Appendix 2. The Midway Orange Line Corridor Serving Chicago

Executive Summary

Working Paper 1 (Subtask 1d, November 25, 1998) develops a theoretical and measurement framework within which the Mogridge-Lewis Convergence Hypothesis (MLC) can be employed in measuring the savings in highway delay attributable to transit and its equilibrating effect on the level of service in the corridor.

The framework also provides an MLC-based approach to making repeated measures of transit-induced savings in corridor delay without the need for repeated MLC surveys. The approach rests on the theoretical proposition, proven in Working Paper 1, that a stable and measurable relationship exists between roadway traffic growth over time and the inter-modal (highway-transit) equilibrium dynamics that give rise to delay savings in a congested corridor. In the absence of major changes in the level of highway supply or transit service in the corridor, this measured relationship, or model, provides a formula-based performance measurement system in lieu of a survey-based approach. In addition to the obvious cost advantages, this approach provides FTA with (i) an efficient means of measuring and comparing transit performance in strategic corridors; and (ii) a consistent performance assessment tool for transfer to MPOs throughout the country.

Purpose and Method

This Working Paper presents a case study of the methodology developed in Subtask 1c in application to the Midway Airport-Chicago corridor. The methodology consists of calibrating the MLC-traffic model with survey data. The model is then used to quantify delay savings attributable to train at present, and at alternative roadway traffic volumes (each for different user categories).

The study consists of four main steps:

Collecting highway travel data (traffic volume, distance, travel time, and vehicle occupancy in the corridor); and train ridership data along the corridor;

Conducting door-to-door travel time surveys and deriving the inter-modal convergence;

Estimating the "with transit" and "without transit" model and related curves and estimating the hours of delay saved due to transit; and

Quantifying delay savings by user category, namely, (i) train riders ("market" benefits); (ii) common segment users ("club" benefits); and, (iii) parallel highway users ("spillover" benefits).

The Midway Airport-Chicago corridor was selected to measure the performance of the train system connecting several residential areas with the Central Business District of Chicago, Illinois. MLC theory predicts that the improved transit system will attract modal explorers, reduce congestion, and improve roadway travel times. As a result, we would expect to see improvements in both highway and transit door-to-door travel times

Principal Findings

The case study finds that based on the MLC model calibrated with 1999 survey data, the magnitude of peak-period delay savings per trip due to transit is about 4 minutes and 43 seconds per door-to-door trip (about 24 seconds per mile). These savings amount to about 8 percent of total door-to-door journey times and align with reasoned expectations.

HLB estimated the hours of delay savings for three different user groups: Train riders (market benefits), users of the I-55 common segment (club benefits), and users of parallel highways (spillover benefits). Table A 2.1 presents the estimated delay savings by category of user. Based on an assumed value of peak travel time of $15 per hour and an average of 250 working days per year, Table A 2.1 indicates aggregate peak delay savings due to transit of $47.3 million for 1999. The savings can be translated to $3.9 million per rail mile.

Table A 2.1 Benefits Summary for the Midway Airport-Chicago Corridor

Benefit Category	Daily Savings In Hours	Daily Savings In Dollars	Yearly Savings In Dollars
Market	1,116	$ 16,735	$ 4,183,761
Club	6,953	$ 104,294	$ 26,073,520
Spillover	4,547	$ 68,211	$ 17,052,831
Total	12,616	$ 189,240	$ 47,310,111

The summary table shows that 55% of the savings are savings by the highway common segment users while only 8% of the savings are savings by the CTA Orange Line users. These results illustrate the significant contribution of transit in reducing congestion on highways near transit lines.

Figure A 2.1 displays the "with-" and "without transit" curves using 1999 convergence data. The vertical difference between the "with-" and "without transit" curves represents the delay savings due to transit at different volumes of I-55 traffic. The curves indicate that in the absence of major infrastructure improvements or radical traffic growth, the performance metric will remain stable.

