say success in preferential treatment implementation. However, one must be careful in trying to replicate the system because the context is a developing country's city with a fast and low motorization and is quite comparable to Curitiba or Quito two decades ago. The mayor Enrique Peñalosa is a major source of dynamism. The following extract shows that the idea of implementing transit system based on full preferential treatment has been in his project for long time.
Peñalosa understood the importance of a cheap and feasible technical solution.
Peñalosa also made sure to raise the community awareness to avoid any nostalgia of the subway or temptation to the private modes. He organized not only the car free day but also a referendum clearly stating the future policy in transportation: promote transit! Eventually, the mayor sustained an entrepreneur policy in the financial aspects of the project. Part of the funding required for the infrastructure was raised through a gasoline tax. Funding public transit by automobilists -- at least in part – can appear controversial but in the Colombian context, it was a redistributive tax in a sense that 10% of the automobilists (in the wealthiest part of the population) were contributing to the welfare of users of public good.
Transmilenio has not been an isolate initiative to develop a new and sustainable Bogotá. Peñalosa emphasized in his speech on the valorization of the urban context by massive investment in public goods, aiming at reforming the social ties: "to wake the pride of the life framework". During his tenure, Peñalosa invests in many libraries, public schools, and parks providing not only usefulness but also adding esthetics. In the transportation aspects, he developed an extensive network of cycle paths combined with green open space to revalorized non-motorized modes.

To tone Bogotá's experience down in a possible replication, we will also look at the general context of Bogotá. Not to deny political entrepreneurship from Colombian politics, we must remember that Bogotá is a growing developing city, dense enough to support the success of a transportation system. Moreover, resistant stakeholders were the current transit industry not the automobilists because of a low.
On the other hand, the transit context was present in Bogotanos' life. Due to the low motorization rates, public transportation was already the dominant mode. Proposition to improve could hardly be challenged by the users because they were aware of the future benefits. One must know that one of the trunks dedicated to Transmilenio was already dedicated to private buses but inefficient due to the chaotic state of the system.

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[7] A tale of two plans: the determinants of plan implementation, Arturo Ardila

Lyon, The National Strategy

Lyon case study illustrates the will of the French government to reconsider its transportation policy; the French state has always been a very centralized country and Paris had long directed the transportation policy. Therefore, we will examine first the national policy evolution then the Lyon case study.

Legislation

As we said, France has always been concentrating its political decisions in Paris, leaving few initiatives to the local powers. However, in 1982 the national government passed the Decentralization Act, aiming at strengthening local powers.

Loi d'Orientation des Transports Intérieurs (LOTI)

Shortly after the Decentralization Act, the government adopted the "Loi d'Orientation des Transports Intérieurs (LOTI)" or Domestic Transportation Orientation Act defining a extensive transportation policy. The LOTI set the principle of right to transportation for all and the necessity of choice of modes. It also emphasized on the public transportation. The cities or municipalities associations were designed to organize urban public transportation, through the Autorités Organisatrices (Transportation Authorities). Finally, the LOTI included the necessity of a medium range intermodal planning through the creation of the Plan de Déplacements Urbains (PDU) or "Urban Mobility Plan". However, the lack of incentives and obligations limited the scope of the PDU.

Loi sur l'Air [8]

In 1996, the increasing congestion and pollution problems in urban centers led the French government to reform the LOTI by the Loi sur l'Air or "Clean Air Act". The initiative of the PDU were not meeting the expectation, therefore the act imposed the creation of a PDU for every municipalities with more than 100 000 inhabitants before 2000. Moreover, the Loi sur l'Air defined strong orientation for the PDU:

- Decrease of the automobile traffic
- Development of mass transit and alternative non-polluting modes like walking and cycling
- Organization of parking inside the PTU, depending on the right-of-way hierarchy
- Incentives for employers to favor public transportation and car-pooling

Public aids are now conditioned on the elaboration of the PDU by local governments.

The French government has been the main actor in establishing policy for transportation in urban centers. Its late preoccupation has been to shift to lighter mass transportation mode called Transport en Commun en Site Propre (TCSP) which is nothing else than preferential treatment. Judging the TCSP more efficient, a circular published in 2001[9] strongly encouraged the development of TCSP for a more balanced capital investments and for a better share of public right-of-ways with cars.

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[8] Loi sur l'Air 30-12-96

[9] Circulaire relative à la mise en oeuvre des plans de déplacements urbains et aux aides de l'Etat aux transports collectives de province, source: www.equipement.gouv.fr

PDU Objectives

The main PDU objectives were the following:

- Capacity Freeze of penetrating axes, capacity decrease of transversal axes
- Creation of plan of 30-km/h areas (traffic calming) in the next decade
- Public Transportation reorganization on the main axes in order to increase level-of-service and the supply

The PDU Implementation

The Decentralization Law created too many levels of decision, thus the State decided to incorporate a recentralization at the local level. Noticing the last of constituency, because of two many interests, the State in order to strengthen the new power in conditioning the funds to a metropolitan perspective.

In the 80's, following the LOTI act, Lyon started its PDU by a planning exercise in order to tackle the growing traffic problem. The process rapidly collapsed because the different cities were trying to attract the state investments without building any coherency at the metropolitan level. Moreover, the State abandoned its financial support.

In 1990, under the leadership of the mayor Michel Noir, the transportation issues came back to the politic agenda. Noir wanted to replace Lyon in a European context and pushed for the creation of two additional subway lines.

In 1995, a new team got elected with Raymond Barre as mayor of Lyon and president of the COURLY (Metropolitan Area). The composition of the COURLY assembly became more coherent. Christian Philip, first deputy, led the SYTRAL (Transportation Authority) with the objective to redefine Lyon's transportation policy.

The Department expressed its opposition to further investments in heavy modes, after the costs overran in the last two lines of subways. At the same time, the State fixed its participation through the Idrac decret: 15% for subway and 40% for light rail. Philip, supported by a political consensus, pushed to give transit full priority, relying on intermediary system. A contract was set between the different actors and the technological choice to LRT.

In October 1997, the PDU was approved, setting a network of 12 LRT lines. The political agenda pushed to fast implementation of 2 lines in 2 years. Indeed, the next city elections were in 2001 and the transportation policy was one of the campaign themes for Philip, a potential successor of Barre. Eventually the first two lines were opened in January 2001. Even though, the implementation was successful, the population was a little deceived by the LRT, as they were expecting a capacity and a speed of a heavy rail. The implementation has not been accompanied by major land use transformation, in spite of incentives. The SRU Act was more oriented on this point.

Future Work

Methodology

Preferential Treatment Definition

The first part of the thesis will be focused on giving a consistent definition of Preferential Treatment. It is most of time restricted to a technology choice for a system (BRT or

LRT). However, one must consider the many different steps that upgrade conventional bus to BRT, then LRT.

Data Analysis
A brief study of aggregate data is made in order to understand which components of preferential treatment are relevant to a policy analysis. It is not aiming at explaining why the implementation actually succeeded but more at giving us some elements of analysis.

Stakeholder Analysis
Using the technological gamut of preferential treatment described in the first part, we want to scan the different stakeholders involve in the policy process. It would be relevant to understand who they are, what their interests are and what maneuverability the have towards other stakeholders.

Theoretical Framework
We would look at the theory behind policy implementation through the agenda building process. In this part, we would come back on the different models on how a stakeholder can support an idea and bring on the top of the agenda.

