Actual Versus Forecast Ridership on MetroLink in St. Clair County, Illinois

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The St. Louis metropolitan area has been seeking to expand its successful light rail transit system known as MetroLink. The initial segment of MetroLink was opened in 1993 and ridership on this segment exceeded the forecasts. The first extension of MetroLink, which opened in May 2001, extends 17.4 mi east from East St. Louis to Southwestern Illinois College (SWIC). Multisystems prepared ridership forecasts for this extension during preliminary engineering in 1996. The existing St. Louis regional demand forecasting model, maintained by the metropolitan planning organization, was employed. Multisystems performed validation and re-calibration of the model to 1995-1996 conditions. Using the validated model, ridership forecasting was conducted for the project for the horizon year (2010) and the opening year (2001). In Fall 2001, Multisystems was asked to prepare forecasts for a second phase MetroLink extension to the east of SWIC. Since the extension to SWIC had already been open for several months and it was reported that MetroLink ridership was growing unexpectedly rapidly, a revalidation to 2001 conditions was incorporated in the new analysis. It was found that actual ridership in 2001 was very similar to the ridership forecast for the 2001 opening year prepared in 1996. The actual ridership on the new segment was merely 6% greater than the forecast. This paper compares the model's ridership projections with the actual ridership and attempts to identify the reasons behind any significant discrepancies. It will also identify how the revalidation improved the model's performance.

INTRODUCTION

Predicting future transit ridership has traditionally been an extremely tough task for transportation planners. Many different models and methods are used to gauge the impact on ridership of future transit projects, enhancements, and improvements. Since the prediction of human behavior is by no means an exact science, considerable deviation can be observed when forecasts are compared and contrasted with actual ridership once the project is implemented. However, a recent comparison has shown that ridership predictions made by Multisystems for a light rail extension in the St. Louis metropolitan area were rather accurate.

PROJECT DESCRIPTION

The initial segment of St. Louis's light rail system, MetroLink, was opened in 1993 and ridership on this segment exceeded the forecasts. An extension of the existing light rail line from its easternmost terminus in East St. Louis further eastward into Illinois was proposed in two phases. The proposed alignment for the expansion can be seen in Figure 1. The first extension, shown in red in Figure 1, was planned to run from the 5th and Missouri MetroLink light rail station to Southwestern Illinois College (SWIC), formerly known as Belleville Area College. Eight new light rail stations were proposed to lie along this 17.4-mi alignment. The second phase of the extension, shown in purple in Figure 1, would run 8.92 mi northeast from SWIC to Mid-America Airport and have three new light rail stations. In 1996, Multisystems, and its subconsultant Warner Transportation Consulting, prepared ridership forecasts for each phase during this project's Preliminary Engineering and Environment Impact Study.

The existing St. Louis regional demand forecasting model, maintained by East-West Gateway Coordinating Council (EWGCC), the region's metropolitan planning organization, was employed for the study. This model uses the MINUTP demand modeling software package. EWGCC had divided the metropolitan area into 1,170 Transportation Analysis Zones (TAZs). In order to best represent current conditions, much of the model needed to be updated. One specific request that was made was to refine the zone system near the alignment of the proposed extension. Multisystems performed validation and recalibration of the model to 1995-1996 conditions, with a special emphasis on St. Clair County. Using the newly validated model, ridership forecasting was conducted for the project for the horizon year (2010) and the opening year (2001).

COMPARISON TO ACTUAL CONDITIONS

The FTA approved only Phase 1 for construction. FTA also requested the Phase 2 be treated as a separate New Starts project. FTA further requested that the final station at Mid-America Airport be dropped from the New Start project since Mid-America Airport had not achieved commercial aviation status. Thus the New Start extension was shortened from 8.92 mi to 2.5 mi, with the terminus being located at Scott Air Force Base.

In Spring 2001, the St. Clair MetroLink Extension to SWIC opened. Initial reports indicated that ridership upon this new segment was growing rapidly. In fact, ridership at the MetroLink stations in Illinois had been growing at a faster rate than at the Missouri stations even before the opening of the extension. In Fall 2001, Multisystems was asked to prepare new ridership forecasts for the new Phase 2 MetroLink extension. The analysis included revalidating a different and more recently calibrated EWGCC model to 2001 conditions. It was decided that it would be wise to wait until ridership on the St. Clair Extension was available and stable. Hence, collection of ridership data on MetroLink, including on the new segment in St. Clair County, was conducted to aid this effort. Upon examination, it was discovered that actual ridership in 2001 on the new segment was very similar to Multisystems' ridership forecast for the 2001 opening year, which was prepared in 1996. The overall ridership on the new segment was merely 5.5% greater than Multisystems' forecast.