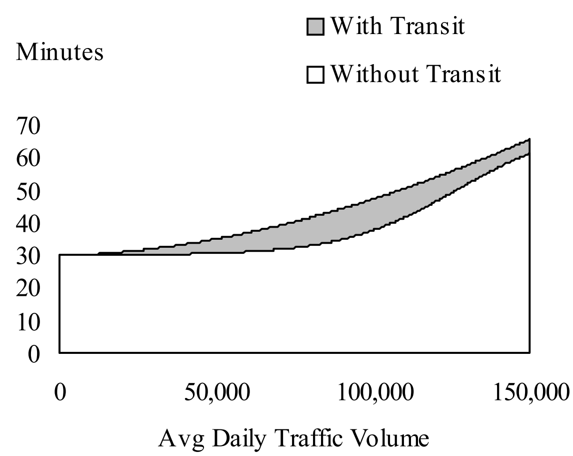


Figure A 2.1 Illustration of the "With" and "Without Transit" Curves for the Midway Airport-Chicago Corridor

Introduction

This report presents the results for the Midway Airport-Chicago corridor case study as part of Streamlined Strategic Corridor Travel Time Management study. The purpose of the study is to use the convergence measurement technique to derive a repeatable performance measurement for rail transit in congested corridors. This case study measures the performance of Dallas's CTA Orange Line using the methodology developed in Subtask 1c. The methodology consists of calibrating the Mogridge-Lewis Convergence Hypothesis (MLC) model with survey data and using the model to quantify delay savings attributable to transit at different roadway traffic volumes. The savings are estimated for three different user categories using highway traffic data and train ridership in the corridor.

Study Methodology

The study methodology consists of four main steps:

1. Collecting highway travel data (traffic volume, distance, travel time, and vehicle occupancy in the corridor); and train ridership data along the corridor;
2. Conducting door-to-door travel time surveys and deriving the inter-modal convergence; (this report also presents a comparison between 1995 travel time survey and the new survey)
3. Estimating the "with transit" and "without transit" model and related curves and estimating the hours of delay saved due to transit; and
4. Quantifying delay savings by user category, namely, (i) train riders ("market" benefits); (ii) common segment users ("club" benefits); and, (iii) parallel highway users ("spillover" benefits).

During the first step, HLB collected HPMS data, local arterials traffic data, and train ridership data from the Illinois Department of Transportation and Chicago Transit Authority (the local transit authority). The data were used to estimate the model parameters.

For the second step, data was collected on site by a survey team. A corridor, as defined in this study, is a principal transportation artery into the central business district. Multiple transportation services are available to commuters who use this artery. Additionally, during the peak period a large number of commuters utilize this route in their door-to-door commute.

A statistical sample of trips was generated in the corridor by identifying random trip end point in the zones at either end of the corridor and joining them so that trips alternated between zones. These zones are catchment zones where travelers converge or diverge from either the transit station or the principal highway route. In this study these zones are defined as the access segment and the component of the corridor common to all trips for a given mode, regardless of trip end location, is defined as the common segment.

Survey crews were instructed to follow specific routes that consisted of an access segment—dependent on the catchment zone considered for the trip—and a common segment. The data collected include start times and arrival times for each segment, by mode, congestion level, seating availability, weather, road conditions, and travel costs for each segment.

Data were collected over a period of three consecutive days (Tuesday to Thursday) during the last week of October 1999. The days of the week were sampled to eliminate fluctuations in traffic patterns and volumes due to the day of week effects. Trips were validated to minimize the effects of unusual or circumstantial conditions. Sixty valid trips were selected to ensure a statistically adequate sample size. The study employed the maps and routes connecting several zones within a residential area to several points within Chicago's central business district.

Step three consisted of estimating the "with transit" curve based on the traffic volume and the door-to-door travel time. Using the model developed in Subtask 1c, HLB derived the "without transit" curve and estimated the hours of delay saved due to transit. This performance metric is defined as the vertical difference between the two curves.