Guidelines
Using the theoretical framework and the stakeholder analysis, we would define strategies adapted to the transit context, more precisely to preferential treatment. This part would constitute the core of the thesis. Based on the following part, we want to build guidelines for each stakeholder:
Defining the stakeholder and its objectives and means
Describing the relationship with other stakeholders
Building constituency and mitigating opposition's interests
Defining opportunities and triggers to reach the decision-maker's agenda
Developing a technological strategy in order to support his policy (which steps must be taken and at what stage of the process)

Case Studies
Some cities have already been able to transfer the road priority to public transportation. Using the guidelines developed above, we would analyze several case studies in order to highlight the strategies implemented by different entrepreneurs. The case studies would try to include the different strategies developed above. We would look at historical implementations (Curitiba, Zurich and Ottawa) as well as cities currently involved in such a process (Hawaii, Lyon, Dublin, Lausanne, Bogotá, Kunming...). The case studies would be mainly based on literature and we hope to contact at least an actor (if possible the entrepreneur).

Application to SJ and CTA
In this final part, we would apply the guidelines to San Juan and Chicago. It would require an investigation on the different aspect of implementation (stakeholders, resources...). It is mainly done in San Juan after the Encuentro.

END-OF-YEAR REPORT

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May 31, 2002

WORKING TITLE, GRADUATE THESIS

Brand Positioning as a Strategic Tool for Transit Competitiveness

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EXECUTIVE SUMMARY

In light of the importance of mode-choice riders as a transit market and transit's decline in overall transportation market share, transit agencies need to compete with automobiles on the basis of customer-oriented service. Brand positioning aids the market-oriented organization in developing a strategic approach to influencing customers' perceptions by using market research and an awareness of the competitive environment to inform the design of its marketing mix elements. This thesis seeks to take brand positioning frameworks used more commonly in the private goods and services sectors and adapt them for application to a transit agency. A brand positioning statement will be developed, followed by an audit of key positioning elements (customer needs, target groups, competitive context, benefits, "reason-why", and brand character) and a competitive positioning assessment. The statement's implications for the design of the agency's service, pricing, communications and distribution will then be outlined. Findings from case studies of effective brand positioning initiatives in public service and transit sectors will be used to refine the positioning framework. The framework will then by applied to develop a brand positioning strategy for a specific section of the transit systems in Chicago and San Juan.

BACKGROUND

It is generally recognized that transit's most significant competitor is the private passenger automobile. In many metropolitan areas, the transit share of the total transportation market is decreasing as a growing percentage of the population relies more on travel by car. In cities such as Chicago and San Juan, the modal choice market – made up of individuals who have the option of using cars or public transportation – is a significant one, though for slightly different reasons. In Chicago, the modal choice segment of the Chicago Transit Authority's ridership has been steadily increasing,

emerging as an important "swing" market. In San Juan, where the new passenger rail system is slated to begin operations in the fall of 2003, its goal of offsetting severe automobile congestion depends in part on attracting mode-choice riders (Hoffman).

In contrast to transit-dependent riders, who are generally price sensitive, mode-choice passengers are typically sensitive to the quality of transit service (Orski). In this context, and in the face of declining transit market share in general, any transit agency that seeks to compete with automobiles must do so on the basis of a service with a strong customer-orientation.

A market positioning strategy is one that communicates to potential (and actual) users of a service the nature of that service in terms that are meaningful to the potential (and actual) user (Heskett). This positioning is a function of both public perception and managerial choice. In the absence of a careful market strategy, services acquire a *de facto* position in the market place determined largely by customers' perceptions of the service's chief relevant characteristics. If service managers learn what these characteristics are through careful market research, they can design and promote services strategically to meet the market place's concepts of need (Hoffman). In many service sector industries, the importance of a positioning strategy has been widely demonstrated. Public transit, in contrast, has been criticized in the U.S. for its poor positioning as the low cost, low quality transportation service (Lovelock, Lewin, Day and Bateson).

LEADING QUESTION

Brand positioning describes the way an organization wants its customers to perceive its class of goods or services versus those of its competitors. An organization is branded by all of the aspects of its interaction with customers and non-customers alike. These aspects are commonly referred to as the "marketing mix" elements and have been defined in a transit context as

- service,
- pricing,
- communications, and
- distribution.[1]

This transit marketing mix implies that decisions made by agency personnel in the operations and planning area have as much effect on customers' and non-customers' perceptions as those in areas more traditionally associated with the marketing role. In this way, it becomes important that transit managers in distinct areas of an agency adopt a common brand that informs the design of all marketing mix elements. To achieve this, it becomes necessary to develop a means by which such a brand identity can be determined.

[1] (Lovelock, Lewin, Day and Bateson)

How can a transit agency determine its most competitive positioning as a brand? Once this is determined, how should this inform the design of its service, pricing, communications and distribution?

THEORETICAL AND PRACTICAL IMPORTANCE

Very little work has been published concerning the application of branding as a strategic tool for improving transit competitiveness. The positive experience with brand positioning witnessed in the private service sector suggests that a similar approach is worth exploring in the context of public transportation services. A framework for developing a competitive brand position, while most widely developed for marketing privately manufactured goods and services, could be important for transit agencies such as the CTA and Tren Urbano from the following standpoints:

- The development of a brand positioning statement aids the market-oriented transit agency in
    1) targeting customer groups most likely to benefit from their service,
    2) understanding the means by which customers perceive benefits,
    3) understanding the agency's capacity to deliver specific benefits against distinct customer needs, and thus
    4) understand the most appropriate competitive positioning of the agency's service relative to other modes of travel.
- An explicit brand positioning for the agency lends consistency and integrity to the decisions made in designing transit service, pricing, communication and distribution.
- A branding strategy (and any sub-strategies) establishes a coherent rationale for the efficient allocation of human, financial and time resources in transit planning, operations and marketing.

A number of theses have been produced in this joint research program that are geared at understanding traveler behavior and perceptions and customer information strategies, all of which are important components of brand positioning. What's missing, however, is the development of a framework by which market research is coupled with what's known about transit agency capacity and its competitive environment to determine a common positioning for the design of the marketing mix elements. It is important to note – and address in the context of this thesis – the high degree to which a robust branding effort depends on the existence of credible market research data.

PROPOSED APPROACH

Publications by Czerniawski and Maloney, Heskett, and Aaker illustrate similar approaches to creating, auditing and assessing brand positioning for private goods and services. This thesis aims to adapt these processes for use in developing a framework for branding public transit services from the perspective of a single agency. As brand

positioning involves a certain degree of comparison between an organization's goods or services and that of its competitors, this research effort will examine transit's positioning in relation to its chief competitor, the private passenger automobile. A key element informing this effort is the recognition of ways in which travel by transit (a public service) can be appropriately compared in a competitive context with travel by car (a private good).

A) Literature Review

A thorough literature review is conducted to identify the critical issues related to positioning strategy, branding, and public transit marketing.

B) Creation of Brand Positioning Statement

A brand positioning statement is a device that allows a transit agency to articulate in clear, concise terms the competitive position the agency does or believes it can occupy in the marketplace. However, the ability to make such a statement results from carefully answering the following key questions:

1) **Customer Needs** – What are the trends in travelers' needs and how are they being satisfied?
2) **Target Customer Groups** – Which customer groups can the agency's service satisfy most effectively?
3) **Competitive Context** – How is the agency's service currently situated in the transportation marketplace structure and how can it substitute for other services?
4) **Benefits** – What benefits do the agency's target customer groups receive from using our service?
5) **"Reason-Why"** – How can customers be assured that the agency's service is beneficial?
6) **Brand Character** – What values distinguish the agency's service from others?

