JOB ACCESSIBILITY
IN THE SAN JUAN METROPOLITAN REGION (SJMR)

-- Maximizing the Benefits of Tren Urbano

[Executive Summary]

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A. RESEARCH OBJECTIVES

- To characterize the social benefits of public transportation, especially rail transit systems, in job accessibility provision.

- To analyze the distribution of the Tren Urbano benefits -- measured in terms of job accessibility enhancement -- among geographical locations and social groups in the SJMR.

- To examine the effects of supplementary transportation and land use policies on maximizing the benefits of Tren Urbano.

B. MOTIVATION

There is an ongoing debate on the effectiveness of rail transit systems. The proponents have a long list of the economic, social and environmental benefits of rail transit. The opponents, however, argue that the claimed benefits are mostly based on hopes and the ultimate gains do not justify the major expenditure of public funds. How to properly identify and measure these benefits has long been the central concern of decision-making regarding rail transit development.

The literature on rail transit benefit analysis has focused on the economic returns of transit projects, although public transportation investments are often made primarily in response to social and environmental concerns. Analyzing the accessibility effect of rail transit using Tren Urbano as a case study will contribute to our understanding of the social benefits of public transportation investments.

As listed in the Final Environmental Impact Analysis, one of the major objectives of the Tren Urbano project is to enhance access to employment opportunities in the Region. The experience of many US metropolitan areas has indicated that the outcomes of major transportation investments are greatly affected by a variety of local policies. It is important to identify what supplementary policies should be in place in order to achieve the project goals and to maximize the potential returns of the investment.

C. RESEARCH METHODOLOGY

Two sets of research questions are addressed. The analytical questions are: How will Tren Urbano affect job accessibility in the SJMR? More specifically, how to define and measure job accessibility? What are the existing patterns of job accessibility in the SJMR? How will job accessibility change as a result of Tren Urbano? What are the distribution effects of the accessibility change? The policy questions are: What strategies will help redistribute the benefits of rail transit toward more desirable social outcome?

What are the main factors affecting the job accessibility in the SJMR? How to maximize the benefits of Tren Urbano in terms of accessibility improvement?

A comparative study method in combining with simple simulations is used for this research. Comparisons of accessibility levels are made between Tren Urbano-Build and No-Build scenarios in 2010, and between 2010 Cases and 1990 Base Case. The unit of analysis is Traffic Analysis Zone (TAZ). Policy scenarios are simulated under several assumptions of transportation and land use policies.

The analysis is conducted in four steps. Step one reviews literature on rail transit benefit analysis and literature on accessibility models and applications. A Hansen-type accessibility model is chosen for our analysis. Step two computes job accessibility in the SJMR for the 1990 Base Case for the purposes of testing the selected accessibility model and setting a benchmark of accessibility level in the Region. Step three measures accessibility for the 2010 Tren Urbano Build and No-Build cases and examines the changes in job accessibility in the Region and for individual social groups. Finally, step four simulates various policy scenarios and analyzes the accessibility effects of these policies on redistributing and maximizing the benefits of Tren Urbano.

The main data sources are the San Juan Regional Transportation Plan (1993) and the US Census (1990). The data include:
(1) 1990 and 2010 trip generation and distribution, travel time matrices by modes and by trip purposes.
(2) 2010 forecasted population and job distributions at the TAZ level in the Region.
(3) 1990 demographic data.
(4) 1992 road networks and geographic boundary files (Census TIGER/Line Files).

ArcInfo/ArcView GIS (Geographic Information System) is the major tool for this analysis.

D. FINDINGS TO DATE AND IMPLICATIONS FOR THE SAN JUAN METROPOLITAN AREA

Findings from Literature Review

The literature on rail transit benefit analysis suggests the following general agreements: (1) Rail transit alone does not cause economic growth, although it supports and contributes to the local economy. Its positive impacts on land use are limited in scale and mainly concentrated in station areas; (2) The contribution of rail transit to the reduction of road congestion and air pollution is observable but often overshadowed by the overall increasing level of congestion and pollution; (3) There are direct benefits from building a rail transit system, for example, creating construction and operating jobs, although these benefits are not the main reasons for rail transit investment decision making; (4) One of the primary goals of transit investment is to obtain social benefits --

providing services to the transit-dependent population, which have not been well examined.