Looking at Figure 2, one can see that ridership exceeded predictions at all of the stations except two, Emerson Park and Memorial Hospital. Although the total observed ridership was

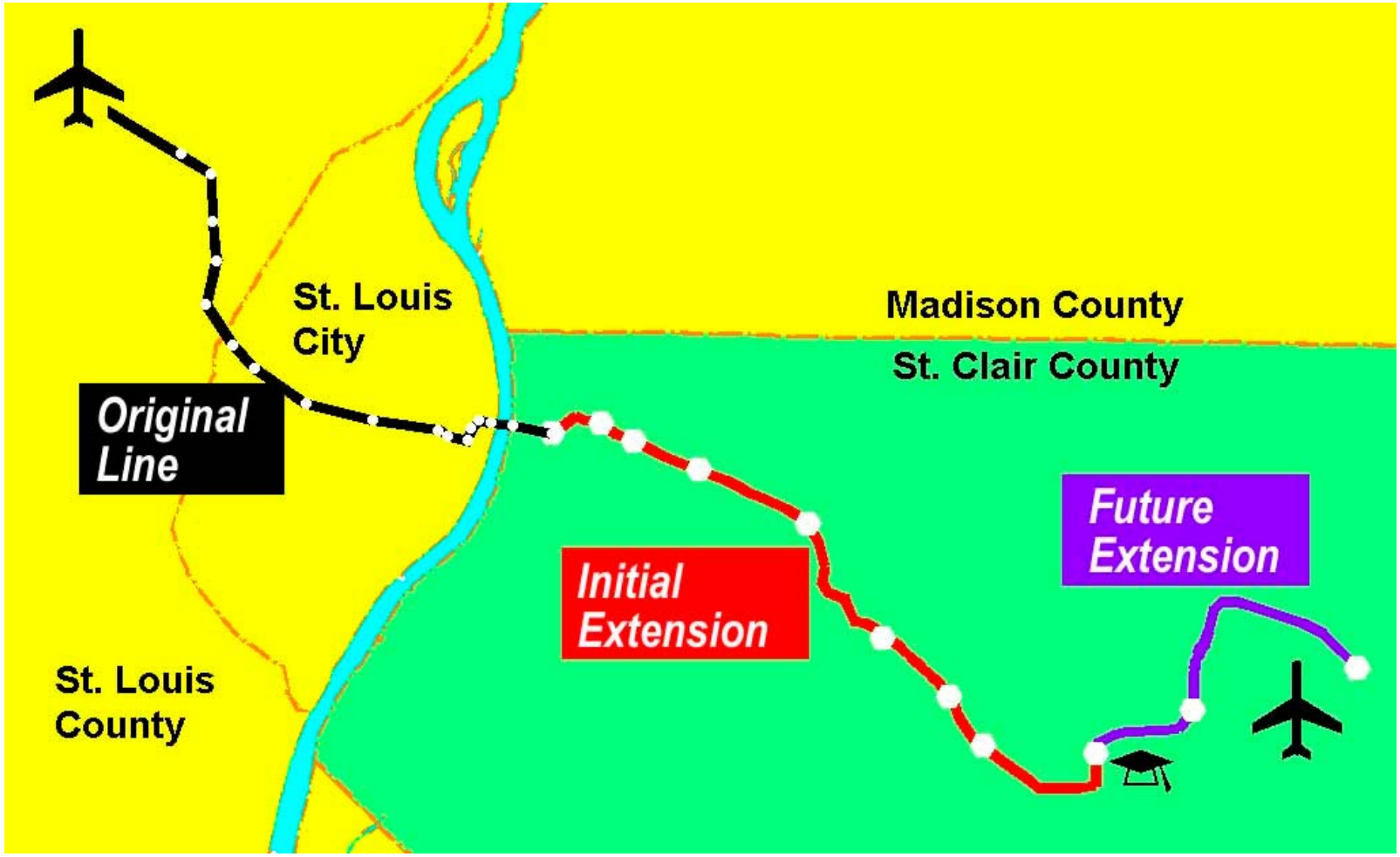

FIGURE 1 Proposed St. Clair MetroLink Extension

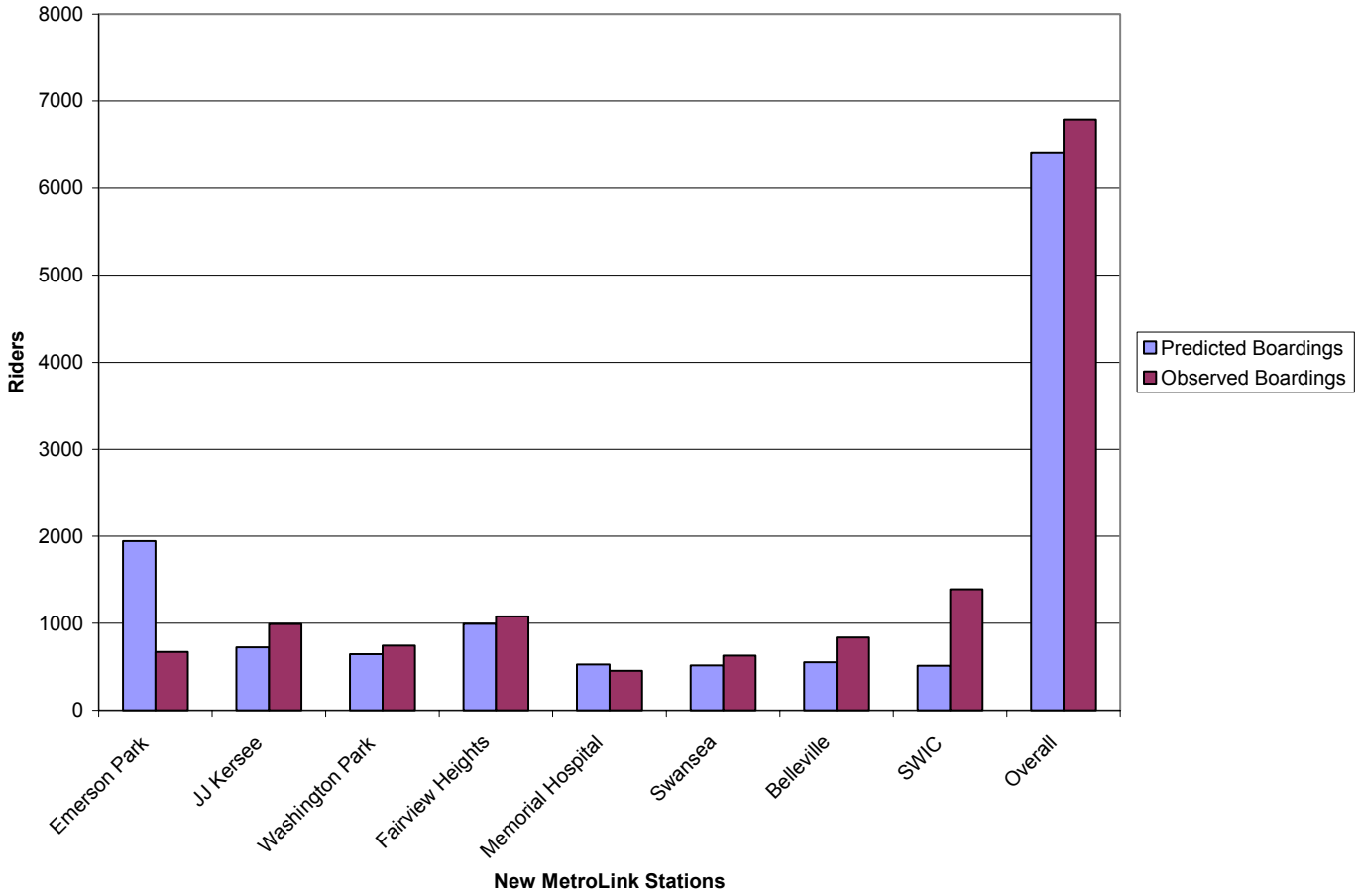

FIGURE 2 St. Clair County Extension MetroLink Ridership.

close to the total predicted ridership, the accuracy varied from station to station. As seen in Table 1, The most significant deviations were at the Emerson Park and SWIC Stations. However, it seems that the large overprediction at the Emerson Park Station was offset by aggregate underprediction at the stations in the eastern part of the county. Nearly two-thirds of the overall overprediction was offset by the underprediction at SWIC alone.

MODELING APPROACH

Multisystems introduced several key innovations during the 1996 modeling process. All of these had the effect of better representing the study area.

Better Representation of St. Clair County TAZ Structure

The TAZ structure for the model was revised to better represent St. Clair County, the focus of the study. Previously, St. Clair County was divided into 132 TAZs of varying size and population. A more detailed zonal system was developed and used in order to improve forecasting accuracy. This was accomplished by the subdivision of large TAZs into smaller compact TAZs. A total of 47 new zones were created in this manner; they can be viewed in Figure 3. The new zone system improves the representation of transit demand and transit access characteristics in St. Clair County.

Several criteria were used to decide which TAZs should be subdivided. Among these factors were zone size, proximity to MetroLink stations, proximity to bus transit, intra-zone variations in household income levels, population density, and land use patterns. The most important factor was proximity to the MetroLink stations followed by proximity to St. Clair County Transit District (SCCTD) bus routes. These factors were considered in reflecting walk access to transit.

TABLE 1 St. Clair County Extension MetroLink Ridership

New MetroLink Stations	Predicted Boardings	Observed Boardings	Difference Between Predicted and Observed	Percentage Difference from Observed
Emerson Park	1945	671	1274	189.9%
JJ Kersee	724	991	-267	-26.9%
Washington Park	644	742	-98	-13.2%
Fairview Heights	993	1078	-85	-7.9%
Memorial Hospital	526	452	74	16.4%
Swansea	515	627	-112	-17.9%
Belleville	552	835	-283	-33.9%
SWIC	511	1390	-879	-63.2%
Overall	6410	6786	-376	-5.5%

