

Factors Influencing Land Development around Rail Transit Stations

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ABSTRACT

Rail rapid transit systems built in the past three decades represent investments in a mode of transportation that nearly all other political, economic, institutional, and regulatory forces have been aligned to defeat. However, it is possible to re-orient metropolitan area development in a manner which will take advantage of the travel efficiencies afforded by rail rapid transit. This thesis examines the factors which have influenced development at over 55 transit stations built in the last 30 years in the Atlanta, Boston, Miami, Toronto, and Washington metropolitan areas.

This research classifies station areas based on "topologies," the intensity of auto- or pedestrian-oriented development, and similar station areas are examined in terms of their development state both prior to station construction and at present. Station areas which exhibit "special" characteristics, such as "new town" development, urban renewal activity, or proximity to a major institution, are also examined. This analysis provides significant implications for planning and development of new rail transit facilities. On a system-wide level, transit network design and station siting must consider the relationship between land use in station areas and their trip generating behavior. Regional intermodal transportation strategies and policies must be coordinated on an institutional level so that highway, transit, and land use plans may also complement one another, and not undercut each other's effectiveness. Citizen input and individual station design play crucial roles in facilitating or precluding potential area development. Although transit access may catalyze land development in a growing district, a new rail station alone is not enough to reverse poor station area economic and land development trends. In this case, a coordinated suite of supporting incentives and regulations must be employed to increase development opportunities.

Comprehensive plans form the basis for implementing other strategies and tools. Effective methods for encouraging transit oriented development include: permitting construction on transit facility air rights, utilizing urban renewal and public land assemblage powers; directing public facility investment into station areas; offering tax incentives to developers; designing for pedestrian access and circulation; reducing the parking supply; and implementing travel demand management programs. Experiences in the five case study cities indicate that low and medium intensity mixed-use station areas are the most likely to be able to be transformed into high intensity districts, while residential neighborhoods are least likely to foster intensification. However, it is important to note that each station has many idiosyncracies, which severely handicaps attempts to draw broad-based conclusions.

The Lessons and implications of this research are applied to the case of the proposed Tren Urbano rail system in San Juan. Puerto Rico. Specific Recommendations are made for development strategies at each off the fifteen proposed stations in the system.

Keywords: Land Use; Station Area Development; Transit-Oriented Development; Mixed-Use Development

Introduction

North American transit agencies, planning boards, and community groups have taken many approaches to encourage certain patterns of development around rail transit stations. By analyzing their goals, actions, and results, a useful guide to the relative effectiveness of alternate development plans, and the public and private actions necessary to realize these plans, has been developed. Factors such as intergovernmental coordination, the political and economic environments at various levels, laws and other institutional issues, government agency intentions and results, community desires and participation, impacts of project funding requirements, development incentives and disincentives, and idiosyncracies of particular localities and types of land uses have been considered. A particular focus of the research is models of development that may be applicable to various proposed station site in San Juan's Tren Urbano projects, although the results are extensible to similar transit projects in other locations.

Goals of this thesis

In spite of the auto-oriented transportation environment of the past thirty years, land development around several recently-constructed transit stations provides many lessons for future station area developments. The environs of most transit stations has been dictated largely by local and regional political and institutional factors—zoning, economic incentives, community participation—and there are many diverse examples of development patterns to be analyzed. Although transit-supportive land use and urban design in its area will solve all of our urban transportation ailments, the success of the Tren Urbano project depends in large measure on the quality of land development surrounding each of its stations. project to examine the patterns of land development Lessons learned from station-area development near existing rail transit stations can serve as a guide for encouraging similar outcomes near Tren Urbano stations.

Methodology: Land Use and Special Attribute Typologies

Land use “typologies,” characterizing rail stations in terms of development intensity and accessibility, form a framework for comparison and analysis. This research includes station-area developments from the Boston, Toronto, Washington, Montreal, Atlanta, and Miami rail transit systems. The 60 stations selected represent a diversity of station functions, and have undergone different degrees of redevelopment before and after the stations were opened. In addition, transit stations with special attributes, such as those near hospitals, universities, or other institutions, as well as stations serving “new towns” or urban redevelopment areas, are compared with other stations sharing that attribute.

The land use typologies used to categorize station areas both before and after station construction are detailed below. Table 2.4 shows the typological classifications for each of the stations analyzed.