In step four, the hours of delay saved due to transit are aggregated into three user categories. Savings by common highway-segment users are estimated using the traffic volume on the segment. Savings by train riders are estimated using the ridership data for each station along the corridor. Savings by parallel highway users are estimated using traffic volume on parallel highways and arterials within the corridor. The magnitude of the savings decreases as the distance between the common segment and the arterial increases.

Plan of the Report

This report presents the results from the Midway Airport-Chicago corridor case study. Following this introduction, Chapter 2 presents an overview of the model and methodology to estimate the delay saving. Chapter 3 displays the corridor characteristics and a description of the principal modes of transportation within the corridor. Chapter 4 presents the results from the 1999 door-to-door travel survey and its comparison to 1995 travel survey. The chapter also shows the model estimation results and estimates the hours of delay saved due to transit per person per day, and provides a monetary value of the delay saved for three user categories. Appendices provide maps of the residential area and the central business district as well as supporting data and supplementary results on the survey findings by route.

Methodolgy and Model Overview

The methodology consists of four steps:

1. Estimating the Corridor Performance Baseline
2. Estimating the Corridor Performance in the Absence of transit
3. Extrapolating Delay Savings Due to Transit
4. Estimation of Corridor Performance without Re-calibration

Estimating the Corridor Performance Baseline

<u>The Model</u> This model establishes a functional relationship between the person trip volume –all modes—and the average door-to-door travel time by auto in the corridor.

The door to door travel time by auto can be determined using a logistic function which calculates the door to door travel time in terms of travel time at free flow speed, trip time by high capacity rail mode, and the volume of trips in the corridor for all modes. The door-to-door travel time can be estimated as follows:

$$\mathbf{T = (T_c - T_{ff}) / (1 + e^{-(\delta + \varepsilon V1)}) + T_{ff}} \qquad \textbf{(1)}$$

Where T_{a1} is auto trip time,
Tc is trip time by high-capacity rail mode
T_{ff} is auto trip time at free-flow speed,
V is person trip volume in the corridor by auto, and
δ, ε are model parameters

Equation 1 implies that the door-to-door auto trip time is equal to the trip time at free-flow speed plus a delay that depends on transit travel time and the person trip volume in the corridor.

In other words, when the highway volume is close to zero, travel time is equal to travel time at free flow speed.($T = T_{ff}$). As the volume increases, the travel time is equal to T_{ff} plus a delay due to the high volume, but adjusted to the travel time by high capacity transit. That is the high capacity transit alleviates some of the highway trip delay as some trips shift to transit.

Equation 1 is transformed into a linear functional form before the parameters δ and ε can be estimated, the transformed equation will be:

$$\mathbf{U = \delta + \varepsilon V_1} \qquad \textbf{(2)}$$

Where $U = \ln [(T_c - T_{ff}) / (T - T_{ff}) - 1]$

Equation 2 is estimated using Ordinary Least Squares regression.

<u>Data</u> The data required for the estimation of the above equations are:

Person trip volume on the highway that can be calculated by dividing the traffic volume by the average vehicle occupancy (auto and buses). These data are available through HPMS database and MPO's traffic data.

Free flow trip time is a constant.

High capacity trip time is a constant.

The parameters δ and ε do not have to be re-estimated each year, they are both specific to the corridor and are relatively stable over the years. So periodically, the person trips volume can be inserted into Equation 1 to estimate the door to door travel time by auto.

Estimating the Corridor Performance in the Absence of transit

<u>The Model</u> This model represents the concept to quantify the role of transit in congestion management. In the absence of transit, the travel time Ta is estimated as:

$$\mathbf{T_a = T_{ff} \ * \ (1 + A (V^*)^{\beta})} \qquad \textbf{(3)}$$

Where T_a is the door to door travel time in the absence of transit,
T_{ff} is the trip travel time at free-flow speed,
V* is the volume of person trips by auto in the absence of transit,
A is a scalar, and β is a parameter.

Equation 3 implies that the door-to-door travel time in the absence of transit depends on the travel time at free-flow speed and the level of congestion on the road in the absence of transit.