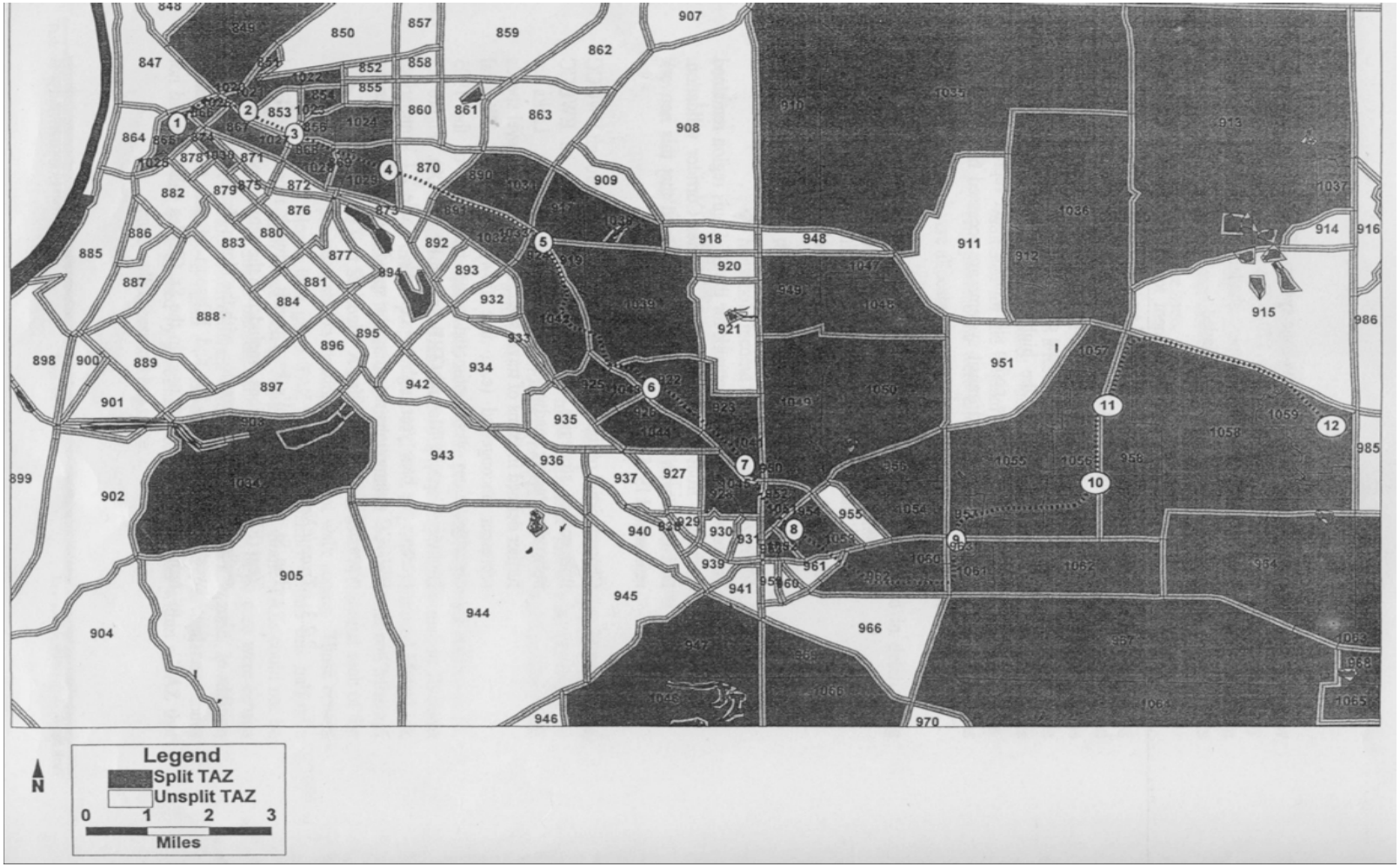

FIGURE 3 TAZ splits in St. Clair County.

The approach to subdividing TAZs worked as follows. New walk only access zones were created around MetroLink station locations as well as along bus routes. A half-mile radius was drawn around each station location to represent walk access to the station. Census blocks in a given TAZ falling within this half-mile radius were grouped together to form a new zone. This new TAZ was therefore carved out of the old zone. A similar process was performed to create new TAZs having walk only access to SCCTD bus routes.

Unfortunately, full trip generation routines were not able to be run for these new zones. The trip ends we received from EWGCC were created using procedures that utilized broad data sets, such as population by income level and employment by type. These data sets were not available at the census block level. To compensate for this, trip ends estimated for the original TAZ were allocated to the new subdivided zones. Trip productions were allocated by population while trip attractions were allocated by a combination of population and area.

Improved Representation of Travel Behavior by Low-Income Residents

Improvements were made in the trip distribution routine to better represent low-income residents' travel behavior than it had been in previous EWGCC travel demand models. Traditionally, low-income persons have been a significant component of transit riders. This becomes even more critical when one considers the relatively low income level of residents in some parts of St. Clair County, specifically in and around the city of East St. Louis.