Concise answers to these questions are captured in the following brand positioning statement, a strategic document that provides a common blueprint for designing transit service, price, communications and distribution elements[2]:

[2] Adapted from Czerniawski and Maloney

To _____, the _____
(target customer group with need X) (transit service brand)

is the kind of _____ that _____
(competitive framework) (benefits)

_____. The reason is _____
(reasons-why)

_____. The character of the service is _____

_____.
(brand character)

See Appendix A for the detailed approach to identifying each of the statement's elements.

C) Brand Positioning Audit and Competitive Assessment

Once the afore-mentioned elements have been developed and combined into a coherent brand position, an audit must be conducted to verify the robustness of the proposed positioning. This audit consists of a verification of the following:

1) Specification of target customer group(s) by demographics, usage behavior, and need mindset
2) Identification of need(s) agency service can uniquely satisfy
3) Appropriate breadth of competitive context
4) Clarity of intended of customer benefits
5) Delivery of meaningful benefit differentiation (versus competition) to target customer group
6) Clear alignment of reason(s)-why with benefit(s)
7) Brand character reflects image and values that agency desires to establish in the marketplace

At this stage, it is also necessary to assess the agency's expressed brand position relative to the experience offered by its competitor, the private passenger automobile. A positioning matrix tool is used to cross-check the inferred positioning of the competition and is composed of the same brand positioning elements (target group, customer needs, competitive framework, benefit, reason-why, brand character). Managers from marketing, planning and operations, and customers make up two groups that provide reactions at this stage to the accuracy of the agency's positioning relative to its competitors.

The positioning matrix can also be used to do the following:

- match competing services with a range of customer needs (emotional to rational)
- create multiple branding scenarios for a new transit service
- if updating the positioning of an established brand, position other brands that are admired and apply what they do well to the agency's own

See Appendix B for the detailed approach to using the positioning matrix tool.

D) Brand Positioning Implications for the Marketing Mix

An audited and competitively assessed brand positioning is then used to inform the design of the agency's service, price, communications and distribution. This process of understanding the brand positioning's implications for the marketing mix seeks to answer the two following questions:

- How should our brand position be reflected in the elements that affect customer perception?
- What is the agency's capacity to "evolve" marketing mix elements as the transportation market changes – in terms of competition, customer habits, and service/technology innovations?

The transit marketing mix elements can be further broken down in the following manner[3]:

1) **Service**
   a) Vehicle characteristics
      - Size
      - Appearance
      - Seating
      - Ride quality
   b) Operating characteristics
      - Average speed
      - Punctuality
      - Schedule headways
      - Quality of driving
      - Crowding
      - Nature of other passengers

[3] Adapted from Lovelock, Lewin, Day and Bateson

2) **Pricing**
   a) Level of fare
   b) Method of payment
   c) Frequency of payment
3) **Communications**
   a) Bus, train operators and other personnel
   b) Media advertising (periodicals, TV, radio)
   c) Outdoor advertising
   d) Electronic – Internet, e-mail, PDA
   e) Direct postal mail
   f) Maps, brochures, signs and timetables
   g) Telephone information service
4) **Distribution**
   a) Location of routes and stops
   b) Location of information sources
   c) Location of fare payment
   d) Timing of service
      - Operating hours
      - Schedules at specified locations
      - Connections to other systems and modes

E) Case studies

The theoretical approach used here to develop a brand positioning framework has been adapted from use in the private goods and services sectors. While empirical evidence exists to support the effectiveness of this approach in these sectors, it is important to identify cases where similar brand positioning initiatives have been effectively pursued in the public services and, more specifically, transit sectors. Findings from such case studies will help to ensure that the approach developed here is an appropriate one with a greater likelihood of success.

SCOPE OF WORK

This research entails the development of a transit brand positioning framework from the perspective of a single agency. This includes the following:

- Categorization of customer needs and targeting of market segments
- Identification of the positioning of services with which a transit agency competes
- Identification of a transit agency's own service capabilities and the differentiated benefits it offers to potential and actual customers
- Identification of transit brand positioning implications for service, pricing, communications and distribution

Once brand positioning implications for the marketing mix elements are established, the logical next step involves the development of an implementation plan for the

modification of existing services or the creation of new ones. To be planned and carried out effectively, this step requires additional insights and expertise of transit managers across a wide range of areas within the agency. However, the breadth and depth of this phase of brand positioning are not within the scope of this research. Nevertheless, an outline can be found in Appendix C to briefly illustrate the important considerations for crafting an implementation plan.

It is also worth noting that when the framework is applied to the Chicago Transit Authority and Tren Urbano, the nature of the positioning implications may make changes to certain marketing mix elements more imperative than others. In this case, select elements may be examined more intensely. Similarly, the credibility of available data could make efforts to address certain marketing elements more advisable than for others.

Given the time and resource constraints on this research, it may also be prudent to limit the framework's application to a specific geographic section of the Chicago and San Juan transit systems. In this case, care will be taken to ensure that the brand positioning framework design is applicable on a system-wide scale as well.

METHODS AND DATA

The robustness of a brand positioning framework depends largely on the credibility of market research (customer and competitor) data that is available. To deem itself a serious effort, this thesis requires access to an assortment of the following sources:

- Customer usage and attitude studies
- Customer satisfaction surveys
- Market segmentation studies
- Needs assessment studies
- Customer focus group reports
- Agency personnel
- U.S. census data

In addition to completed studies, the nature of the brand positioning framework also requires the involvement of customer groups and transit agency personnel during specific junctures of its development (See Appendices A and B).

APPENDIX A:

CREATING A BRAND POSITIONING

A) Customer Needs: What are the trends in travelers' needs and how are they being satisfied?

1) External Analysis: Customer Needs and Competition
   a) Use usage & attitude, customer satisfaction, and market segmentation studies to determine present "need categories"
   b) Use combination of qualitative (focus group), quantitative, and intuitive (agency personnel) studies to develop emerging need categories that reflect future trends over an established period (5, 10, 15 years, etc.)
   c) Establish early association between functional and emotional needs
   d) Establish order of importance of needs as understood from qualitative and quantitative data
   e) Determine competitor's effectiveness in meeting customers' explicit and prospective needs

2) Internal Analysis: Agency service delivery against customer needs
   a) Begin with performance gaps (more explicit needs vs. customer satisfaction levels)...
   b) ...follow with exploration of prospective needs of specific segments within each need category
   c) How effectively do/can we meet explicit and prospective needs?
      - Explore linkages between established/prospective customer needs and agency's service traits. Note: Identify customer needs as expressed by customer (not as inferred by agency to suit service traits)
      - Begin articulating a realistic vision of future marketing mix developments. What are our competencies as a transit agency? Where are we constrained in meeting a category's basic needs? Where might we invest in new competencies?

B) Target Customer Groups: Which travelers can our service satisfy most effectively?

1) Identify target groups using the following:
   a) Demographics
   b) Current usage habits
   c) Need mindset (customer identity and outlook that cannot be described using demographics and current usage habits)

2) Exercise precision in targeting groups and balance size of group with agency ability to deliver meaningful message through the brand

3) Apply "ideal target customer profile" tool
   a) Concrete description of customer(s) that is (are) ideal for the agency's service, reflecting the values, practices, attitudes and need-mindset for which the agency's service and its benefits are most appropriate

C) Competitive Structure: How is our service currently situated in the transportation marketplace structure and how can it substitute for other services?