Land Use Typologies for Station Area Development Analysis

Intensity-Based Classifications

- **Rural, Undeveloped, Low-Density Land:** Primarily agricultural, rural, or low-density single home neighborhoods. Features include residential densities of 3 units/acre or less and automobile-oriented design characteristics: cul-de-sacs, large setbacks, lack of sidewalks, etc.
- **Low Intensity Mixed Use:** Automobile-oriented, low-density development including office parks, shopping centers, stand-alone commercial properties, and light industry.
- **Medium Intensity Residential:** Most residential areas built prior to 1940. Characteristics include 5-10 units/acres, gridiron street patterns, small setbacks, on-street parking, and high pedestrian and transit accessibility.
- **Medium Intensity Mixed Use:** Includes prewar commercial centers and suburban “downtowns,” with good pedestrian and transit accessibility.

Table 2.4 Matrix for Evaluating Station Area Special Attributes

		Actual Post-Station Neighborhood Characteristics						
		Special Attributes						
		"New Town"	University Area	Medical Center	Urban Renewal Area	Park-n-Ride/ Transit Transfer Center		
Pre-Station Neighborhood Characteristics	General Attributes	Rural, Undeveloped, Low Intensity Residential (postwar conventional suburban)	Scarborough Center, TTC				Fairfax Cnty, WMATA MARTA end of line stations TTC end of line stations	
		Low Intensity Mixed-Use (parking lot oriented shopping, multi-family residential, & light industrial)	Jeff. Davis Corr., WMATA				Dadeland N&S, M-DTA Rockville Pk. Corr., WMATA New Carrollton, WMATA Wellington, MBTA	
		Medium Intensity Residential (prewar neighborhood)				Anacostia, WMATA	Anacostia, WMATA Quincy Adams, MBTA	
		Medium Intensity Mixed-Use (town center, prewar commercial, vacant industrial)		Van Ness-UDC, WMATA Virginia Sq-GMU, WMATA AUC Stations, MARTA Shaw-Howard U, WMATA Ruggles, MBTA	LMA, MBTA	Rhode Island Av., WMATA Shaw/U Street, WMATA Peachtree Corr., MARTA Ruggles, MBTA Northwest Miami Fruitvale, BART Green Line, CTA	Decatur, MARTA Quincy Center, MBTA Rhode Island Av., WMATA Vn Ns & Fish Hgt, WMATA Alewife, MBTA North Quincy, MBTA Bethesda, WMATA Ballston, WMATA North Avenue, MARTA Eglinton, TTC	
		Suburban High Intensity Mixed-Use (highrise, abundant parking, "edge city")			Med. Cntr, WMATA Med. Cntr, MARTA			
		Urban High Intensity Mixed-Use (highrise, limited parking)				Downtown Miami, M-DTA Downtown Atlanta, MARTA Back Bay/South End, MBTA		

- **Suburban High Intensity Mixed Use:** “Edge Cities,” with high-rise offices, millions of square feet of retail on large plots of generally contiguous land with adjacent surface parking.
- **Urban High Intensity Mixed-Use:** Development which conforms to the traditional notions of a downtown. They are often the traditional focal points of transit service, indeed an entire region’s transit system.

Special Neighborhood Attributes

- **New Town:** This category is reserved for large-scale station developments on large parcels of commonly-owned land developed under a master plan. The development is meant to function as a cohesive neighborhood when finished.
- **University Area:** Stations within walking distance of a university, which generate significant student and commuter ridership, are classified as such.
- **Medical Center:** Like universities, medical centers are major traffic generators, and thus receive special designation.
- **Urban Renewal Area:** These are areas experiencing severe economic and physical decline with potential for redevelopment.
- **Park-n-Ride/Transit Transfer Stations:** A station which serves as a modal interchange with automobiles, buses, or other transit vehicles.

The stations are applied to a matrix of pre-station neighborhood characteristics and post-station neighborhood characteristics. Analysis of the transformations in these stations reveals a number of tools and techniques for influencing development at these transit stations.