Earlier models had distributed trips based solely on automobile travel times during trip distribution even though many transit-dependent residents would choose their travel destinations based on transit accessibility. In an effort to be inclusive of this transit-dependent population, the new model considered transit travel times as well as automobile travel times in its trip distribution. Paths built only on highway times were replaced by a weighted sum of paths built over the transit and highway networks. Transit path times were computed by summing the time for the transit walk, in-vehicle travel time, transfer time, and boarding time. For zone pairs without a transit connection, the transit path time was assigned to be 150 min, the maximum impedance used in the trip distribution routines. Transit travel times were then weighted according to the percent of households in each TAZ that were assumed to lack vehicular access, while highway travel times were weighted according to the percent of households in each TAZ that were assumed to have vehicular access. These two weighted travel times were then summed. This percentage of transit-dependent riders was calculated from 1990 census data in the following fashion. The percentage of households without vehicles at the census tract level was compared to the percentage of low income households at the census tract and TAZ levels to determine the comparable percentages of zero vehicle households at the TAZ level. This behaviorally sound adjustment channeled more trips from low income, transit-dependent areas to destinations served by transit.

Improved Distribution of Journey to Work Trips

Census data on the income distribution of workers by zone of employment was incorporated in the distribution step of the model to obtain a more realistic distribution of workers to jobs of appropriate wage levels. The reliance of earlier models on the gravity model for HBW distribution caused previous misrepresentation. For example, higher wage central business district (CBD) jobs are usually filled by members of high income suburban households making

long commutes. However, previous models tended to assign the lion's share of these jobs to residents of East St. Louis due to its close proximity to the St. Louis CBD. This situation was rectified by consulting Table 2 and 3 of the Census Transportation Planning Package of the 1990 Census data and identifying the income distribution of workers by their zone of employment. Incorporating this information by income tertile into the model added precision and greater credibility to the model's HBW distribution.

Downtown Fare Free Zone

The downtown fare free zone, which operates on MetroLink between Union Station and Laclede's Landing during midday hours, was included in the regional model for the first time. This was handled by creating transit paths and calculating impedances based on free fares for trips originating and ending in the St. Louis downtown area (a subset of zones within a reasonable walk distance of MetroLink stations in the free zone).

TABLE 2 Automobile Access Boardings and Vehicle Counts on the St. Clair County MetroLink Extension

New MetroLink Stations	Predicted Boardings	Observed Vehicle Counts	Difference Between Predicted and Observed	Percentage Difference	Ratio of Modeled Drive Access to Observed
Emerson Park	665	328	337	102.7%	2.03
JJ Kersee	0	0	0	0.0%	0.00
Washington Park	438	181	257	142.0%	2.42
Fairview Heights	534	514	20	3.9%	1.04
Memorial Hospital	116	204	-88	-43.1%	0.57
Swansea	190	387	-197	-50.9%	0.49
Belleville	97	199	-102	-51.3%	0.49
SWIC	197	383	-186	-48.6%	0.51
Overall	2237	2196	41	1.9%	1.02

Note: Park-and-Ride/Kiss-and-Ride may exceed vehicle counts as a result of vehicle occupancy or turnover.

TABLE 3 Access Mode Percentages

New MetroLink Stations	From 2001 Survey			From Model		
	Drive	Walk/Bike	Bus	Drive	Walk/Bike	Bus
Emerson Park	72%	7%	21%	34%	26%	40%
JJ Kersee	10%	11%	77%	0%	28%	72%
Washington Park	61%	4%	35%	68%	29%	3%
Fairview Heights	76%	1%	23%	54%	12%	34%
Memorial Hospital	91%	2%	7%	22%	9%	69%
Swansea	87%	11%	3%	37%	34%	30%
Belleville	42%	22%	35%	18%	53%	30%
SWIC	83%	13%	5%	39%	46%	15%

Note: The percentages from the 2001 Survey are only for access between homes and MetroLink stations. The Drive Percentage from the 2001 Survey includes drive alone, carpool, taxi, and kiss-and-ride modes

Post-Model Adjustments

Two important post-model adjustments were added to correct for the model's underestimation of off-peak non-work discretionary trips. Previous models focused on population and employment to forecast traditional home-to-work peak trip making as well as other trips. Little attention was paid to credibly forecasting non-HBW trips. However, in reality, a significant portion of MetroLink's ridership is comprised of people, both tourists and residents, making non-work or non-home based trips. Not surprisingly, the model had been underpredicting the attractiveness of this mode (MetroLink) for these trip purposes. Steps were taken to correct this problem and to more accurately represent total MetroLink ridership for all purposes and time periods.

Seasonal Adjustment

A seasonal adjustment, designed to reflect additional trips, either generated by tourists or made for other non-work activities, was introduced. This factor is based on the ratio of the 1996 validation year observed actual off-peak non-event weekday MetroLink boardings to the unadjusted off-peak MetroLink boardings generated by the model. The resultant ratio was then applied to the 1996 modeled non-event weekday MetroLink boardings. In this fashion, the "low" off-peak MetroLink counts were factored up to their actual counts. This same seasonal adjustment factor, developed during the calibration and validation of the model to existing 1996 conditions, was then applied to modeled non-event weekday MetroLink boardings in the future forecasts.

