Forecasting Future Transit Route Ridership

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ABSTRACT

This paper contains an analysis of the ridership potentials of various public transportation options for the Michigan Avenue Corridor in East Lansing (1). Ridership projections were based on: corridor population and employment growth; changes in service levels resulting from the various options; and effects of changes in gasoline price, parking costs, and increased traffic congestion. An origin-destination matrix of bus riders was derived from on-and-off counts. Differential growth rates for various sections of the corridor were developed and applied to this derived matrix to derive future bus trip interchange patterns. Elasticity factors were applied to specific trip linkages to estimate the impacts of reduced travel times for both the $0.35 fare in effect during 1979-1980, and the $0.50 fare placed in effect during June, 1981. Sensitivity analyses were conducted to quantify the impacts of changes in gasoline costs and availability, increased traffic congestion, and changes in downtown parking policy. Ridership estimates were developed for 1985 and 2000 for five service options. The daily ridership would increase from 6,235 passengers in 1980 (with a $0.35 fare) to between 7,200 and 9,000 passengers by year 2000 for a $0.50 fare. Peak-hour one-way riders at the maximum load point would rise from 440 passengers in 1980 to 860 passengers by year 2000 depending on the service option. The ridership forecasting methods have applicability in other urban areas as well. They are particularly valuable where it is reasonable to assume that transit will retain its share of the corridor travel market (i.e., short-range forecasts). Where this is not the case, adjustments can be made to the future-year base service option before elasticity factors are applied.

Many public transportation planning decisions must be based on a limited amount of data. This is especially true for forecasting future route ridership in a small or medium-size community where detailed travel patterns or network information is not available.

Long-term patronage forecasts for corridor transit alternatives in a medium-size urban area--Lansing, Michigan are developed in this paper. It shows how future corridor ridership can be estimated based on on-and-off counts, population and employment forecasts, travel time studies, and elasticity factors.

In addition, the paper also contains an analysis of ridership potentials of various public transportation options for the Michigan Avenue corridor in Lansing and East Lansing, Michigan. It is based on surveys and analyses conducted during 1981-1982 as part of an alternatives analysis study.

GENERAL PROCEDURES

The transit ridership estimates were based on the following steps:

1. A field reconnaissance study was made to identify corridor characteristics, observe traffic conditions, and determine travel times.
2. Available information on population, employment, bus ridership, and traffic flow was assembled and reviewed; this included population forecasts, on-and-off bus ridership surveys; and traffic volume trends. The data were analyzed to obtain a picture of existing conditions and likely changes over the next several decades. Agency projections were modified where appropriate to reflect the 1980 U.S. Census results, and prospects for growth in Michigan State University (MSU) enrollment and Lansing central business district (CBD) employment.
3. A generalized origin-destination pattern for Route 1 bus riders was derived from the Capital Area Transit Authority's (CATA) on-and-off passenger counts.
4. Bus travel patterns for 1985 and the year 2000 were derived, taking into account corridor population and employment growth. Differential growth rates for various sections of the corridor were developed and applied to the derived origin-destination matrix to develop 1985 and 2000 bus trip patterns, assuming that existing bus service is adjusted to reflect and realize this corridor growth.
5. Travel time estimates were developed for five basic transit service options:

- the base condition
- improved bus service
- trolley bus
- high-capital bus (busway)
- light rail transit

6. Elasticity factors were then applied, taking into account (a) changes in service levels resulting from the various options, and (b) effects of changes in gasoline prices, parking costs, traffic congestion, and transit fares as follows:

- The elasticity factors were applied to specific trip linkages to estimate the impacts of reduced travel times for each service option. Estimates assumed that the fares would be the same for each option, and that there would be no sustained fuel shortages or major policy disincentives to driving.
- Ridership estimates were keyed to the $0.35 fare in effect during 1979-1980; they were then

adjusted to reflect the $0.50 fare in effect in June 1981, based on information received from CATA.

• Sensitivity analyses were conducted to quantify the effects of changes in gasoline cost and availability, increased traffic congestion, and changes in downtown parking policy.

• Estimates were prepared for 1985 and 2000 ridership on a daily basis, and also for peak-hour, peak-direction passenger flows past the maximum load point.

The ridership forecasts assumed that the base condition would adjust existing services sufficiently to enable ridership to increase proportional to population and employment growth in the corridor; otherwise, bus ridership would essentially remain at existing levels. Ridership would also increase as service levels in the corridor were improved--the increases would reflect both trips diverted from cars and new trips.

EXISTING CORRIDOR CHARACTERISTICS

The Michigan Avenue Corridor was defined as an area approximately 1 mi wide bisected by Michigan and Grand River Avenues, having as its western terminus the Lansing CBD, and extending eastward through the East Lansing CBD to Hagadorn Road and beyond to the Meridian Mall--a major generator (see Figure 1).

Development Patterns

The 7-mi corridor had a population of approximately 90,000 people in 1980--approximately 22 percent of the 417,000 people residing in the Tri-County Region. It contained more than 40 percent of the 140,000 jobs in the Tri-County area, including the Lansing CBD (20,500 jobs); MSU (8,800 jobs), and the East Lansing CBD (1,800 jobs). It includes MSU with 45,700 students, the Frandor Shopping center with 500,000 ft^2 of floor space, and Meridian Mall with 1 million ft^2.