The volume of person trips by auto in the absence of transit, however, depends on several factors:

The existing auto and bus person trips on the highway.

The percentage of person transit trips shifting to auto

The percentage of person transit trips shifting to bus

The number of additional cars in the highway

The number of additional buses in the highway

The occupancy per vehicle in the absence of transit

The volume of person trips by auto, in the absence of transit, can then be estimated as:

$$\mathbf{V^{*} = V_1 + \alpha_1 V_c + \alpha_2 V_b} \qquad \textbf{(4)}$$

Where V_1 is the existing auto volume,

V_c is the transit person trips diverted to cars,

V_b is the transit person trips diverted to buses, and

$\alpha_{1,}$ α_2 are the coefficients that incorporate the passenger car equivalent factor, and the occupancy per vehicle (cars and buses).

The trips diverted to cars and buses depend mainly on the degree of convergence in the corridor. This degree of convergence reflects the transit user behavior and the composition of these users. The transit users can be divided into 3 categories:

Type 1: "Explorers" who are casual switchers and who will divert to Single Occupancy Vehicles in the absence of transit.

Type 2: Commuters with low elasticity of demand with respect to generalized cost and who will divert to use the bus or carpool.

Type 3: Commuters with high elasticity of demand with respect to generalized cost and who will forgoes the trip.

The higher the degree of convergence (auto and rail door to door travel times are very close), the higher the shift of transit riders to cars and buses. Therefore, higher degree of convergence will lead to higher delay, which translates into higher savings due to transit.

In words, Equation 3 shows that in the absence of transit and in the case of a high degree of convergence, the person trip volume is very high which translates into a high trip time (excessive delay). The relationship between trip time and person trip volume can be expressed as a convex curve (as the volume increases, travel time increases at an increasing rate). Figure A 2.2 illustrates the relationship between the volume and travel time both in the presence and in the absence of transit.

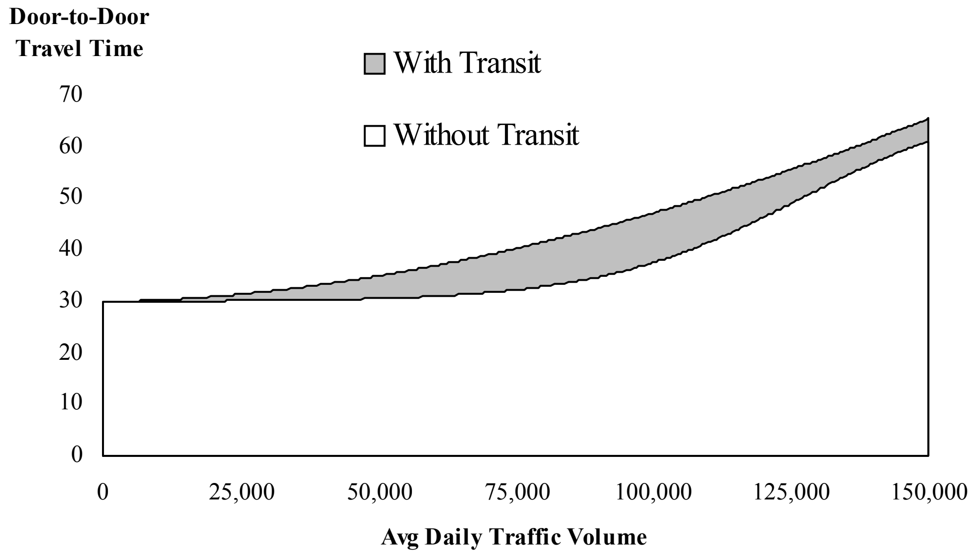


Figure A 2.2 Illustration of the "With" and "Without Transit" Curves for the Midway Airport-Chicago Corridor

Data The data required to populate this model consist of:

Highway person trip volume (used in the previous model)

Transit ridership data

Fleet composition (cars and buses percentages out of the total traffic)

Cars and buses vehicle occupancy

Passenger car equivalent factor

Degree of convergence to determine the percentage person trips shifting to cars and buses

Free-flow travel time which is a constant

Equation 3 is specific to the corridor and do not need to be estimated each year. It will only be necessary to re-estimate them with an updated degree of convergence if a major change is made to the transit level of service or the highway structure.