Adjustment for Special Events

Special events, such as concerts, entertainment, and sporting events, were known to have a large impact on MetroLink ridership. Special events occur on approximately 59% of the weekdays during the year. Hence, it was decided to create two distinct types of daily ridership profiles—one for event days and one for non-event days. The event day profile was created by applying an adjustment to increase boardings at MetroLink stations in a manner consistent with an "average" observed event day during the year. Using special event count data collected by METRO from 1996, it was estimated that the average weekday event-day event ridership is 4,200. Note that this figure takes into account the larger impact of baseball games than other events. This average event day may understate the impact of either an afternoon or evening event on a single day because it is assumed to be the average of event days with afternoon and evening events. A composite average weekday MetroLink ridership profile was then created by averaging the two (event and non-event) forecasts and weighting it by the number of weekdays with and without special events.

Special event ridership on the yet unbuilt St. Clair MetroLink extension was assumed to behave much like the existing pattern on the existing MetroLink segment in Missouri. The extension was assumed to offer enhanced access to MetroLink from most of St. Clair County; this enhanced Illinois MetroLink access would be comparable to the good access to MetroLink on the Missouri side. Therefore, it was assumed that the ratio of special event day ridership to weekend ridership in Illinois would equal the ratio in Missouri. Additionally, special event ridership was assumed to be distributed among the Illinois MetroLink stations in a pattern similar to its distribution at Missouri stations. Special event ridership in Illinois was primarily allocated

to MetroLink stations having large park-and-ride facilities; some walk and bus access special event MetroLink trips were distributed over nearly all the stations.

DISCREPANCIES

Although the overall number of actual boardings on the St. Clair County MetroLink Extension is relatively close to the number of modeled boardings, the same cannot be said when boardings at individual stations are compared. Other discrepancies were discovered as the collected data and the modeled data were scrutinized at a finer level of detail. Upon closer examination, differences were seen between the observed rider behavior and modeled behavior in the realms of MetroLink access mode shares, specifically automobile access, and in park-and-ride station choice.

Access Mode

Comparison of Vehicle Counts to Modeled Automobile Access

One clear discrepancy between the 2001 forecast (from 1996) and the observed 2001 data concerns access mode, specifically automobile access. Vehicle counts were performed at Illinois MetroLink stations on several weekdays in November 2001. These observations are compared to the modeled data in Table 2 and illustrate the wide distribution of accuracy.

As seen in Figure 4, the model overpredicted boardings resulting from auto access in the western portion of St. Clair County, while underpredicting boardings of the same type in the eastern portion of St. Clair County. Every station in eastern St. Clair County, with the exception of Fairview Heights, was underpredicted by at least 75% while the new East St. Louis stations (Emerson Park and Washington Heights) were overpredicted by more than 50%. Once again, the overall overprediction and underprediction at the stations seem to balance each other out. As seen in Table 2, the overall observed automobile total is 1.9% less than the predicted total. It would appear that a shift in park-and-ride patterns is to blame for the great discrepancies in the overall predicted ridership. The automobile access pattern comes close to mimicking the overall ridership pattern.

However, this parking analysis is imperfect. The vehicle counts may underestimate the actual number of passengers boarding by automobile access in two ways. First, counts of parked cars may have missed some turnover of vehicles parked at the stations. Second, some automobile access riders carpool or kiss-and-ride. Hence, the differences between the observed parked cars and the modeled automobile access boardings may actually be less than shown in Figure 4. Overall, the ratio is 1.02, which is reasonable considering the aforementioned factors.

Comparison to On-Board Survey Results

An on-board survey was included as part of the MetroLink data collection effort in 2001. MetroLink riders traveling to, from, and within Illinois in the St. Louis metropolitan area were surveyed on October 4, 2001. Among the questions asked of riders were several concerning access mode. Riders were asked how they accessed their home MetroLink station. Looking at the home end allows us to contrast use of park-and-ride, bus, and walk. Table 3 displays these percentages along with the access mode percentages associated with the modeled boardings.