Traffic and Person Flows

Daily and peak-hour traffic flows on Grand River Avenue between Michigan Avenue and Bogue Street, as observed by the Michigan Department of Transportation, approximated 39,000 vehicles; peak-hour peak-direction flows ranged from 1,700 to 2,100 vehicles--approximately 4-5 percent of the daily two-way total. The 2,100 vehicles operated in three lanes on a 28-ft wide roadway through signalized intersections in East Lansing. Buses carried approximately 12 percent of the daily person-movements along Michigan Avenue and about 4-8 percent within the corridor. During the morning peak-hour, 11,000 people entered downtown Lansing, of which 11 percent came by bus.

Travel Times and Traffic Conditions

Relatively little congestion was observed in the corridor and its environs. Speeds along Michigan Avenue between Cedar Street and Marsh Road approximated 28 to 32 mph during the a.m. peak, 29 mph midday and 25 to 26 mph during the p.m. peak. They were largely governed by the traffic signal progression that is reportedly set for 30 mph. Travel times between the Lansing CBD and Abbott in East Lansing approximated 8-10 min by car, 15 min by express bus, and 15-20 min by local bus with variations by time of day. Travel times between the Lansing CBD and Marsh Road (Meridian Mall) approximated 14-17 min by car, 25 min by express bus and 30-35 min by local bus (see Table 1).

Bus Ridership

Public transport was provided by two agencies--CATA and the MSU bus system. CATA's bus fleet included 74 buses and 6 paratransit vehicles of which 52 ran in peak periods and 35 ran midday. Weekday CATA ridership averaged 16,000 in 1980, reaching 20,000 on days when MSU was in session. MSU bus system daily ridership ranged from 7,500 in the spring of 1980 to 17,000 during the 1980 winter term. A $0.35 to $0.50

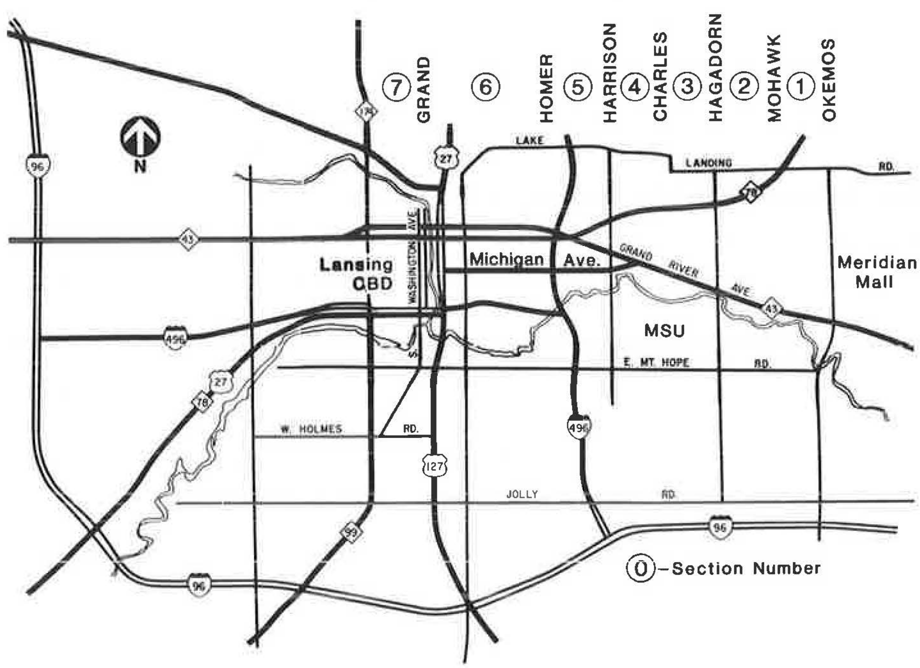

FIGURE 1 Study corridor and environs.

TABLE 1 Michigan Avenue Profile Comparative Avenue Travel Times

Direction of Travel	Grand-Abbott (min) Automobile	Local Bus	Express Bus	Grand-Marsh Road (min) Automobile	Local Bus	Express Bus
Eastbound						
AM	9	15		14	30	
Midday	8	20		15	35	
PM	10	20	15	17	35	25
Westbound						
AM	9	15		16	30	
Midday	8	20		15	35	
PM	10	20	15	17	35	25

Sources: Michigan Department of Transportation speed runs; CATA Route 1 schedules, effective September 15, 1980; H.S. Levinson speed runs, June 1981.

CATA fare increase in 1981 resulted in a 7-8 percent decline in average weekday ridership.

Daily ridership in the corridor totaled 6,235 passengers in 1979, of which Route 1 (East Lansing Mall) carried 5,470 passengers, or one-third of the system's total weekday ridership. Westbound buses during the morning peak hour on a typical April 1980 day had 90 riders on vehicles at the eastern end of the study area (Meridian Mall). The number of riders on buses increased to 280 west of Abbott in downtown East Lansing and reached 440 as buses entered the Lansing CBD.