Extrapolating Delay Savings Due to Transit

While the MLC hypothesis proves to be valid during the peak period only, the delay savings due to transit can be estimated during off-peak as well. This metric can be estimated as the vertical difference between the "without transit" curve and the "with transit" curve. That is at a specific person trip volume, the difference in travel times between the two cases can be defined as "the hours of delay saved due to transit".

The estimated hours of delay savings due to transit are an aggregation of three different user savings: savings by train riders (market benefits), savings by highway users (club benefits), and savings by users of parallel highways (spillover benefits).

The *market* benefits are estimated based on delay saved (which depends on the distance traveled) for each rider within the common segment.

The *club* benefits are estimated based on the volume on the common segment using origin-destination table and the daily trip distribution.

The *spillover* benefits are estimated based on the savings per mile, traffic volume, and the distance traveled on segments parallel to the common segment. The spillover benefits are calculated by multiplying the traffic volume with a percentage of the delay savings. This percentage decreases as the distance between the common segment and the parallel highway increases.

Estimation of Corridor Performance without Re-calibration

The framework, presented above, provides an MLC-based approach to making repeated measures of transit-induced savings in corridor delay *without* the need for repeated MLC surveys. The approach rests on the theoretical proposition, that a stable and measurable relationship exists between roadway traffic growth over time and the inter-modal (highway-transit) equilibrium dynamics that give rise to delay savings in a congested corridor. In the absence of major changes in the level of highway supply or transit service in the corridor, this measured relationship, or model, provides a formula-based performance measurement system in lieu of a survey-based approach. In addition to the obvious cost advantages, this approach provides FTA with (i) an efficient means of measuring and comparing transit performance in strategic corridors; and (ii) a consistent performance assessment tool for transfer to MPOs throughout the country.

Corridor Overview

The Midway Airport-Chicago corridor is about 12 miles in length and connects the residential areas surrounding Midway Airport with Central Business District in Chicago, Illinois. The Midway catchment zone is centered at Midway Airport. Trip end points within the residential zone are no more than a 15-minute drive to the Midway CTA Station. The downtown Chicago zone, centered on the Downtown Loop, extends no more than one block outside the Downtown Loop. Travelers disembark at the station which is closest to the trip end point. The Midway CTA Orange transit line opened for service on October 31, 1993. App. Annex A1 provides maps of the residential and business district zones considered in this study.

Principal Travel Modes

The “principal travel mode” is defined as the mode used during the common segment of each individual trip. The Chicago-Midway Corridor is primarily served by two key transportation modes, automobile and heavy rail (CTA Orange Line). The study of the corridor focused on both inbound and outbound commuter trips between the central business district in Chicago, (the loop), and the residential area surrounding the Midway Airport. Automobile routes can be broken into three distinct sections:

1. The route between the residential point and the junction of Cicero Avenue and I-55, the Stevenson Expressway (Access1);

2. The route between the junction of Cicero Avenue and I-55 and the junction of the John F. Kennedy Expressway (I-90/94) and Madison Street in Chicago (Common Segment); and
3. The route between the junction of the John F. Kennedy Expressway (I-90/94) and Madison Street and the CBD point (Access2).

For a morning rush hour trip, survey drivers followed Access1 to the common segment. The route taken for the common segment began at the junction of Cicero Avenue and I-55, the Stevenson Expressway and proceeded East on I-55 to the JFK Expressway North and exited at the Madison Street exit. From the end of the common segment, the driver followed Access2 to the downtown points, at which time they parked at the closest parking lot and proceeded on foot to the end point. The evening rush hour trip covered the same progression in the opposite direction, except that the common segment began at the junction of Monroe Street and the JFK Expressway.