There is no unanimous definition of accessibility in the literature. Appropriate explanations mostly rely on the intended applications. Nevertheless, some degree of consensus exists at the operational level: Accessibility refers to, in a broad sense, the proximity from one point to a set of points with which there are attributes (e.g. opportunities) associated. Spatial separation constrains the number of opportunities available. People seek and compete for the opportunities. The constraints are characterized by some forms of functions of travel costs (time, distance, or monetary costs). In our study, accessibility is defined as *the ease to reach spatially separated opportunities using a particular transportation system.*

In practice, accessibility can be applied to: (1) summarize the structure of the built-environment; (2) serve as an input variable in travel demand modeling; and (3) evaluate system alternatives.

Findings from the 1990 Base Case Study

For the 1990 Base Case, job accessibility is measured for all transportation modes. The resulting accessibility pattern associated with each mode is analyzed in considering the features of the SJMR built environment and the service characteristics of each mode. Measured job accessibility results are also examined for five TAZ groups classified by the 1990 median household income -- High (>$12,500), Medium High ($10,000~$12,500); Medium ($7,500~$10,000); Medium Low ($5,000~$7,500); and Low (<$5,000). The main findings are:

- Measured accessibility patterns conform with our qualitative knowledge about the Region, suggesting that our chosen accessibility measure is applicable to this analysis.

- At the aggregate level, due to their location patterns, the lower income groups are in a relatively disadvantageous situation in terms of job access, compared with the higher income groups. There are needs for the lower income people to improve their accessibility to jobs in the Region.

- The provision of job accessibility by public transportation, especially those with fixed-guideways, is geographically constrained.

Findings from the 2010 Tren Urbano-Build and No-Build Case Studies

At the regional scale, the overall job accessibility of transit users is enhanced due to the introduction of Tren Urbano. The worst case is the 2010 Tren Urbano No-Build, with a much lower accessibility level even when the effect of job increase is included. At

a finer scale, all income groups are better off in the Tren Urbano-Build Case but worse off in the Tren Urbano-No-Build Case from the 1990 Base.

Geographically, the impact of Tren Urbano *alone* on job access is highly localized in the areas along the track alignment. Zones close to Tren Urbano experience the highest gain. Thus, integrating rail with other transportation modes is essential, not only for the interests of higher rail transit ridership, but also for geographically extending the benefit of Tren Urbano.

Among the social groups, the higher-income gains slightly more on average than the lower-income due to the location patterns of these groups. The result is based on the 1990 income classification and does not account for possible spatial re-distribution of income groups in the future. It indicates that, if the land use pattern (in terms of job and population distribution across the Region) remained unchanged from 1990 to 2010, the discrepancy in job accessibility via public transportation systems between higher and lower income groups would be likely to increase. To optimally redistribute the accessibility benefits of Tren Urbano among the social groups, land use policies become the key.

Policy Scenario Analysis Results

There are two basic approaches to improving job accessibility: mobility improvement and land use reconfiguration. With the mobility approach, three scenarios are analyzed. In each scenario, a ten-percent reduction in zonal travel time is assumed for one of the three transit modes.

With the land use approach, three strategies are studied. The first is to increase development intensity in station areas. The second is to encourage mixed land use. And the third is to improve the land configuration to make the areas more pedestrian friendly.

At the regional level, all else being equal, a ten percent reduction in zonal travel time by rail (i.e. Tren Urbano) has the greatest effect on improving job accessibility. The result of Publico service improvement is close to that of rail. On the other hand, a ten percent reduction in zonal bus travel time has little effect on the regional job accessibility.

For individual income groups, service improvements of rail and Publico result in different job accessibility changes. The discrepancy in accessibility level between the lower and higher income groups will reduce with Publico service improvement but increase with rail service improvement.