1) Diagramming tool

In this stage it is important to define a competitive context or framework against which the agency can deliver a meaningful point of difference to establish a competitive advantage. The aim is to get customers to perceive the agency brand as a substitute for a broader set of services.

   a) Clarify expected sources of demand/volume for the agency brand. Note: If exercise leads to broader volume sources for the brand, creation of a broader designation for the brand should follow
   b) Determine the specific services or products with which the agency competes. Note: As a reflection of current market structure, diagram needs to be updated as marketplace is re-structured in the future

D) Benefits: What benefits do our target customer groups receive from using our service?

Benefits can be understood as functional or emotional. Functional benefits concern the benefits that come from the service and address the inherent award to the customer. Emotional benefits represents another classification of benefits to the customer, but are characterized more by feelings and beliefs as opposed to performance factors.

1) Benefit laddering tool
   a) Identify potential service, customer and emotional benefits, reprising the target customer group definition
   b) Select benefits...
      - That are most meaningful to target customers
      - Against which agency can deliver given its service capabilities
      - Which can be used to differentiate agency's service vs. the competition
   c) Confirm conclusions with customers

2) Verify benefit-target customer group relationship

3) Verify benefit-competitive framework relationship

4) If benefits are multiple, successful and effective communication to customers can be improved by
    a) Utilizing a single-minded proposition to align them
    b) Broadening the competitive framework
    c) Employing multiple executions

E) "Reason-Why": How can customers be assured that our service is beneficial?

Incorporating a solid "reason-why" into the brand positioning presents an opportunity to establish the brand's credibility. Credibility devices are intrinsic to service (design or process-driven) or extrinsic (endorsements, tests). The reason-why should dovetail with the primary benefit, providing the linchpin of the brand positioning statement.

1) Distinguish legitimate "reason-why" material from benefit material

2) Use checklist to identify good starter list of credibility material for brand positioning statement
    a) Provide reasons-why for benefit. Options include design, process, endorsement, research, source, etc.

3) If "reasons-why" are multiple, make sure they are aligned in a single-minded proposition that's articulated in customer language

F) Brand Character: What values distinguish our service from others?

Brand character serves to differentiate services with common features and benefits. It reflects a set of values that give customers an additional reason to choose a particular brand.

1) Brand characterization exercise
    a) Start with someone or something concrete that everyone knows (celebrity, specific societal role familiar to all, animal, music, or borrow from well known, established brand)
    b) Define personality characteristics of chosen persona that match brand
    c) Identify personality characteristics you wish to establish for brand consistent with service feature

APPENDIX B:

COMPETITIVE POSITIONING ASSESSMENT

A) Positioning Matrix Tool:

1) The positioning matrix allows the agency to cross-check the inferred positioning of their competitors, using the brand statement elements (target group, customer needs, competitive framework, benefit, reason-why, brand character). Positioning matrices should be made a part of strategic planning cycle and therefore updated regularly.

2) Assemble varied group of colleagues together with available information about competitors

3) Build an individual, then consensus matrix, assessing the competitive positioning of the brands in the category

4) Assess the following:
   a) Continuity of six brand positioning statement elements
   b) Linkage within the following pairs: customer need(s)-benefit(s), target customer group-brand character, benefit(s)-reason(s) why
   c) For each of the six elements:
      - Determine specific point of reference
      - Can differentiation be neutralized, rendered obsolete?
   d) Have advanced category users (customers) indicate the following:
      - What the current brand positionings are
      - Which positionings have the most appeal
      - What the transit agency might do to strengthen positionings

APPENDIX C:

BRAND POSITIONING IMPLEMENTATION

Once the brand positioning implications for transit service, pricing, communications and distribution have been identified, a plan must be developed to address the means by which the necessary changes are implemented.

A) Program Goals

1) By marketing mix element
2) Alignment with brand positioning statement
3) Strategic
4) Phases
5) Specific goals (quantifiable?)
6) Realistic (attainable)
7) Prioritization

B) Action Plan

1) Activities by goal/strategy
2) Responsibility
3) Schedule by milestones
4) Tangible and intangible results

C) Budget

1) Resources
2) Money
3) People
4) Time
5) Amount and Allocation

D) Monitoring

E) Evaluation

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A Quantitative Look at the Affects of Design on Mode Choice

Using public transportation requires more than just riding the train from station to station. People must get from their starting point to the train and then from the station to their destination. While the train portion of the trip is important in the traveler's decision to use transit for their trip, it is the entire trip experience that is considered when choosing a mode. In addition to insuring a quality train ride, the access and egress trips should also be as accommodating and pleasant as possible. This paper attempts to answer two questions. The first is whether or not the access environment affects people's mode choice. Secondly, what other benefits can be gained from improved station area design?

Can the physical environment surrounding a station affect if how people choose to get to transit stations and whether or not they decide to use transit at all? Travel demand models are mathematical equations that are created to describe travel behavior. Models determine what factors affect a person's decision to travel, where they are going, what mode they will use and what path they will take, generally taken one step at a time. Historically, mode-choice models have relied solely on time and cost as determinants. This is starting to change as researchers have begun to look into physical and spatial variables as factors in mode choice.

A 1997 study by Robert Cervero and Kara Kockelman tried to quantify the effect of the built environment on mode choice by creating forecast models based on data from the San Francisco Bay Area. This study did not look specifically at walk to transit trips, but all trip-making decisions. In another study that same year, Loutzenheiser (1997) describes the attributes of those who walk to Bay Area Rapid Transit (BART) stations. Loutzenheiser (1997) compares urban design characteristics to individual and socioeconomic characteristics such as age, race and income. He claims that "walk distance and characteristics of the individual trip maker are primary determinants of the choice of BART access mode" (Loutzenheiser, 1997, p. 44) while when "controlling for individual characteristics, urban form plays a much more significant role in mode choice." (Loutzenheiser, 1997, p. 47) These statements are supported by Cervero and Kockelman (1997) who includes individual characteristics in his base models. It is important to point this out as it shows the difficulty of relying solely on land use changes to increase walk access to transit. A second paper by Cervero (2001) looked specifically at two data sets describing walk access to transit. These case studies were conducted near BART stations and suburban Maryland stations of the Washington Metrorail. The following will combine information from these three studies that have tried to quantify attributes of transit access mode choice decisions and prioritize these factors.

Physical design factors have traditionally been broken into three categories, coined by Peter Calthorpe as the 3D's, density, diversity and design. Density and diversity have been heavily scrutinized for their effects on transit ridership while design's affect on mode choice has been more difficult to measure. Non-physical characteristics were also found to have substantial impacts on travel behavior.