The routes for the CTA Orange Line mode can be broken into three distinct sections

1. The route between the residential point and the Midway CTA Station (Access1);
2. The route between the Midway CTA Station and the Lasalle/Van Buren CTA Station (Common Segment); and
3. The route between the Lasalle/Van Buren CTA Station and the CBD point (Access2).

For a morning rush hour trip, survey crews drove Access1 to the Midway CTA Station parking lot and walked from the lot to the train station. The route taken for the common segment consisted of a train ride that begins at the Midway CTA Station and continues to the Lasalle/Van Buren CTA Station. From the end of the common segment, the surveyor walked Access2 to the downtown points. The evening rush hour trip covered the same progression in the opposite direction. On average, trains run every 10 minutes during peak hours. Table A 2.2 displays some of the principal performance and service characteristics of the corridor. Figure A 2.3 shows the Midway Airport-Chicago corridor and the main highways and arterials in the area.

Table A 2.2 Performance and Service Characteristics

	Automobile	Train
Number of stops	N/A	8
Number of Streets and Highways	2	N/A
Tolls/Fares for a one way (in dollars)	$0.00	$1.50

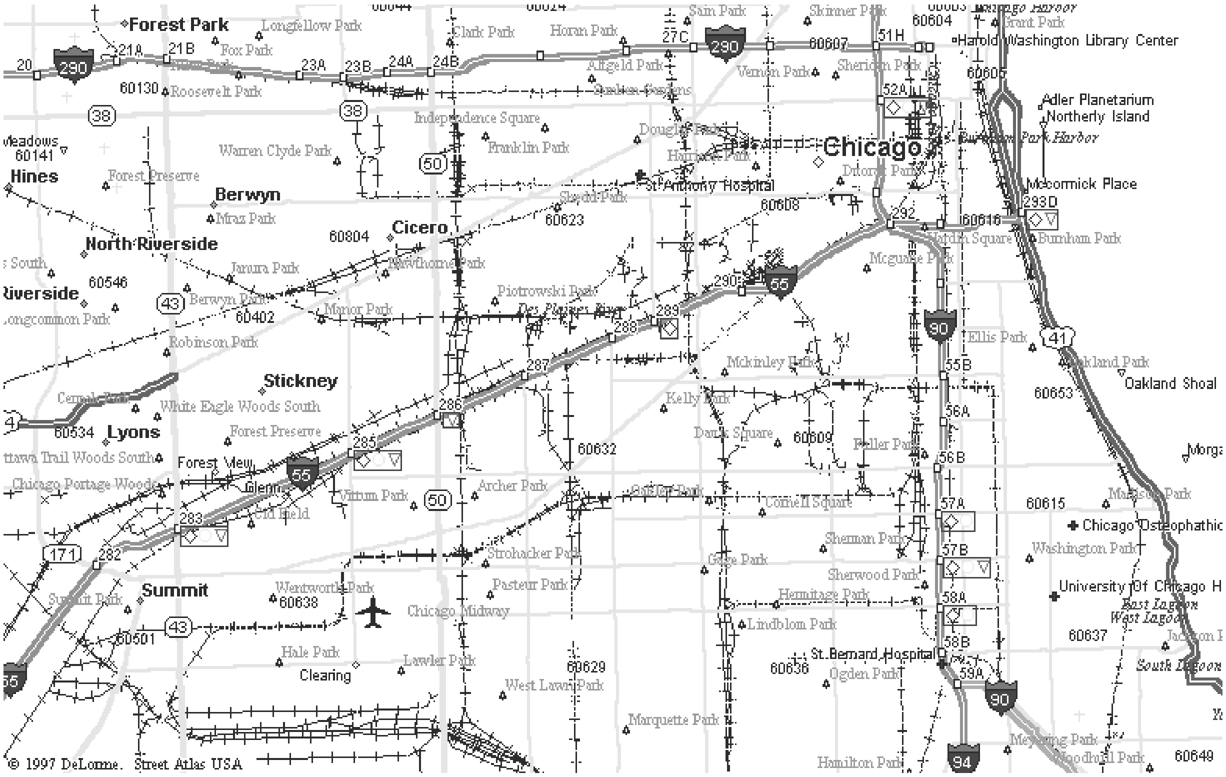


Figure A 2.3 Map of the Midway Airport - Chicago Corridor

Principal Findings

This chapter starts by presenting the results from the door-to-door travel survey conducted during the last week of October 1999. The travel survey data are used to derive the inter-modal convergence level in the Midway Airport-Chicago corridor. The chapter then presents the estimation of the hours of delay saved due to transit for different user categories.