Observed Land Use Transformations

Table 3.1 summarizes the land use transformations observed in the case study areas after transit station construction. Most station areas did not see a dramatic change in density after transit station construction. More typically, growth occurred at the prevailing scale of development. In no case was there an example of an area de-intensifying. This type of transformation would be difficult to accomplish and unlikely in

Table 3.1 Likelihood of Successful Land Use Transformations

		Actual Post-Station Neighborhood Characteristics						
		General Attributes						
		Low Intensity Mixed-Use	Low Intensity Mixed-Use	Medium Intensity Residential	Medium Intensity Mixed-Use	Suburban High Intensity Mixed-Use	Urban High Intensity Mixed-Use	
Pre-Station Neighborhood Characteristics	General Attributes	Rural, Undeveloped, Low Intensity Residential	▲	▲	●	●	●	●
	Low Intensity Mixed-Use	▽	▲	●	●	▲	▲	
	Medium Intensity Residential	▽	▽	▲	●	●	●	
	Medium Intensity Mixed-Use	▽	▽	▽	▲	▲	▲	
	Suburban High Intensity Mixed-Use	▽	▽	▽	▽	▲	▲	
	Urban High Intensity Mixed-Use	▽	▽	▽	▽	▽	▲	

Legend: ▽ Unlikely ▲ Likely ● Possible

any environment, particularly in the high-value land surrounding transit stations. In addition, Low and Medium Density Residential areas are not likely to experience a dramatic shift toward high-intensity uses, given residents' vested interests in their neighborhoods.

The two classifications which show the greatest propensity for changing land attributes were Low and Medium-Density Mixed Use areas. Station areas which were initially of these types became either Suburban or Urban High-Intensity Mixed Use areas. Each of the newly-developed urban areas were developed according to a comprehensive plan, usually with a street grid of frequent cross-streets and plentiful pedestrian amenities. The Suburban High intensity districts did not have existing traditional street patterns and were not as likely to have followed a development plan.

Critique of Station Area Development Typology

The primary intention of this model is to be able to draw generalized conclusions about how political, institutional, and economic factors influence the nature of the change in land usage around recently constructed transit stations. By reducing the sensitivity of the analysis model to a small number of neighborhood features, it is possible that its value as an analytic tool has been compromised. Every individual case has so many idiosyncracies that it would be impossible to deduce any broadly applicable conclusions about similar stations, because none would exist under such a fine-grained analysis. A more effective typology would allow just enough detail to draw relevant conclusions without being encumbered by irrelevant nuances of individual station areas, but not so simplistic that the conclusions are meaningless or inapplicable. While the model used in this analysis is neat, concise, and easy to understand, categorizing individual stations and recording changes in land use classifications required significant qualitative judgments by the author, adding further uncertainty to the trends observed.

Lessons and Techniques for Station Area Development

For a rail transit system to realize its potential, the system's planners must remain cognizant of the far-reaching impact of transportation on urban activity. Spatial

relationships between jobs, housing, recreation, shopping, and institutions have a direct bearing on the urban quality of life as well as decisions about travel modes. These relationships may be publicly regulated and ought to conform to a regional vision for the area. Planners, citizens, and community leaders must determine what trips can occur on which modes, and plan the transportation infrastructure and future land development to reflect those choices. Such macroscopic decision making and policy coordination has a profound impact on the effectiveness of any transit system.

Nonetheless, there are general techniques for encouraging transit-oriented design in station areas at a microscopic, that is, individual station level. These are explained below:

Microscopic Techniques for Influencing Station Area Development

- **Comprehensive Plan for Station Area Development:** Many governments have utilized a comprehensive plan to guide all aspects of land development, zoning, and urban design in a station area. A comprehensive master plan insures that a station area will develop in a pre-prescribed manner, usually with excellent pedestrian and transit access.
- **Increased Densities Required:** Because low densities cannot take advantage of the high degree of accessibility provided by a rail transit station, minimum densities are often stipulated for station areas. This increases the number of destinations within walking distance of the station, thereby encouraging use of the system.
- **Increased Densities Permitted (bonus or by right):** A more incentive-driven way of encouraging higher densities is to offer developers bonuses if they design their projects at a higher-than-normal density. Similarly, a city might choose to allow higher densities, but not required them, in its zoning code.
- **Mixed-Use Development Required or Encouraged:** Mixed-use development promotes "trip-chaining," the combination of many tasks into one trip. Mixing office, retail, and residential development ensures that a variety of destination types are easily accessible by transit. Like density guidelines, mixed-use development may be either encouraged or required.