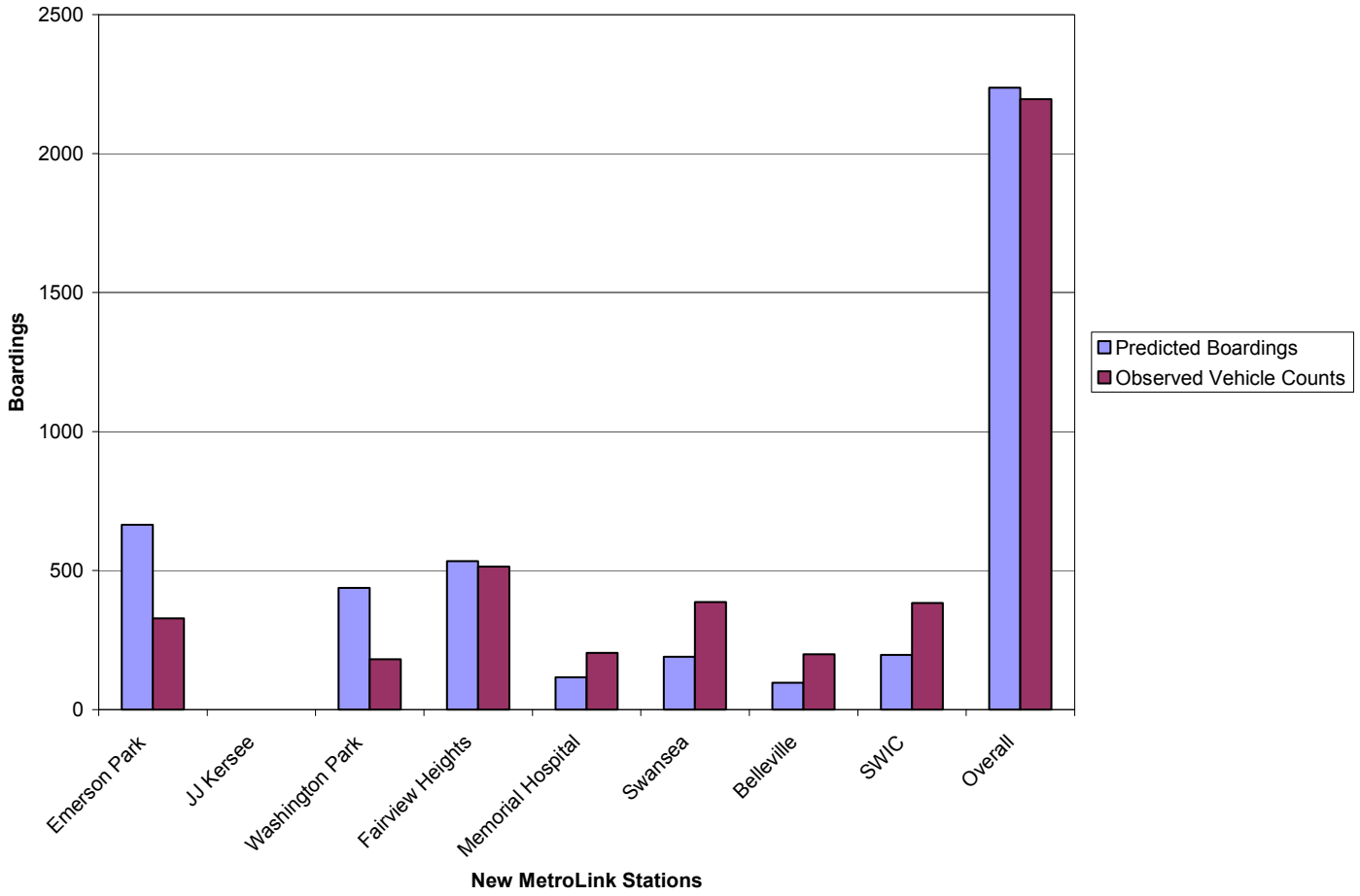

FIGURE 4 Automobile access on the St. Clair County MetroLink extension.

Note that the drive percentage from the 2001 survey includes drive alone, carpool, taxi, and kiss-and-ride modes. Significant and substantial differences exist between the survey percentages and the modeled results. Surveyed drive access is considerably higher than predicted at every station except Washington Park. Across the board, surveyed walk percentages were a lot lower than predicted in the model. With three notable station exceptions—Jackie Joyner Kersee, Washington Park, and Belleville—surveyed bus access at the Illinois stations was lower than predicted in the model; however, bus access at the Jackie Joyner Kersee and Belleville Stations were only 5% higher, which is not a huge difference.

Some of the differences in the percentages of bus access at stations may be attributed to the fact that the actual 2001 SCCTD service differs considerably from the service modeled (in 1996) for the 2001 forecast. The current SCCTD bus system is a pure feeder bus system; all bus routes terminate at MetroLink stations. On the other hand, the modeled SCCTD service contained some non-feeder bus routes. Also, most Illinois MetroLink stations are not served by the same number of SCCTD feeder routes as they were in the 2001 forecast. MetroLink stations in the western portion of the county have less bus service than was modeled. The Belleville and Swansea Stations each have more service than when modeled. The only stations served by the same number of SCCTD routes in 2001 as when modeled are Fairview Heights and SWIC. Moreover, almost every SCCTD bus route has undergone revisions. That is to say, nearly every route travels a different alignment than was modeled in 1996, not to mention schedule changes. Population centers, as well as attraction areas, are not necessarily currently connected to the same MetroLink stations as they were in the modeled 2001 forecast.

So, as in the vehicle count analysis, comparing the specific modal access percentages gleaned from the survey against the modeled modal access percentages is imperfect. However, it does provide us with the knowledge that a considerably higher percentage of riders access MetroLink by automobile than was predicted.