The Convergence Level

The starting point to estimate the "without transit" curve is to determine the convergence level based on the key findings from the 1999 door to door travel data.

The door-to-door travel survey for the Midway Airport-Chicago corridor found that:

- Average door-to-door travel times for auto and rail, are similar, 61.1 minutes by rail versus 57.8 minutes by auto (Table A 2.3). The 1995 findings show a similar travel time by rail (60.6 minutes) but a lower travel time by auto (54.2 minutes). The findings imply that the roadways are experiencing higher congestion in 1999 compared to 1995, leading to an increase of 6.6 percent in travel time.
- Travel time reliability, as represented by the standard deviation of average travel time is 7.6 for train mode and 9.8 for the auto mode (Table A 2.3).
- Commuters experienced similar travel times in the morning and in the evening reflecting the similar traffic dynamics of the inbound peak flow versus the outbound peak flow in the corridor (Table A 2.4).

- Statistical analysis shows that the mean trip time by train was at most 7 minutes longer with 90% confidence (Table A 2.4), compared to 9 minutes in 1995. This finding validates the MLC hypothesis stating that higher congestion leads to higher intermodal travel time convergence.
- The common segment travel time was slightly lower for the train mode than for the transit mode, 29.8 minutes versus 31.4 minutes. The difference of 2 minutes between the two modes is due to the congestion on I-55 (Table A 2.3).
- Similarly, access segment travel time was higher for train commuters than for auto commuters (31.3 minutes) and transit commuters (26.3 minutes) (Table A 2.3).

Table A 2.3 Results for the Midway Airport-Chicago Corridor based on 1999 and 1995 findings

	1999 Findings		1995 Findings	
	Automobile	CTA Rail	Automobile	CTA Rail
	Total Travel Time			
Mean	57.77	61.06	54.2	60.6
Standard Deviation	9.76	7.60	13.3	8.2
	Access Segment Travel Time			
Mean	26.33	31.28	28.2	32.1
Standard Deviation	4.58	8.12	9.5	6.5
	Common Segment Travel Time			
Mean	31.44	29.78	26.1	28.5
Standard Deviation	9.31	2.80	7.5	3.8
Sample Size	30	30	30	30

Table A 2.4 Comparison of AM and PM Trip Times by Modes

	Auto	CTA Rail
Inbound AM Average Trip Time	58.22	60.0
Outbound PM Average Trip Time	57.33	62.1

The results in Table A 2.4 indicate that transit in the defined corridor has drawn door-to-door travel times by highway and train to within 7 minutes of one another during congested roadway conditions (with 95 percent statistical confidence).

Although an inter-modal travel time convergence of 7 minutes is sufficient to yield delay savings to highway users (as compared to the "without rail" case – see below), full convergence would of course yield even greater savings

The Mogridge-Lewis framework predicts that non-time related roadway travel costs (i.e, the non-time elements of "generalized cost" such as parking costs, fuel costs and so on) account for the "7 minute wedge." Train users are expected to re-explore the roadway option to the point at which the value of non-time generalized cost factors just equals the value of the travel time advantage offered by road. If non-time costs are moderate to high, travel time convergence will occur at a non-zero time differential between road and rail.