DEVELOPING TRAVEL PATTERNS

A profile of eastbound and westbound Route 1 ridership was derived from CATA on-off counts. Table 2 gives a summary of weekday eastbound and westbound ridership that includes the following data:

1. The maximum accumulation of passengers that occurred in Section 6 between Homer and Grand.
2. Approximately 47 percent of all riders boarding westbound buses had destinations in the Lansing CBD; similarly, approximately one-half of all eastbound alighting passengers initiated their trip in the Lansing CBD.
3. On the average, 21 percent of all Route 1 riders had their origin or destination in the East Lansing CBD.
4. The surveys also found that approximately 55 percent of the total riders passed the maximum load point--this corresponds to a turnover of about 1.8. One set of (westbound) riders boards buses for destinations at MSU or downtown East Lansing. Another group of riders boards buses west of the East Lansing center for destinations in the Lansing CBD. The bus trips between each pair of sections were derived from the CATA counts on a proportional basis. Because of the short length of most sections, it generally was assumed that bus riders would travel from one section to another. However, in the case of Sections 1 and 6, intra-section trips were included.

Figure 2 shows how the trip matrix was developed. Section 1, for example, had 13 percent of all westbound "on" trips, and 1.1 percent of all westbound "off" trips. Thus, 11.9 percent of these westbound trips were to other sections. Section 2 had 2.1 percent of all westbound "off" trips. Because no intra-Section-2 trips were assumed, these trips came from Section 1. The remaining 9.8 percent of trips from Section 1 were to other sections. Section 3 had 6.8 percent of all "off" trips, which came from Sections 1 and 2. Section 1 contributed 9.8/(9.8 + 13.1) percent or 43 percent, which is 2.9 trips; and Section 2 contributed 13.1/(9.8 + 13.1) percent or 57 percent, which is 3.9 trips. This process was repeated until a complete trip matrix was obtained. It was varied slightly to account for intrazonal trips in Section 6.

The results of this process are given in Table 3. The 1979-1980 Route 1 ridership patterns by type of trip can be summarized as follows (note that Charles is the eastern limit of most transit options):

Type of Trip	1979-1980 Ridership Percent	Percent (cumulative)
Begin and end east of Charles	10.0	
East of Charles to or from points between Charles and Grand	20.6	
East of Charles to or from Lansing CBD	9.2	39.8
West of Charles to or from points between Charles and Grand	22.4	
West of Charles to or from Lansing CBD	37.8	60.2
	100.0	100.0

TABLE 2 1979-1980 Route 1 Daily Ridership Profile for Both Directions—Percentage Distribution

Section (WB-off; EB-on)	Lansing CBD Orientation (WB-on; EB-off)	Meridian Mall Orientation (EB-on; WB-off)	Accumulation of Riders (% of maximum accumulation on line)
1 Meridian-Mohawk	13.0	1.1	20.2
2 Mohawk-Hagadorn	13.1	2.1	39.5
3 Hagadorn-Charles	13.7	6.8	53.0
4 Charles-Harrison	30.5	12.3	86.9
5 Harrison-Homer	13.3	8.0	96.7
6 Homer-Grand	16.4	22.7	100.0
7 West of Grand	–	47.0	84.4

Note: WB = westbound and EB = eastbound.
Source: CATA ridership survey.

PROJECTING CORRIDOR AND RIDERSHIP GROWTH

General growth trends were derived from an analysis of actual experience and agency forecasts. They were modified as appropriate to reflect results of the 1980 U.S. Census, and likely development in central Lansing. These growth trends were developed before the economic recession occurred in central Michigan; therefore, they may be optimistic when viewed from the perspective of 1985--especially Lansing CBD employment.

Corridor Growth Indices

Growth factor summaries for the corridor are given in Table 4. These indices that 1985 travel would

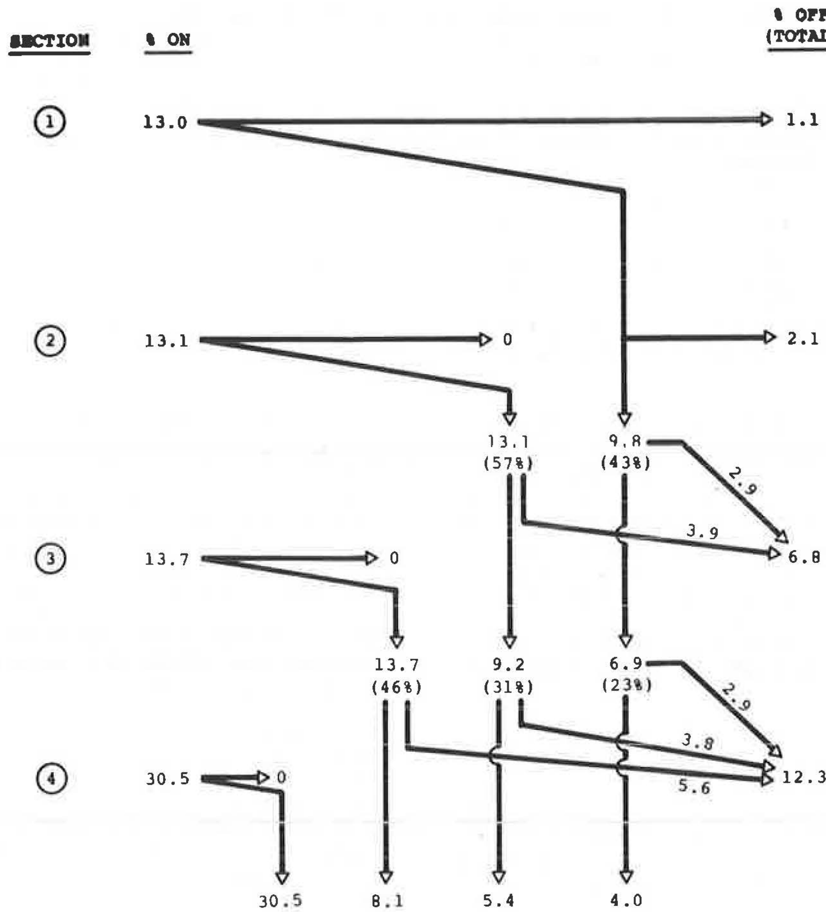

FIGURE 2 Sample development of O-D matrix.