- **Pedestrian and Transit Amenities Required:** Because transit trips begin and end as pedestrian trips, it is important to design station areas with a safe and pleasant pedestrian environment. This will make access to the transit station easier, and will encourage walking trips to nearby shops, offices, and residents. Similarly, transit transfer areas should provide weatherproof shelter, adequate lighting and security, and a pleasant waiting environment.
- **Reduced Parking Required:** This technique is most effective around large institutions and offices, less effective around retail development. Reduced parking compensates for the expected decrease in automobile usage due to the presence of transit. Decreased surface lot area also increases the pedestrian-friendliness of station area.
- **Air Rights Development:** Allowing construction over transit stations or rights-of-way increases the density of the station area, thereby increasing the number of destinations accessible by transit. In addition, air-rights development may prove to be a non-farebox revenue source for the transit agency.
- **Public Assemblage of Land:** The public sector can encourage planned station area development by assembling individual parcels of land for a developer, decreasing the complexity and risk of the development.
- **Active Public Strategy to Encourage a Particular Land Use:** By locating a major public facility in a station area or offering incentives for developers to construct a major "anchor" project, a government may promote any number of goals: economic development, creation of a community focal point, etc.

Implications for Tren Urbano

Explosive auto-oriented urban growth in the postwar era has proceeded hand-in-hand with public transit's decline in San Juan, making it one of the most automobile-dependent cities in North America in spite of its high densities and modest incomes. Tren Urbano could be the catalyst for a shift in travel behavior in the high density corridors which the system serves. It may also encourage new development within the Tren Urbano corridor to assume a more pedestrian and transit-accessible form.

Many of the case studies from other North American cities are appropriate to the varied station areas along the Tren Urbano alignment. Table 4.1 classifies Tren Urbano stations according to their post-station development potential. The primarily residential

Table 4.1 Matrix for Classifying Tren Urbano Station Areas and Development Potential/Goals

		Actual Post-Station Neighborhood Characteristics					
		General Attributes					
		Low Intensity Mixed-Use	Medium Intensity Residential	Medium Intensity Mixed-Use	Suburban High Intensity Mixed-Use	Urban High Intensity Mixed-Use	
Pre-Station Neighborhood Characteristics	General Attributes	Rural, Undeveloped, Low Intensity Residential (postwar conventional suburban)	Torrimar		Jardones de Caparra/ Río Bayamón		
	Low Intensity Mixed-Use (parking lot oriented shopping, multi-family residential, & light industrial)	Las Lomas San Alfonso De Diego Villa Nevarez					
	Medium Intensity Residential (prewar neighborhood)						
	Medium Intensity Mixed-Use (town center, prewar commercial, vacant industrial)			Río Piedras Bayamón Centro			
	Suburban High Intensity Mixed-Use (highrise, abundant parking, "edge city")					Hato Rey Consider Centro Médico	
	Urban High Intensity Mixed-Use (highrise, limited parking)					Santuce	

stations along the 65th Infantry Highway are likely to see little new development. However, increased pedestrian amenities should be provided, and resident should be encouraged to participate in the station planning process. The declining Bayamon and Rio Pedras town centers stand to regain a significant portion of their former economic significance, as they share potential for new development and will also serve as major transfer centers into the system. Significant real estate development can be expected to continue in the Hato Rey corridor, though its design should be geared more toward pedestrians and transit that is currently the case. Station areas with special significance, such as Centro Medico, the University of Puerto Rico, and a new town development at Bayamon will all benefit from the improved accessibility afforded by Tren Urbano.

Table 4.2 lists recommended strategies for influencing land development around the proposed Tren Urbano stations, based on the techniques used successfully for similar station area attributes in other cities. Many of the techniques utilized in other cities to promote quality transit-oriented development are applicable to the Tren Urbano case.

Presently, most of the technical design of the Tren Urbano system has been based on the beliefs, intuition, and experience of the decision makers. Ideas about how stations will work with existing neighborhoods or create new ones, and how the automobile, pedestrian, and transit modes will interact at various stations are still being developed. San Juan, then, is at a critical point in its transportation history, headed either toward automobile domination or a shift toward more multimodal access. The ultimate direction will depend on the decisions of public officials, actions of citizens, and the success of the design and operation of the transit system.