Reasons for Disparity in Park-and-Ride Lot Choice

Clearly, the model did not accurately predict the behavior of park-and-riders at the station level. The aforementioned Figure 4 illustrates the disparity between observed vehicle counts at MetroLink stations and the modeled automobile access boardings. Moreover, the on-board survey of riders also demonstrated that some MetroLink riders chose park-and-ride lots other than those the model had originally predicted. The residential locations of the park-and-riders at each Illinois station were mapped using zip codes and specific addresses where available (and geocodable). These did not always fall into the park-and-ride catchments area that had been designated for each specific station in the model. One noticeable element was that in reality, park-and-riders from the same home location often chose to travel to different stations. A review of the model assumptions, in combination with survey responses, suggested the following reasons for this difference: (1) parking availability, (2) perceived versus actual travel time, and (3) safety, convenience, and familiarity.

One of the primary determining factors used by the model for park-and-ride station choice is parking constraint. However, this does not concur with the responses to a question posed on the on-board survey. Park-and-riders at each Illinois MetroLink station were asked why they chose to park at that particular MetroLink station. As seen in Table 4, availability of parking was the deciding factor for less than 10% of the respondents at all but two Illinois MetroLink stations; in no case did more than 15% of respondents cite this as an answer.

TABLE 4 Reasons for Station Choice

	It takes the least time to drive there	It feels like a safer location	It is the most likely to have parking available when I arrive	I am most familiar with that station and how to get there	I try to park as close to St. Louis as I can	Other
College	83%	8%	1%	1%	6%	1%
Belleville	74%	4%	15%	4%		3%
Swansea	84%	5%	4%	4%	1%	3%
Memorial Hospital	96%	1%	1%	1%		
Fairview Heights	75%	8%	9%	2%	2%	2%
Washington Park	80%		4%	4%	4%	8%
Emerson Park	74%	9%	9%			9%
5th and Missouri	65%	10%	15%	10%		
East Riverfront	15%	41%		30%	14%	

The principal component of park-and-ride station choice for the model is travel time. Consistent with the model, the vast majority of survey respondents cited least travel time as the primary reason for station choice. However, a distinction needs to be made between modeled travel time and perceived travel time.

For example, the model assigned park-and-riders living along the Interstate 64 corridor to the large park-and-ride lots at Emerson Park and Washington Park. These stations have good Interstate access and hence, short travel times. However, vehicle counts and boardings at these stations were considerably lower than predicted. One possible explanation is that the incidence of road congestion en route to the stations, not uncommon on interstates, may have discouraged people from parking at these stations and instead caused them to park at MetroLink stations geographically closer to their homes. For some, travel to stations via local roads with lower speed limits may be preferable to traveling on a crowded highway. Another likely explanation is that in-vehicle travel time on MetroLink may be even a greater factor in decision-making than the model anticipated. People from eastern St. Clair County who are predisposed to take transit may be willing to travel to the geographically closest MetroLink station irrespective of overall travel time. For example, people may prefer to spend more time aboard MetroLink instead of driving to a further "downstream" park-and-ride location if a long trip is being made. Some riders may choose to minimize their access times even if it means a longer overall travel time.

Although the majority of park-and-riders used travel time as their chief decision making tool, many did not. Park-and-riders at 5th and Missouri and East Riverfront Stations are the least likely of any of the Illinois park-and-riders to report that time to drive there is the most important factor. These park-and-riders were also the only ones to cite familiarity and safety concerns as significant reasons for their station choice. These two stations are the only Illinois MetroLink stations to predate the St. Clair Extension.

Combining the higher numbers for safety and familiarity, as well as the relative unimportance of travel time, suggests the possibility that some 5th and Missouri and East Riverfront riders have not experimented with the parking at the new MetroLink stations closer to their homes. Instead of parking at the large new park-and-ride lots at nearby Emerson Park and Washington Park, they continue to park at the other East St. Louis MetroLink stations out of habit. This assertion is supported by the fact that more than three times as many vehicles were observed at the 5th and Missouri station park-and-ride facility as were expected from the model.

CONCLUSION

Underprediction and overprediction of boardings at individual MetroLink stations seem to have balanced out so that the total ridership on the new extension closely matches the observed total. Unanticipated changes in the study area, such as the loss of commercial air service at MidAmerica St. Louis Airport and the reconfiguration of the feeder bus system, likely contributed to the deviations at specific stations. The fact that the total boardings on the St. Clair Extension were as close as they were is probably due to a number of improvements made to the model including: better representation of the TAZ system in St. Clair County, improved representation of travel behavior by low-income residents, inclusion of the fare-free zone, improved distribution of journey to work trips, adjustments for seasonality, and adjustments for special events. Given the deviations at individual stations, it is expected that further refinements could be made. Opportunities for such refinements may include revisions to park-and-ride catchments areas for Illinois MetroLink stations and adjustments for special generators in Illinois, such as Scott Air Force Base, SWIC, and riverboat casinos. These enhancements, among others, were in fact included in the most recent St. Clair modeling efforts by Multisystems.

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