TABLE 3 Estimated Distribution of Route 1 Bus Riders from 1979 to 1980

Section (WB-off; EB-on)	WB-On; EB-Off (%) 1	2	3	4	5	6	7	Totals
1 Meridian-Mohawk	1.1							1.1
2 Mohawk-Hagadorn	2.1	–						2.1
3 Hagadorn-Charles	2.9	3.9	–					6.8
4 Charles-Harrison	2.9	3.8	5.6	–				12.3
5 Harrison-Homer	0.6	0.9	1.4	5.1	–			8.0
6 Homer-Grand	1.2	1.7	2.5	9.4	4.9	3.0		22.7
7 West of Grand	2.2	2.8	4.2	16.0	8.4	13.4	–	47.0
Totals	13.0	13.1	13.7	30.5	13.3	16.4	–	100.0

Note: WB = westbound and EB = eastbound.
Source: CATA ridership survey.

TABLE 4 Travel Growth Indices in the Michigan Avenue Corridor

Basis	Ratios[a] Year 1985	Year 2000
Regional population growth	1.07	1.27
Corridor population growth:	1.08	1.31
East Lansing		
Lansing Township		
Meridian Township		
Corridor employment	1.06	1.21
CBD Lansing employment	1.17	1.36
Traffic growth in East Lansing area	1.05	1.20
Averages	1.09	1.27

[a]Calculated ratios are future year to 1979-1980 base year.

average approximately 9 percent more than in 1980, while 2000 travel would increase approximately 27 percent. Thus, assuming bus ridership in the corridor would retain its present market share, it would grow by 27 percent between 1980 and 2000--from 6,235 to 7,920 riders.

A more refined set of growth factors were derived for specific types of trips in the corridor. Three sets of population factors and four sets of employment factors were developed, drawing on previous analyses and, where needed, the Tri-County zonal employment forecasts. Composite factors for expanding bus trips were then derived based on the geometric mean of employment and population change for specific trip linkages as follows:

Factor (for a trip between Section i and j),

$$F_{2,1} = [(P_2/P_1)_i \times (E_2/E_1)_j]^{1/2} \quad (1)$$

where

Section i = the section furthest to the east, relative to the Lansing CBD;
Section j = the section furthest to the west, relative to the Lansing CBD;
P_1 and P_2 = the population of various zones associated with Section i at times 1 and 2; hence, P_2/P_1 is their ratio; and
E_1 and E_2 = the employment of various zones associated with Section j at times 1 and 2; hence, E_2/E_1 is their ratio.

The various factors that were applied to specific trip linkages are given in Table 5.

Bus Ridership Implications

Bus ridership was estimated for 1985 and 2000 by applying both average and sectional growth factors. In both cases, it was assumed that sufficient service adjustments would be made to enable ridership to keep pace with corridor population and economic growth. It was also assumed that there would be no fare increases, relative to the base year, in real dollars.

Table 6 contains a representation of the anticipated 2000 bus ridership matrix for Route 1. Ridership is expressed on a percentage basis, with 1979-1980 ridership equal to 100 percent. For 2000, Route 1 ridership would increase by 25.7 percent.

Table 7 contains a summary of present and anticipated ridership. Corridor bus ridership would grow from 6,235 in 1980 to about 6,800 in 1985 and 7,900 by 2000. The average and sectional factors give similar results. As in 1980, about 55 percent of the daily riders would pass the maximum load point.

Peak-hour, one-way bus riders at the maximum load point in 1979-1980, 1985, and 2000 are given in Table 8. These calculations assume that the peak-hour riders would increase proportional to daily ridership. Under these assumptions, peak-hour ridership on Routes 1, 13, 15, and the Meridian Mall express would increase from 440 in 1979-1980 to 490 in 1985 and 585 by 2000.

Developing Ridership Projections

Ridership was projected for four basic transit service options based on (a) the effects of changes in travel times and fares, and (b) the effects of changes in other factors.

Initial Assumptions

The initial projections of 1985 and 2000 ridership based on changes in service levels and fares reflected the following assumptions:

1. The base condition would adjust bus service frequencies to reflect ridership generated by population and economic growth in the corridor. Other-

TABLE 5 Growth Factors By Section

Section	Ratios 1985/1980	Ratios 2000/1980
Individual factors		
A. Meridian Township population	1.137	1.549
B. East Lansing population	1.058	1.203
C. Lansing population (in corridor)	1.000	1.000
1. Meridian Township employment	1.080	1.562
2. East Lansing employment (including Frandor)	1.052	1.562
3. Lansing employment (in corridor excluding CBD)	1.035	1.132
4. Lansing CBD employment	1.171	1.366
Combined factor for various trips[a]		
A-1 Meridian–Meridian	1.108	1.555
A-2 Meridian–East Lansing	1.094	1.332
A-3 Meridian–Lansing (in corridor)	1.084	1.324
A-4 Meridian–Lansing CBD	1.154	1.455
B-2 East Lansing–East Lansing	1.055	1.174
B-3 East Lansing–Lansing (in corridor)	1.046	1.167
B-4 East Lansing–Lansing CBD	1.113	1.282
C-3 Lansing–Lansing (in corridor)	1.017	1.064
C-4 Lansing (in corridor)–Lansing CBD	1.082	1.169

[a]Factors are computed as the square root of the population factor multiplied by the employment factor.