Distance

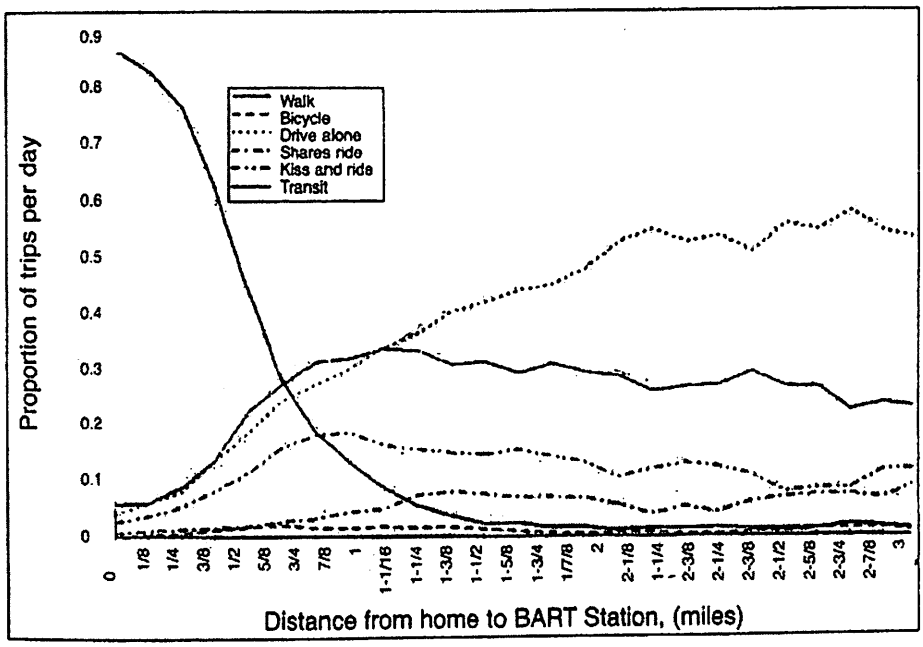

Figure 1. Distribution of means of access as a function of distance to BART station for journeys-to-work: 0- to 3-mile distance, derived for all BART stations

Figure 1: Cervero (2001)

Distance is one of the most important factors in determining what mode people will choose. Both Cervero (2001) and MGP Stringham (1982) have looked at mode choice to transit based on relative distance from the station. Figure 1 shows the mode share vs. access distance from the Cervero (2001) study. In both analysis, walk trips dominate trips of less than 0.6 miles and drop off significantly after that. Stringham (1982) shows walk trips petering out to zero at around 0.7 miles while Cervero (2001) finds that 10% of trips of 1.0 mile trips to transit are walked and only about 1% are willing to walk 1.5 miles. Traditionally 0.5 miles is given as the distance people are willing to walk. Loutzenheiser (1997, p. 43) study found though, that people are not very adept at perceiving walking distances. There was actually a negative correlation between perceived walking distance and straight line trip distances, which implies that if perceived distances can be affected through design, people would walk farther to access transit.

Bus transit becomes the dominant mode choice for trips from .6 to 1.0 miles. Cervero (2001) shows that bus garners 30% of these trips while Stringham (1987) had a more optimistic 80% of trips of this length being by bus. It is possible that Stringham's study, which sampled people in Edmonton and Toronto, used systems with more developed feeder systems or less available parking than BART. Also, bus ridership went into a steep decline during the 80's possibly accounting for lower bus ridership levels in the Cervero (2001) study.

After 1.0 mile, driving alone becomes the dominant mode share. Kiss & ride and shared ride make up 20% of longer trips to transit. Bicycle to transit shares are low at all levels but appear to peak at the 5/8^{ths} of a mile level. Trips between 3/8ths to 2 miles seemed to make up the majority of bike trips. This distance encompasses a greater range than walking and should be encouraged as a way to extend the catchment area of the station.

Transit Service

Transit service (bus) frequency and coverage, was generally as or more significant than the built environment factors in affecting mode choice and VMT. (Cervero and Kockelman, 1997) Having bus service between the home and rail station, decreases the number of people walking to the station, but increases the number of people accessing rail by non-SOV modes. Bus and walking can be seen as competing modes for transit access although as discussed earlier, people generally choose to walk if the distance is short and use the bus when the trip is longer. One way that a transit agency could improve the percent of people taking the bus to rail transit is to encourage seamless transfers between modes. Cordelia Crockett discusses transfer improvement techniques. Design specific transfer improvements will be explored further. Improving bus service or pedestrian amenities may sway access from one mode to the other. Improving both increases the access to transit trip for more rail users in addition to improving overall mobility within the neighborhood.

Parking

The amount of parking available was found to increase the number of people driving to the station. (Loutzenheiser, 1997; Cervero, 2001) Parking spaces at transit stations not only make driving to the station easier, but they often reduce the quality of accessing transit by other modes. A station surrounded by parking creates a sea of cars that must be navigated, often with little infrastructure provided for pedestrians or cyclists to reach the station. This parking creates unusable dead space and increases the distance for pedestrians and cyclists between their origin and the station.

Density

Two 1990 studies concluded that doubling residential densities reduced personal vehicle travel by 20-30 percent.[1] Loutzenheiser found density to be the most significant station area variable significant factor and Cervero and Kockelman (1997) found density to be significant when comparing SOV travel to other modes. The 2001 Cervero study disaggregated density into residential density and employment density and found that although density at both ends of the trip is important, residential densities played a larger role in getting people to walk to transit. Denser communities put more people into a smaller space, creating more possible connections within a smaller area. Density supports non-motorized trips by providing a larger population base from which to attract riders. More riders can also instigate more frequent service, improving trip quality and encouraging more ridership. Dense neighborhoods make driving less appealing because more people are vying for limited street and parking resources, making driving more costly and inconvenient as there are.

Mixed Land Use

Mixing of land uses encourages transit use both in residential neighborhoods (Cervero, 2001) and also at employment centers (Cervero, 1989). Mixed land use and vertical mixed land use were both significant factors in determining mode choice. Mixed land use was found to be the most important design factor in determining if someone would use a non-SOV mode[2]. Stations surrounded by retail were found to attract the most pedestrians but just having an activity center within the neighborhood boosted the number of walking trips as well. (Loutzenheiser, 1997)

More diverse communities provide opportunities to take care of multiple needs within a single neighborhood as opposed to leaving the neighborhood (generally by car) to complete errands. Having retail, and service businesses mixed with offices and homes, presents the opportunity for trips to be made by foot or transit. In mixed neighborhoods, knowing that the supermarket is near the transit station allows people to link these trips that would otherwise need to be made by car if each land use was separated. Mixed uses at business centers make having a car at work unnecessary for daytime errands such as working out, visiting the doctor and having lunch out. Many people claim that they drive to work in order to have the ability to chain trips together. The CTA passenger amenity survey found that only 15% of commute trips actually included an additional stop. Of these stops, the majority were for personal or household business and 19% were

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[1] Harvey, G. *Relation of Residential Density to VMT per Resident.* Oakland: Metropolitan Transportation Commission. Holtzclaw, J. "Manhattanization versus Sprawl. How Density Impacts Auto Use Comparing Five Bay Area Communities." Proceedings of the Eleventh International Pedestrian Conference. Boulder, Colorado: City of Boulder, pp. 99-106. –Don't have original sources, cited through Cervero, Robert. Transit-Supportive Development in the United States: Experiences and Prospects. Berkeley: National Transit Access Center, March 1994. Pp. 18.

[2] Having a driver's license was the most influential factor overall. (Cervero, Kockelman, 1997).

to pick up or drop off children at day care or school (CTA, 2001). Having amenities around the station provides people with the comfort of knowing they can run errands and still use transit.