Directions for Further Research and Action

This research has exposed several related issues that warrant further study. The methodology used in this study may be developed further to suggest additional trends and properties which are correlated with various neighborhood development attributes. To perform such analyses, the factors defining the typologies in this study may be subjected to a more rigorous statistical analysis. By comparing travel behavior, development trends, and demographic characteristics on a microscopic level using local and census data,

**Table 4.2 Recommended Strategies for Influencing
Tren Urbano Station Area Development**

Post-Station General Attribute Station Area Station	Comprehensive Plan for Station Area Development	Increased Densities Required	Increased Densities Permitted (by "bonus")	Increased Densities Permitted (by "right")	Mixed-Use Development Required	Mixed-Use Development Encouraged	Pedestrian and Transit Amenities Required	Reduced Parking Required	Reduced Parking Permitted	Air Rights Development Permitted Over Station	Public Assemblage of Land for Development	Active Public Strategy to Market/ Encourage Particular Land Uses
<i>Low Intensity Mixed-Use</i>												
65th Infantry Corridor												
Torrinar	•			•	•	•	•	•	•	•		
Las Lomas	•			•	•	•	•	•	•	•		
San Alfonso	•			•	•	•	•	•	•	•	•	
De Diego	•			•	•	•	•	•	•	•	•	
Villa Nevarez	•			•	•	•	•	•	•	•	•	
<i>Medium Intensity Mixed-Use</i>												
Jardones de Caparra/												
Rio Bayamón	•	•		•	•	•	•	•	•	•	•	•
Río Piedras	•	•		•	•	•	•	•	•	•	•	•
Bayamón Centro	•			•	•	•	•	•	•	•	•	•
<i>Urban High Intensity Mixed-Use</i>												
Hato Rey Corridor												
Nuevo Centro	•	•	•	•	•	•	•	•	•	•	•	•
Hato Rey Centro	•	•	•	•	•	•	•	•	•	•	•	•
Centro Judicial	•	•	•	•	•	•	•	•	•	•	•	•
Centro Médico	•	•	•	•	•	•	•	•	•	•	•	•
<i>Urban High Intensity Mixed-Use</i>												
Sanurce												
Sagrado Corazón	•			•	•	•	•	•	•	•	•	•

this classification system may make clear useful factors and trends for advanced model building.

To achieve a "client" level of transit riders—a population which relies on transit by choice, not necessity—a critical mass of station area development must be achieved. Furthermore, complementary relationships exist between stations—land uses and traffic generated by one station influences the land use and traffic attracted to others (for example, the relationship between park-and-ride stations and central business districts). The notions of complementary land uses, critical masses, and client populations are vague and need further refinement. This may yield quantifiable measures about the transit/land use relationship.

Bibliography

Añas, Alex and Regina Armstrong. *Land Value and Transit Access: Modeling the Relationship in the New York Metropolitan Area*. Washington, D.C.: Urban Mass Transit Administration, U.S. Department of Transportation, September 1993.

This study examines the relationship between transit facilities and adjacent land markets. It concludes that the increase in real estate value makes it suitable for high-end residential development and sales tax-generating retail facilities. Lower income housing projects are more difficult to construct in station areas, because the price of land strains the resources of advocacy organizations, and municipalities are generally hostile toward resource-consuming residents who generate little tax revenue.

Bernick, Michael and Robert Cervero. *Transit Villages in the 21st Century*. New York: McGraw-Hill, 1996.

A very useful resource on the potential of transit-oriented development, published after the completion of this thesis. It contains a wealth of information about station-area development and more general discussion on the potential role of transit in the U.S. Several case studies from North America and Europe are examined.

Cervero, Robert. "Rail Transit and Joint Development: Land Market Impacts in Washington, D.C. and Atlanta." *Journal of the American Planning Association*, 60, No. 1, pp. 83-94, 1994.

This paper examines land developments spawned by the presence of urban rail transit systems. Cervero concludes that "...urban rail transit will significantly benefit land use and site rents only if a region's economy is growing and a number of supportive programs are in place, for example permissive zoning to allow higher densities, and infrastructure such as pedestrian and street improvements. Transit guides rather than causes growth, and by itself rarely effects significant land use changes."

Jackson, Kenneth T. *Crabgrass Frontier: The Suburbanization of the United States*. New York: Oxford University Press, 1985.

A classic documentary of the social, political, and cultural forces behind the suburbanization of the United States. Explains the emergence of the automobile as the predominant mode of transportation.

Landis, John, Robert Cervero and Peter Hall. *Transit Joint Development in the U.S.: An Inventory and Policy Assessment*. Unpublished Paper, 1991.

The authors examined 114 projects in over 20 cities, and found four conditions to be necessary for successful joint development: an active and healthy local real estate market; redevelopment agencies with an entrepreneurial bent; coordination among developers and public agencies; an understanding among public agencies that quality joint development has benefits beyond revenue generation (such as increased transit usage).

Research Summary prepared by Randy J. Knapick