TABLE 6 Anticipated Distribution of Route 1 Bus Riders—2000 Weekday

Section (WB-off; EB-on)	WB-On; EB-Off (%) 1	2	3	4	5	6	7	Totals
1 Meridian-Mohawk	1.7							1.7
2 Mohawk-Hagadorn	3.3	–						3.3
3 Hagadorn-Charles	3.9	5.2	–					9.1
4 Charles-Harrison	3.9	5.1	6.6	–				15.6
5 Harrison-Homer	0.8	1.2	1.6	6.0	–			9.6
6 Homer-Grand	1.6	2.3	2.9	11.0	5.7	3.2		26.7
7 West of Grand	3.2	4.1	5.4	20.5	10.8	15.7	–	59.7
Totals	18.4	17.9	16.5	37.5	16.5	18.9	–	125.7

Note: Maximum accumulation = 67.5/125.7 = 53.7 percent; WB = westbound and EB = eastbound.

TABLE 7 Summary of Present and Anticipated Bus Ridership for a Typical Weekday—Base Condition

	Year		
Route	1980	1985	2000
1	5,470	5,940	6,876
Meridian Mall Express	300	346	436
13-15	465	503	544
Totals	6,235	6,789	7,856
Index from Table 6	1.00	1.09	1.26
Applying total average growth factor from Table 4	6,235	6,796	7,917
Index	1.00	1.09	1.27

Source: Michigan Department of Transportation, East Grand River Corridor Review Draft.

TABLE 8 Present and Anticipated Peak Hour—Peak Direction Bus Riders at Maximum Load Point in the Base Condition

Route	Year 1979-1980	Year 1985	Year 2000
1 East Lansing—Meridian Mall	300	330 (1.10)	390 (1.30)
Meridian Mall Express	75	90 (1.20)	115 (1.53)
13-15 Groesbeck	65	70 (1.08)	80 (1.22)
	440 (1.00)	490 (1.12)	585 (1.33)

Note: Figures in parentheses reflect ratio to 1979-1980 base.
Source: CATA Ridership Survey.

wise, the base case ridership forecast would not be realized.

2. Each option generally would provide the same basic service frequency between Meridian Mall and downtown Lansing. Running times reflect the transit service characteristics developed by the George Beetle Company (2).

3. An effective level of local service would be maintained between East Lansing and downtown Lansing under all options.

4. Schedules between Route 1 feeder services and the trolley bus, busway, and light rail services would be fully coordinated to minimize transfer times. A two-minute transfer time was assumed for these options.

5. Ridership in each of the seven sections along Grand River and Michigan Avenues was assumed to be concentrated at the easternmost point in each section.

6. Ridership growth in the Williamstown Express bus route--to east of the study area was not considered.

7. Fares would remain at 1980 levels ($0.35) in real dollars. A $0.50 fare, such as established in 1981, would reduce stated values by 7-8 percent, based on CATA's system-wide experience.

8. Parking charges in the Lansing and East Lansing CBDs would remain at present levels in constant dollars.

9. The real cost of gasoline would remain constant.

10. There would be no major shortages in gasoline.

Elasticity Factors

The percent change in the number of trips that occur in response to a 1 percent change in any of the "costs" of travel is called the demand elasticity. Thus, a 50 percent gain in ridership from a 100 percent reduction in travel time would reflect an elasticity of 0.5. The percent change in transit trips as a result of a 1 percent change in automobile parking or congestion costs is called the cross-elasticity.

The elasticity factors were based on current experience. They were as follows:

Elasticity	
In-vehicle travel time	-.500
Headway	-.250
Fare (CATA experience)	-.267
Cross Elasticity	
Automobile travel time versus busway and light rail	.500
CBD parking costs for work trips only	.450
Automobile operating costs	.180

Application of Elasticities

In applying these elasticity factors, it was necessary to make certain assumptions regarding transit travel times and headways for each option. Ridership estimations first assumed that headways would be generally similar for each option, and then were analyzed for differences in service frequencies.

Travel Time Changes

Table 9 gives the one-way in-vehicle travel times from downtown Lansing to Charles Street in East Lansing and Marsh Road at the Meridian Mall. Times are shown for the base condition, three bus options, a light-rail option, the existing express bus service, and automobile trips. A 2-min coordinated transfer in East Lansing is included in the trolley bus and light rail options.

TABLE 9 Estimated One-Way Travel Times To and From Capitol Avenue in Downtown Lansing

Alternative	To and from Charles (min)	To and from Meridian Mall (min)
Base condition	22.0	36.0
Low-capital bus	19.0	33.0
Trolley bus	17.0	33.0[a,b]
High-capital bus	12.5	26.5[b]
Light rail	11.5	27.5[a,b]
Existing express bus to Meridian Mall (schedule)	15	25
Automobile	8-11	14-17

[a] Assuming a 2-min transfer penalty.
[b] Using H.S. Levinson estimate of 14-min local bus schedule time between East Lansing (Charles Street) and Meridian Mall; from CATA Route 1 schedule, effective September 15, 1980.