Household

Household characteristics were found to be extremely significant in transit access mode choice, in many cases taking precedence over design characteristics The number of private vehicles per household and whether the person had a driver's license were more significant than the built environment factors in affecting mode choice and VMT. Personal business trips were more likely to be made by a non-personal vehicle mode than other trips such as shopping because one is less likely to carry purchases with them. (Cervero and Kockelman, 1997)

Loutzenheiser (1997, p 43) found, "walk distance and the characteristics of the individual trip maker are the primary determinants of the choice of BART access mode." People who walk to stations have a predisposition to do so based on gender, ethnicity and income. Loutzenheiser found that men were more likely to walk to transit than women, possibly due to concerns for personal safety. Ethnicity was also found to play a role in access mode choice. Loutzenheiser found that Blacks and Asians were less likely to walk to transit, with Asians preferring to take transit and Blacks to drive to the station. It is possible that some of this ethnic variation is due to ethnic concentrations living near stations with particular neighborhood designs or concerns. The study also found that transit riders over age 65 were less likely to walk than use another access mode. This may be due to decreased physical mobility of this age group. No significant variation was found in other age categories. When other factors were controlled for, income had a negative correlation to walking to transit.

While it appears that personal and household characteristics can make a difference in how a person reaches transit, some of these findings could be changed through physical form. If security were really the cause of fewer women walking to transit, then enhancing security surrounding stations would be beneficial. If ethnic variation is due to neighborhood characteristics, specific station areas could be targeted to better meet the needs of the surrounding communities. Ethnic advertising campaigns, although not design oriented, may also be a tool to promote alternative access to transit in these communities.

Physical

General

The 1997 Cervero and Kockelman survey incorporated sidewalk provisions, street light provisions, block length, planted strips, lighting distance and flat terrain into a walking quality factor was created to condense the analysis. Combined, these factors (listing in descending importance by factor loading)

explained 18% of the variation in mode choice. (Cervero and Kockelman, 1997, p 210) The likelihood using a mode other than a personal motorized vehicle (transit and non-motorized) was strongly affected by the walking quality factor and somewhat by the intensity factor. The walking quality component was found to be moderately influential in having people choose non-single occupancy vehicles for non-work trips. (Cervero and Kockelman, 1997) These factors aggregate physical design features in attempt to actually measure travel behavior relating to design and were able to correlate behavior changes to variation in urban design.

Street Layout

Street layout was one design element that was investigated. 'Four-way intersections' (Figure 2: Intersection Layout) were found to significantly reduce the number of vehicle miles traveled for non-work trips and increase non-single occupant vehicle (SOV)[3] trips in Cervero's 1997 study and in the Montgomery County case study in his 2001 report. This makes sense as 4-way intersections allow access to the most directions, making routes shorter and more direct, which encourages walking. 4-way intersections give higher degrees of decision-making to the traveler, making it more convenient to drop people off or make additional stops in shorter distances.

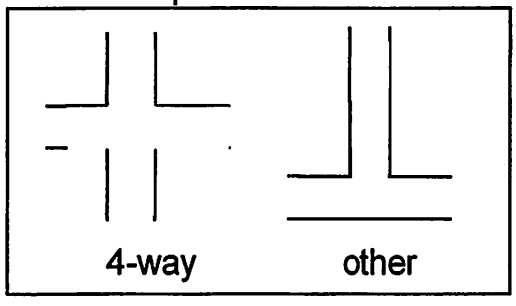

Figure 2: Intersection Layout

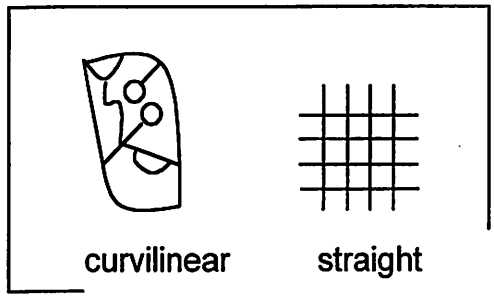

Figure 3: Street Grid

Straight sides on blocks were surprisingly found to increase vehicle trips. (Cervero and Kockelman, 1997, Loutzenheiser, 1997) It has been thought that straight-sided blocks shorten walking distances, which would encourage pedestrian travel and decrease vehicle trips. Although straight-sided blocks may improve pedestrian travel, they simplify vehicle travel as well.

The proportion of and proximity to arterial streets and highways is found to reduce walking (Cervero, 2001, Loutzenheiser, 1997). These auto-focused corridors make driving trips more attractive because they allow higher travel speeds. Higher vehicle speeds and longer and more dangerous street crossings discourage walking on these wide streets. In addition, many arterial streets are designed for cars with no pedestrian-oriented lighting, harsh pedestrian environments with unkempt sidewalks, and no amenities such as benches, shade or pleasant sightlines.

[3] Non-SOV trips include ride-sharing (in a private vehicle), transit and non-motorized travel.

Both front- and side-lot parking had a significant negative affect on non-SOV travel. Sidewalk width had a small but measurable influence on a person's decision not to take a personal motorized vehicle. (Cervero and Kockelman, 1997) In the Maryland case, sidewalks improved the likelihood that a person would walk to or from the transit station.

Stations located in freeway medians averaged 7% fewer trips than those at non-median stations. (Cervero, 2001) Freeway medians are considered very unpleasant places to walk. Under elevated highways can be dark, making it difficult to see and colder. Bridges above at or below grade expressways leave people exposed to the elements since there is generally no protection from buildings or trees. Vibrations of the highway, noise, dirt and pollution associated with the automobile can make these areas unpleasant for walking. Retail opportunities and 'eyes on the street' are generally not found at median stations.

In Cervero's 2001 study, the most significant factors in a person's decision to walk to transit include distance from the station, density, mixed land-use, parking availability, transit service level and station setting. Station area design has shown to have a minor affect on transit-access mode decisions, although the cost and availability of parking, distance from station, personal/household traits, density, mixed use all carry more weight. The characteristics that affect the decision to walk to transit are summarized in descending order of importance below.

Factors affecting decision to walk to transit:

- Land use – *Retail at station and residential surrounding is most effective for increasing walking, followed by mixed land uses.*
- Walking distance – *Shorter distances lead to more walking.*
- Vehicles per person – *Fewer vehicles lead more walking.*
- Parking availability – *Fewer spaces lead to more walking.*
- Street width – *Wider streets with more lanes lead to less walking.*
- Density – *Higher densities lead to more walking.*
- Transit level of service – *Increased local transit leads to less walking but more bus access to transit.*
- Employment density and accessibility - *More jobs near transit lead to more walking from home to the station.*
- Sidewalk ratio – *Higher percentages of streets with sidewalks lead to more walking.*
- Grain of street network – *The smaller, more numerous blocks lead to more walking.*
- Proximity to freeway – *The closer a freeway, the less likely a person is to walk.*
- Freeway median station – *Fewer people walk to stations in freeway medians.*

Both density and design have been quantitatively proven increase non-car trips. Design, the third D, is much more qualitative in nature although some studies have been done on this subject. Cervero and Kockleman (1997) showed that physical environmental factors are marginally important for mode choice. These factors are more important in non-work trips than in work trips. Of these, mixed land use and density are the most important features for encouraging non-

personal vehicle trips. Being able to take direct routes and a lack of parking are important for encouraging people to leave their car at home. Walking quality, especially providing sidewalks and lighted walks, can affect people's mode choice although pedestrian amenities are weak incentives for actually convincing people to leave their car at home.

It is possible, as Cervero (1994, p. 220) concludes that "such micro-elements seem to be too "micro" to exert any fundamental influences on travel behavior. It was seen that non-work trips were more susceptible to design characteristics. Attracting these less scheduled trips may serve a transit agency well as they encourage ridership during off-peak periods when the system is underutilized.