As expected, increasing residential density or job opportunities in station areas would all result in a higher level of regional job accessibility. Combining the two has even greater effect on job accessibility enhancement.

Conclusions and Policy Recommendations

- Challenges and Opportunities

The strongest message this analysis has delivered is that, without additional transportation and land use policies to support Tren Urbano, the benefits of the investment in this rapid transit system would be quite limited, both geographically and socially.

Two factors account for this potential undesirable outcome. First, public transportation, especially rail transit systems such as Tren Urbano, generally has fixed routes. Its provision of accessibility is therefore geographically constrained. Second, due to the historical land use patterns in the SJMR, mid- and higher- income groups as well as jobs are centrally located. Tren Urbano alignment goes to the central areas of the Region.

There are great opportunities for policy makers to intervene in order to maximize the benefits of Tren Urbano. From transportation planners' perspective, there are untapped potentials for further improving Publico services. From land use planners' perspective, there are nearly 1200 acres of vacant land near Tren Urbano (Phase I) stations, which are developable.

- Policy Recommendations

1. Develop high-flexibility transportation systems as complements to rapid rail transit. In the context of San Juan this means to pay particular attention to the Publico service improvement and/or, if necessary, to provide similar van services by public transportation agencies. The service should be well integrated with Tren Urbano in terms of coverage, route design, fare structure, physical connections, schedules, and other service features.
2. Encourage higher land development intensity in station areas. For residential development, a minimum gross density of 10 units per acre in station areas is highly recommended. For non-residential uses such as commercial and office buildings, higher FAR should be encouraged. Large surface parking surrounding stations, which is a common practice to accommodate the demand for park-and-ride, is an *undesirable* development pattern. Vertical parking facility should be provided when the demand for park-and-ride is high.
3. Promote mixed land use in station areas. Providing mixed land use activities in station area development is more effective than single uses in improving job accessibility. Attentions should be directed toward affordable housing and lower wage jobs in formulating station area land development plans so that lower income households have opportunities to relocate to areas with higher accessibility by public transit.
4. Create pedestrian-friendly station environments. This is largely the work of architects and urban designers. A pedestrian-friendly station environment helps improve the image of rail transit as a commuting mode. At the system-wide scale, a Walkability

Index (WI) can be used to evaluate the walking environment of station areas and provide inputs to architects and urban designers. A station with a value of 0.6 WI or higher can be considered pedestrian-friendly.

- Implications for the phasing strategies of Tren Urbano extensions

The analyses of the 2010 cases also shed lights on the phasing strategies of Tren Urbano extensions. Should joint development in station areas be the major concern, Phase II (extension to Carolina) would be the best choice because of the availability of large amount of vacant developable land (2,121 acres) close to the proposed stations. On the other hand, Phase III (extension to Old San Juan) would provide direct access to 6.1 percent of the jobs in the SJMR. It would also serve directly five percent of the Region's population plus tourist visiting the historical sites. Therefore, it would generate larger fare revenue. It is recommend that Phase III be considered as a priority among the three extension proposals.

- Directions for Future Studies

There are at least three areas that warrant further study. The first, analytically, is to examine the interactive relationship between Tren Urbano and land use activities. In this study, when examining the effects of land use strategies on regional job accessibility, we applied a simplified method to relocate workers or jobs. Ideally, the land market's response to Tren Urbano under various policy scenarios should be modeled in a more rigorous manner.

The second, methodologically, is to improve the accessibility measure to capture the magnitude, in addition to the directions, of the accessibility effects of Tren Urbano. The limitation of Hansen-type accessibility measure applied to our analysis is that the calculated accessibility scores are unit free and have no intrinsic meaning. It is important to incorporate behavioral component into the measurement while maintaining its simplicity.

The third, operationally, is to automate accessibility analysis procedure in a GIS environment. In this study, GIS has proved to be a useful tool to assist analysts to link and process geographical and statistical information, and to visualize the experimental and final results. Ideally, these steps should be integrated into a seamless procedure.