The data show that in-vehicle automobile travel times are faster than transit travel times for all transit service options. The automobile also provides faster access times to the common line-haul sections--because (a) feeder bus service is infrequent, (b) there appear to be no park-and-ride sites along the line, and (c) there are no waiting times associated with car trips at the residential end of the line. For these reasons, the various transit options are not likely to attract motorists unless major increases in automobile disincentives are implemented.

Table 10 gives one-way in-vehicle travel times from downtown Lansing to the easternmost point in each of the previously defined sections. These comparative travel times were used with a -0.500 elas-

TABLE 10 Estimated One-Way Times From Lansing CBD (Ionia Street at Seymour Avenue)

Section	Base Condition	Low-Capital Bus	Trolley Bus	High-Capital Bus	Light Rail
CBD	-	-	-	-	-
Grand-Homer	11.0	9.5	8.5	7.0	6.0
Homer-Harrison	17.0	15.0	14.0	10.0	9.0
Harrison-Charles	22.0	19.0	17.0	12.5	11.5
Charles-Hagadorn	26.0	23.0	23.0[a]	16.5	17.5[a]
Hagadorn-Mohawk	31.0	28.0	28.0	21.5	22.5
Mohawk-Meridian Mall (Marsh Road)	36.0	33.0	33.0	26.5	27.5

Note: Travel times are from CBD to underscored street.
[a]Includes 2-min transfer time.

ticity to estimate ridership changes from travel time improvements.

The percent changes in travel time for each cell in the year-2000 trip matrix were estimated. The elasticity factor was then applied to these individual values to determine the changes in riders. In Table 11, all ridership is expressed in percentage terms, with the 1979-1980 total ridership equal to 100.0. Ridership was then summed for the Route 1 service, and the ridership for these other lines along Michigan Avenue was added. The resulting year-2000 ridership projections are given in Table 12. A similar procedure was used to estimate 1985 ridership. This led to the following weekday ridership estimates based on a $0.35 fare in real dollars and a 1979-1980 ridership of 6,235 passengers:

Case	Total Riders By Year 1985	2000
Base condition (with service adjusted to reflect growth)	6,800	7,860
Low-capital bus	7,100	8,200
Trolley bus	7,200	8,300
Busway	7,700	8,900
Light rail	7,750	8,950

Anticipated peak-hour peak-direction passengers at the maximum load point are given in Table 13. These estimates are generally based on existing peaking characteristics. However, it was assumed that peaks for the base service condition, improved bus, and trolley bus options would increase another 10 percent by the year 2000. High capital bus and light rail ridership estimates were increased by 25 percent to reflect both the additional peaking and larger person-capacity of articulated buses and light-rail vehicles. These latter adjustments produce ridership estimates that correspond to 15 percent of the daily riders passing the maximum load point in the heavy direction during the peak-hour. (As previously indicated, approximately 60 percent of the daily riders pass the maximum load point. Thus, for

TABLE 11 Percent Summary of Weekday Ridership Projections for Various Service Options in Michigan Avenue Corridor

Section	1980	Year 2000 (% of ridership) Base	Low-Capital Bus	Trolley Bus	High-Capital Bus	Light Rail
Grand-Homer	13.0	18.4	18.5	18.5	19.1	18.9
Homer-Harrison	13.1	17.9	18.2	18.1	18.9	18.7
Harrison-Charles	13.7	16.5	17.0	16.8	18.3	17.7
Charles-Hagadorn	30.5	37.5	40.2	42.3	46.2	46.7
Hagadorn-Mohawk	13.3	16.5	17.2	17.7	20.1	20.1
Mohawk-Meridian Mall (Marsh Road)	16.4	18.9	20.2	21.0	22.4	23.5
Total	100.0	125.7	131.3	134.4	145.0	145.6

TABLE 12 Total Summary of Weekday Ridership Projections for Various Service Options in Michigan Avenue Corridor

Section	1980	Year 2000 (total ridership) Base	Low-Capital Bus	Trolley Bus	High-Capital Bus	Light Rail
Grand-Homer, Homer-Harrison, Harrison-Charles, Charles-Hagadorn, Hagadorn-Mohawk, Mohawk-Meridian Mall (Marsh Road)	5,470	6,876	7,182	7,352	7,932	7,964
Meridian Mall Express	300	436	436	436	436	436
Routes 13-15	465	544	544	544	544	544
Total	6,235	7,856	8,162	8,332	8,912	8,944
Indices	1.00	1.26	1.31	1.34	1.43	1.43

TABLE 13 Anticipated Peak-Hour One-Way Riders at Maximum Load Point Based on Travel Time Changes

Year and Service	Base Condition	Improved Bus	Trolley Bus	Busway	Light Rail
1979-1980					
Route 1	300	-	-	-	-
Meridian Mall	75	-	-	-	-
Routes 13-15	65	-	-	-	-
Corridor Totals	440	-	-	-	-
1985					
Route 1	330	345	350	380	380
Meridian Mall	90	90	90	90	90
Routes 13-15	70	70	70	70	70
Corridor Totals	490	505	510	540	540
Adjusted Totals[a]	-	-	-	675[a]	675[a]
2000					
Route 1	390	405	415	450	450
Meridian Mall	115	115	115	115	115
Routes 13-15	80	80	80	80	80
Corridor Totals	585	600	610	645	645
Adjusted Totals	645[b]	660[b]	670[b]	805[a]	805[a]

[a]Includes 25 percent increase to reflect greater peaking in future years.
[b]Includes 10 percent increase to reflect greater peaking in future years.