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Making the Changes Happen: Current Institutional Coordination and Funding with Regards to Station Area Improvements

Once decisions have been made as to what design features are desired around a transit station, the process of transforming that space needs to begin. Two factors are responsible for moving a project from the drawing board to reality. The first obstacle is to determine who is responsible for the changes that need to occur.

The design elements important to accessing a transit station are under the jurisdiction of many agencies and not just the transit agency. The city transportation and engineering groups may work with the state DOT in control of the streets, sidewalks and signals. Redevelopment authorities, aldermen, private landowners and community members have a vested interest in making sure the area is safe and vibrant. The transit agency also has a interest in encouraging a vibrant community and safe and smooth access to the station, encouraging a higher level of transit use. These stakeholders may work in a coordinated fashion to work towards a safe, cohesive neighborhood[1], or acencies may work hapazardly, taking an inwardly focused view looking at their projects in isolation of other projects or goals for the neighborhood. Historically, streetscapes have not been dealt with as an entire unit, except when they were first designed. Street paving or sidewalk improvements generally occur when the materials crack or traffic flows change. Traffic lights and pedestrian improvements are made when an accident has occurred. Any additional improvements may happen be part of a citywide program such as a street lighting project or as a special project such as plantings or benches when funds become available. Some of these projects are currently underway in Chicago. This may be due in part, to different agencies focusing on their own projects in an isolated fashion.

Currently, the CTA does not take a proactive role in improving the physical amenities of those accessing transit. Unofficial contacts with the Chicago Department of Transportation (CDOT) and IDOT and the Planning Department provide opportunity for the CTA to provide input on projects that are brought to their attention. Relationships between agencies are forged on a piecemeal basis, through personal contacts and occasional outreach efforts. Below is a description of some of the projects that focus attention on stration area improvements. Interagency relationships on these projects are described to give a sense what type of coordination occurs.

Transit Stations/Stops
Ownership and maintenance of CTA rail facilities is shared between the Chicago Transit Authority and CDOT. Station ownership is based on historic factors

[1] A BID is one organizational type that might want to be explored.

leading to different lines having different ownership. Where the City constructs and owns a facility, an Operations and Maintenance agreement transfers ongoing regular maintenance and operations responsibilities to the CTA. Historically, the CTA has had to defer needed maintenance due to under funding. The current capital budget has provided funding for the CTA to make many long-needed improvements. While the CTA has undertaken an aggressive rehabilitation program, this work has focused on the stations themselves and rarely looks beyond the station entrance. Although the station itself is an important feature in people's transit experience, accessing the train begins beyond the front door of the station. Improving conditions that one faces while accessing the station is an important part of insuring that transit is a viable alternative to driving.

An example of the complexity of CTA/city interactions is the purchase of street furniture by the city. The city is in the process of contracting with JCDecaux for street amenities that will include 2000 bus shelters. One half of these shelters will be replacement shelters for current shelters. The other 1000 will be new bus shelter placements. *Bus shelter location decisions were given to each alderman to decide where in their district the shelters would be most useful. Their decision making process was/was not made with consultation from the CTA. The CTA is currently working on a bus stop reduction program and is eliminating or moving a number of stops. The city needs to coordinate the shelter program to insure that they are not replacing shelters at stops that will be eliminated or moved. In addition, the CTA can provide information as to what bus routes and/or stops are the most heavily used and should therefore have a higher priority for receiving a shelter.*

Streetscapes

Chicago has recently expanded its neighborhood center street improvement program, also known as its streetscaping program. Janet Attarian runs the program within CDOT's Bureau of Transit and Bridges. Community members, including aldermen and business associations can request a streetscaping project for a neigbhorhood's commercial center. The projects average 6 blocks but can be up to 16 blocks long. CDOT then assists the neighbhorhood in determining a design, which generally includes a public process. Ms. Attarian is currently working on a design palette with different options for different basic design elements that each neighborhood can choose. For example, there may be 3 to 6 types of trash receptacles, including traditional and contemporary choices. This will simplify requisition and maintenance of these amenities while allowing neighborhood character to blossom. This program requires the neighborhood to secure funding for the project.

Without talking to anyone actually at IDOT, my understanding of IDOT relationship to CTA stations is that the city owns the stations along the IDOT controlled expressways although the CTA does the maintenance. The bridges over the expressways are owned by IDOT and maintained by the city. (But

financed by IDOT.) IDOT follows the AASHTO (or other Federal standards) when designing and constructing their facilities. They do not provide funding beyond the minimum standards, which include chain link fencing and street lighting that focuses on the roadway instead of the sidewalk. Different opinions have been given on the flexibility of IDOT to approve variations from the design standards. If IDOT were to give design approval, non-IDOT funding would be required to pay for it. There is currently some coordination between CTA, CDOT/DPD and IDOT, which is being overseen by Mary Kramer at the CTA.

Station Area Development

One way to make station areas more comfortable is to insure that the development surrounding stations is not only adjacent to the station but also oriented to transit, not only physically, but in terms of use as well. Chicago is currently rewriting its zoning code for the first time since 1957. The CTA is following this zoning rewrite and has requested a transit zone be developed. Two different issues of concern to the transit agency need to be included; preserving potential and current transit corridors and requiring transit-oriented development. The details of this zoning designation have not been worked out and it is unclear how a single zoning designation might meet these two different needs. The CTA has kept up to date with the zoning reform process and has provided imput to the process but has no decision-making power. Local businesses or neighborhood groups may also be able to coordinate efforts to affect station area development and coordinate station area improvements.

Coordinating different improvement projects can lead to cost savings and a "complete" change for the area being renovated, creating a more dramatic impact on the neigbhorhood. In order to do this, different agencies need to communicate and coordinate their work plan capital improvement projects. Although each agency may have different projects at the top of their lists, if other agencies are working in areas where an agency may have interest in doing a project down the line, it may be worth bringing it up on the priority list. If one organization, the alderman, a neighborhood chamber of commerce, the CTA or city planning or transportation department were willing to be the overseer of community change/planning, a more holistic effort could allow a multiplier effect on single improvement projects.

Puerto Rico

Until the present, transportation modes other than driving were ignored. Pedestrian infrastructure was designed to minimum standards[2] and then encroached upon even further. Utility poles block the sidewalk where cars have not turned it into additional parking space or landowners have not enveloped it into their private property. The current pedestrian fabric is torn and of poor quality. If walking is to be seen as a viable mode for accessing transit, streetscape improvements will need to be made. Bicycle transportation is not

[2]Generally a 1-meter sidewalk and a 1-meter buffer.

currently seen as an alternative due to the lack of bicycle infrastructure (roadspace and storage facilities) and the Puerto Rican heat.

Although the current pedestrian fabric is poor, there is some hope for the future. Puerto Rico recognizes that the pedestrian network needs to be improved and has set up a centralized way of dealing with them. Streetscape improvements are organized very differently in Puerto Rico. The Highway and Transit Authority (HTA) is in charge of building and maintaining roads, while Tren Urbano, currently a non-entity under HTA auspicies, is providing expertise in pedestrian design. The Planning Board is a "statewide" agency that designs comprehensive plans and approves building permits. The "Ordinacion Terretoriales" or the Territory Ordinance Plan was designed to give more planning autonomy to those cities that have shown that they have the capacity to do their own planning. (or have the political support to approve them anyway.) There are currently 4 cities in Puerto Rico that have obtained autonomy. Bayamon is the only city within the Tren Urbano alignment. San Juan is currently in the 4th of 5 stages and is expected to get autonomy within the next year. Regardless, ??? legislation, gives the 500 meter radius surrounding transit stations special status as transit accessible districts with regional importance. This means that even in autonomous cities, the 500 meters surrounding transit stations are under the control of the regional planning board.