Source: 1985-2000 Base Conditions are taken from Table 8; increased ridership for various options is based on ratios in Table 10.

8,900 daily riders in the year 2000, under the high capital bus and light rail options .15 x .60 x 8,900, or approximately 800 riders, would pass the maximum load point in the peak-hour peak direction trip.)

Fare changes

The preceding patronage estimates would be reduced 7-8 percent with a $0.50 fare (constant dollars) based on CATA's actual 1980-1981 experience.

Headways

All alternatives assumed that service frequency would be keyed to demand. In all cases, frequencies would equal or exceed current service frequency west of Charles. The higher ridership on the busway and light rail options would be absorbed by the larger capacities of the vehicles. Differences in frequency among the various options (7.5- to 10-min headways) coupled with a low headway elasticity (-0.25) suggest minimal ridership impacts. Consequently, no adjustments were made.

Sensitivity Analysis

Selected sensitivity analyses were performed to assess the effects of changes in traffic congestion, parking policy, and fuel costs and availability on potential transit ridership in the Michigan Avenue Corridor. These analyses drew on experiences throughout the United States as they relate to the Lansing-East Lansing situation.

Traffic Congestion

Travel growth of 26 percent by the year 2000 will substantially increase daily traffic flows along Michigan and Grand River Avenues and other streets in the corridor. Corridor peak-hour traffic growth will be slightly less, ranging from 15 to 20 percent overall. The additional traffic on Michigan Avenue will increase peak-period car and on-street transit travel times by up to 20 percent (i.e., an additional 1-2 min between Grand and Abbott, and another 1-2 min between Abbott and Meridian Mall).

Available cross-elasticity data give 0.32 for bus riders and 0.84 for rail rapid transit riders, assuming that transit is not affected by congestion (3). Elasticities of 0.4 to 0.5 have also been used in analyzing light rail transit patronage.

Accordingly, a cross-elasticity of +0.5 was applied to the busway and light rail options. An assumed 20 percent increase in corridor congestion here would yield a 10 percent gain in riders. Year 2000 corridor ridership would approximate 9,705 for the busway and 9,740 for the light rail. Anticipated year-2000 peak-hour one-way riders at the maximum load point would approximate 860. Thus, as automobile traffic becomes more congested, the light rail and busway options would become more attractive.

Parking

Stabilizing the downtown Lansing parking supply would produce up to 750 additional riders at the maximum load point; however, such a parking freeze was considered neither realistic nor practical. Moreover, it would seriously deter additional investment resulting in fewer transit riders than the preceding figures suggest.

Studies have suggested a cross-elasticity between transit ridership and parking rates of 0.51 for work trips and 0.38 for nonwork trips. Accordingly, a 0.45 factor was applied to 50 percent of the downtown Lansing's 15,000 parking spaces (3). State employee parking would account for 40 percent of the year-2000 supply, and an additional 10 percent of the spaces would continue to be available without charge as follows: (a) A 50 percent increase in parking costs (in constant dollars) would result in an 11 percent increase in corridor transit ridership; and (b) A 100 percent increase in parking costs (in constant dollars) would result in a 22 percent increase in corridor transit ridership.

Gasoline Price Increases

Automobile costs in 1990 will be slightly less than in 1980 because of greater fleet efficiency and stabilized fuel costs. However, automobile costs by 2000 could be 20 percent higher, assuming a high gasoline price scenario (4).

Cross-elasticities between increased transit ridership and automobile operating costs (excluding parking) have been reported as 0.21 for work trips, and 0.12 for non-work trips. That is, a 100 percent increase in fuel and automobile operating costs would result in a 12-21 percent increase in transit ridership (3). An elasticity of 18 percent and a real gas cost increase of 20 percent would result in a 3.6 percent gain in transit riders, in the study corridor; a 50 percent cost increase would produce a 9 percent gain. Consequently, increases in the cost of gasoline would not substantially increase corridor transit patronage unless unforeseen conditions occur.

Reduced Fuel Supply

A sustained fuel shortage could increase transit riding in the Michigan Avenue Corridor by 15-20 percent. This estimate is based on a 15-20 percent gain in Dallas (1973-1974) and 17 percent gain in Baltimore (1978-1979) (5,6).

Summary of Impacts

Anticipated year-2000 impacts of increased traffic congestion, parking supply constraints and costs, higher gasoline prices, and fuel shortages are given in Table 14. Because some overlap, the combined effects of several measures would be less than their sum.

Summary of Ridership Forecasts

The patronage estimates suggested for use in comparing alternative public transport systems are given in Table 15. These forecasts recognize that bus ridership would not keep pace with population and economic growth unless service is improved. The year-2000 ridership estimates for the light rail and high capital bus options reflect the impact of increased congestion. The peak-hour ridership estimates assume some increased peaking as follows:

- There were 6,235 daily riders in the corridor from 1979 to 1980. By 2000, assuming a $0.50 fare, ridership could approach 9,000 for some of the options.
- Peak-hour ridership was 440 in 1974 at the maximum load point. By 2000, this ridership could approach 800, assuming a $0.50 fare.

The ridership forecasts reflect the changes in activity anticipated in the corridor as of mid-1981. Faster rates of population and economic growth, concerted efforts to revitalize central Lansing, and expansion of State of Michigan employment and MSU

TABLE 14 Anticipated Effects of Traffic Congestion, Parking Constraints, Fuel Costs, and Shortages on Michigan Avenue Corridor Ridership

Impact	Percent Change	Percent Increase in Year 2000 Transit Riders	Transit Riders Affected
Automobile driving times	+20	+10	Busway, Light Rail options
Stabilizing downtown Lansing parking supply	–	+50	All options
Stabilizing state employee parking supply in downtown Lansing	–	15-20	All options
Downtown Lansing parking rates	50	11	All options
	100	22	All options
Increased gasoline costs per mile of travel	20	4	All options
	50	9	All options
Sustained fuel shortage	–	15-20	All options

TABLE 15 Summary of Daily Riders in Corridor

Alternative	No. of Riders by Year and Fare: 1980, $0.35	1985: $0.35	1985: $0.50	2000: $0.35	2000: $0.50
Daily Riders in Corridor[a]					
Base service alternative					
Status quo	6,235	6,300	5,800	6,300	5,800
Service adjustment keyed to travel growth	6,235	6,800	6,260	7,860	7,230
Low-capital bus	6,515	7,100	6,530	8,200	7,540
Trolley bus	6,630	7,200	6,620	8,300	7,640
High-capital bus	7,120	7,700	7,080	9,700[b]	8,920[b]
Light Rail Transit	7,145	7,750	7,130	9,740[b]	8,960[b]
Peak-Hour Riders at Maximum Load Point in Corridor[c]					
Base service alternative					
Status quo	440	450	410	450	410
Service adjustment keyed to travel growth	440	490	450	645	590
Low-capital bus	460	500	460	660	610
Trolley bus	470	510	470	670	620
High-capital bus	500	675	620	860	790
Light Rail Transit	500	675	620	860	790

Note: Data are rounded. Fares are in constant dollars; riders paying a $0.50 fare = 92 percent of riders paying a $0.35 fare.
[a]Base condition (1979-1980) = 6,235 daily riders at $0.35 fare.
[b]Includes adjustment for traffic congestion.
[c]Base condition (1979-1980) = 440 daily riders at $0.35 fare.

enrollment could result in higher future ridership. Conversely, lower corridor growth could keep the ridership near existing levels. With no population growth, and no changes in fares, the high-capital bus and light rail options were estimated to attract 17 percent more riders than the base service condition.

Changes in Lansing's economy over the last 5 years suggest that the initial 1985 and 2000 population and employment forecasts were too high. Therefore, it is not likely that the year-2000 ridership forecasts would be achieved unless dramatic changes in the economy take place.

IMPLICATIONS

The use of on-and-off transit counts and travel elasticity data in conjunction with population and employment change provides a reasonable approach to estimating corridor transit ridership for various service options. While the data is site-specific, the techniques can be applied in other urban areas.

The method is realistic for existing or short-range growth. The effects of service improvements alone, 17 percent over base conditions, appear reasonable. The method assumes that transit system ridership would keep pace with population and employment growth in a corridor. Such a condition, however, does not always exist; therefore, a broader application would require analysis of trends in transit's market share, and application of appropriate adjustments to the forecasted future trip interchanges. Given such adjustments, the methods then can be applied to estimate the ridership impacts of fare, service, and travel time changes.

REFERENCES

1. H.S. Levinson. Travel Demand Analysis--Michigan Avenue Corridor--Lansing, East Lansing, Michigan. Prepared for City of Lansing, City of East Lansing, Michigan Department of Transportation, East Lansing, Sept. 1981.
2. Michigan Avenue Corridor Study, Final Report. George Beetle Company, Prepared for City of Lansing, City of East Lansing, Michigan Department of Transportation, East Lansing, 1982.
3. P. Mayworm, A. Lago, and J.M. McEnroe. Patronage Impacts of Changes in Transit Fares and Services. Ecosometrics, Bethesda, Md., 1980.
4. Profile of the 80's. Assistant Secretary for Policy and International Affairs, U.S. Department of Transportation, Feb. 1980.
5. W.G. Barker and L.C. Cooper. An Approach to Local Transportation Planning for National Energy Contingencies. North Central Texas Council of Governments, Arlington, Texas, Jan. 1978.
6. C.R. Goodman. The 1979 Gasoline Shortage Impact of Travel in the Baltimore Region. In A Transportation Revolution, Compendium of Technical Papers, 51st Annual Meeting, Institute of Transportation Engineers, Boston, Mass., Aug. 16-20, 1981.

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Transit Service Contracting: Experiences and Issues

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ABSTRACT

Public transportation's fiscal problems have stimulated interest in service contracting as a strategy for improving the cost-effectiveness of service delivery. This paper contains a review of available evidence on transit service contracting with a particular focus on: (a) the extent of service contracting, including who practices it and the types of services involved, (b) the motivations for contracting, (c) the estimated costs and subsidy savings that can be realized from contracting, and (d) the major obstacles to this strategy. Available information indicates that transit contracting is a widely used strategy for supplemental DRT service and for small transit systems in states where state funds are available to subsidize transit. However, despite the impressive numbers of contracted services, they represent a small percentage of transit expenditures. The motivation for contracting is almost invariably financial, and contracting can save substantial sums. Compared to public agency operation, private sector contracting can produce cost savings of 15 to 60 percent, and subsidy savings of 50 percent or more. Resistance from transit, labor, and management to service contracting constitutes the major reason these large cost and subsidy savings have not induced more public agencies to contract. Management is reluctant to relinquish operational control, fearing a diminishment of service quality, and labor fears a loss of jobs.