Luis Garcia, an associate member of the Planning Board described their proposal for insuring a better development surrounding the station. The Planning Board proposes to deal with land within the 500-meter radius transit zones with a 2-pronged approach. The Puerto Rican government owns a great deal of land. The Board proposes working directly with other agencies to negotiate good transit-oriented design of these properties. It is unclear as to how effective this negotiation tactic will be. Negotiations failed to affect the construction of a state insurance building near the Martinez Nadal station.

Within the next few months, the Planning Board will develop a transit overlay district to be applied to private property within the transit zone. Some of the features that will be included are additional height allowances (possibly through transfer of development rights), requiring or suggesting mixed use, maximum parking allowances and possibly some design guidelines.

Some specific streetscape improvements are coverend by the Tren Urbano contract, while others within the the 400 meter station area have been gtaken over by others or have been noted for future improvement contracts. HTA is responsible for this program but has given responsibility for it to the Tren Urbano design team let by Elmo Ortiz and Javier Mirandes. Various important arteries have been designated for streetscape improvements in the Key Pedestrian Corridors plan. The Tren Urbano staff created detailed plans for streetscaping around the Martinez Nadal station. This design is expected to be a prototype for consultants who will design the streetscape improvement plans for the other

stations. HTA will then take over construction management of these projects. It will be important that a design-focused inspector be associated with the project to insure that the renovations actually contain the design features. This was a problem in the station construction process as many design features get lost between the architectural drawings and the engineering drawings used for construction.

Even before a project can get off the ground, funds need to be procured for implementing improvements. In Chicago, CDOT has been able to obtain CMAQ (Congestion Management/Air Quality) funding for their station renovation projects. Although further CMAQ funding is in question, it was unofficially decided that CDOT, as opposed to CTA would chase after that funding.

Puerto Rico has included funding for streetscape improvements in the contract to build Tren Urbano. X% of projects funds will be spent on improvements. It is unclear how large of a dent these funds will make in the auto-dominated design of the city.

Other Funding Programs

Other regions are looking to provide funds for encouraging non-automobile transportation through development and redesign projects near transit. These projects, both run by Metropolitan Planning Organizations (MPOs), provide funding that encourages, multiple stakeholders to work together to create transit friendly urban space. They have used the funding as an incentive to cooridinate planning and create buy-in for projects.

The San Francisco Bay Area's MPO, the Metropolitan Transportation Commission (MTC) and the Atlanta Regional Commission, Atlanta's MPO both have innovative programs designed to encourage transit oriented growth by directing Federal funds towards transportation projects that are part of smarth growth initiatives.

MTC's project, Transportation for Livable Communities, (TLC) is a unique program that provides funds for planning and capital projects that support non-automobile travel. The program which started in 1998 has provided $46 million for 107 projects and will make $27 million per year available until TEA-21 (Transportation Equity Act for the 21st Century) expires in 2004. Of the $9 million annually that comes from the Federal Government, $5 million comes from the Congestion Mitigation and Air Quality Program (CMAQ) and $4 million from the Transportation Enhancements Program. TLC is broken into two projects, the Neighborhood Capital and Planning Grant Program and the new Housing Incentive Program.

The Neighborhood Program is broken down into two areas, with $475,000 available for planning projects and $9 million available for capital improvements.

Both programs are designed to encourage transit-oriented development, sidewalk improvements, bicycle amenities and other transportation facilities that encourage non-auto travel. Capital funds must be used for transportation improvements such as those mentioned above although the project itself may have a broader scope. The programs are geared toward cities, transit agencies and non-profit organizations and encourage projects to work with community groups. A sample project is the Ed Roberts Campus, which has received two $50,000 planning grants from MTC and matching funds from the City of Berkeley and BART[3]. The project will convert the east side of the Ashby BART station into a community center designed to meet the needs of the disabled population. The first of the grants was used to do an initial plan including design guidelines, a financial plan and initial outreach to the community. The second grant focused on traffic flow patterns on the site.

The second program is a new initiative based on a San Mateo County project called the Housing Incentive Program (HIP). HIP funds are used to encourage the development of high density housing near transit. This program funds transportation improvements similar to those in the Neighborhood Program but requires has more focused requirements, which are seen below.

- Housing projects must be in their planning stages as the goal of the funds is to convince cities and expedite the approval process for projects that may otherwise be denied or highly contested.
- Projects must be within a 1/3-mile walk from transit which provides a maximum of 15-min headway during the peak periods. Transit services include rail, bus or ferry service.
- Funding is given based on the number of bedrooms developed and the density of the projects
    - 25 units per acre → $1,000 per bedroom
    - 40 units per acre → $1,500 per bedroom
    - 60 units per acre → $2,000 per bedroom

  An additional $500 per bedroom is given for all affordable units.
- An ADA accessible pedestrian path must exist between the housing development and the transit station.

The first year of this program was a huge success and can now provide valuable insight on organizing this type of project. The program received 16 applications and found that $15 million of the requests were eligible for funding. The available $9 million was distributed proportionately to the amount requested to all eligible projects leading to the creation of over 5,000 market rate bedrooms and 2,000 affordable bedrooms. An important lesson that emerge from first year is the complexity of developers working with cities, and funders make meeting an annual deadline difficult. A rolling application process would probably work better

[3] http://www.mtc.ca.gov/projects/livable_communities/tlc_grants.htm

for this type of project. The interest in the project has encouraged more money to be put towards these kinds of projects in the future.

As a part of the 1999 Regional Transportation Plan, the Atlanta Regional Commission wanted to focus policies to encourage investment in existing town and activity centers within their region. The Livable Centers Initiative (LCI) was set up to focus federal transportation funds[4] to support the development of these centers. The program provides $1 million annually from 2000-2004 for planning studies and $350 million for transportation projects. The goals of LCI are to encourage mixed land use projects, multi-modal transportation access and an inclusive planning outreach. Eligibility requirements allow local governments and non-profits to receive funding as long as they have qualified local government status, a program that requires cities to meet minimum planning standards for their communities. NGOs need to show approval from the local government for the project. 20% matching funds are also required. As of April 2002, 35 studies had been completed; 28 spearheaded by local government and seven by NGOs. In addition to providing funding, LCI organizes quarterly meetings which allows projects to confer on the process and issues that they are dealing with. A developer's fair is set up to give exposure to the LCI projects and coordination with housing programs have been organized by the Partnership for Regional Livability to combine transportation projects with other urban issues. Professional assistance access to SMARTRAQ Modeling software are made available to participating organizations.

Both the San Francisco and Atlanta programs are focused on the idea of creating partnerships between cities, the surrounding communities and developers. By encouraging organizations to work together, they create incentives for comprehensive planning of an area. Even more importantly these MPOs have chosen to focus on the multi-modal integration of development and urban infrastructure. Chicago and San Juan could also make the decision to focus federal funding on these types of projects.

Italicized portion is not corroborated. This information needs to be double checked with Linda Fuller.

[4] STP 33 (C) funds encompass the bulk of the funding.