Table A 2.5 Statistical Testing of Convergence Hypothesis

	1999 Findings		1995 Findings	
Difference in Mean Travel Times by Mode: (Auto- CTA Orange Line)	3.3		6.4	
Standard Error of the Difference of the Means (minutes):	2.3		2.7	
Hypothesis:	Significant at	Significant at	Significant at	Significant at
"The difference between the mean travel times by modes is at most..."	0.10 Level (90% Confidence)	0.05 Level (95% Confidence)	0.10 Level (90% Confidence)	0.05 Level (95% Confidence)
7 Minutes	YES	NO	NO	NO
8 Minutes	YES	YES	YES	NO
9 Minutes	YES	YES	YES	NO
10 Minutes	YES	YES	YES	NO
11 Minutes	YES	YES	YES	YES

Methodology Application on Midway Airport - Chicago Corridor

Data HLB obtained traffic volume data (HPMS data) from the Illinois Department of Transportation and Chicago Transit Authority (the local transit authority. In addition, door-to-door travel time survey was conducted to derive the degree of convergence in the corridor.

Model The traffic volume and travel time data were used to populate the model. Equation 1 is estimated as follows:

$$\mathbf{T_{a1} = (70 - 30) / (1 + e^{-(-6.871 + 5.422\,E\text{-}05\,(V))}) + 30} \qquad \mathbf{(1)}$$

When V is equal to 0, the travel time is equal the travel time at free flow speed (30 minutes). For an auto traffic volume of 136,000 between Midway Airport and Downtown Chicago (based on 1998 O-D tables), the travel time is equal to 54 minutes.

Similarly, Equation 2 is estimated based on auto travel volume, transit ridership data, and convergence level estimate from the survey.

$$\mathbf{T_{a2} = 30 * (1 + 6.62779E\text{-}10\,(V^*)^{1.79})} \qquad \mathbf{(2)}$$

The auto traffic volume in the absence of transit is determined by adding the auto volume in the presence of transit to the generated auto trips by transit riders. The generated trips are based on the following assumptions:

- About 40% of person transit trips will be forgone (determined by the corridor convergence level).
- The average vehicle occupancy is 1.2 for cars and 40 for buses.
- Car trips will make about 90% of trips.

Benefit Estimation

To estimate the travel time saving (TTS) attributed to transit, the current traffic volume is inserted into Equation 1 and 2. An auto volume of 138,100 results into:

$$T_{a1} = 55.93, \quad T_{a2} = 60.63, \text{ and . } TTS = T_{a2} - T_{a1} = 4.71$$

That is on average, on Midway Airport-Chicago corridor, transit saves about 5 minutes per auto trip (24 seconds per mile) during the peak period. Once the average travel time saving per vehicle is estimated, the savings are weighted to reflect the congestion level at each time of the day.

Feeding the volume levels for 1999, for the Park Lane-Dallas corridor into equation (1) and (2), HLB estimated the hours of delay saved due to transit for 1999. The estimated hours of delay savings due to transit are an aggregation of three different user savings: savings by train riders (market benefits), savings by I-55 common segment users (club benefits), and savings by users of parallel highways (spillover benefits).

The market benefits are estimated based on delay saved (which depends on the distance traveled) by each rail rider within the common segment (Table A 2.6). The club benefits are estimated based on the volume on the common segment using origin-destination table and the

Table A 2.6 Market Benefits for the Midway Airport-Chicago Corridor

Station	Trips	Daily Savings (hours)
Midway	7542	355.23
Pulaski	5481	258.16
Kedzie	2726	121.97
Western	3315	148.33
35^{th} and Archer	2078	88.09
Ashland	1262	53.50
Halsted	2258	90.40
Roosevelt	2021	80.91
Adams/Wabash	6665	251.14
Lasalle/Van Buren	3268	123.14
Total	36,616	1,116

daily trip distribution (Table A 2.7). The spillover benefits are estimated based on the savings per mile, traffic volume, and the distance traveled on segments parallel to the common segment

(Table A 2.8). The magnitude of savings by the commuters on these highways decreases with the distance to the common segment.

Table A 2.9 shows the summary of benefits by category. The results indicate that the delay saving due to transit is about 5 minutes per trip one way (about 24 seconds per mile). Using a travel time value of $15 per hour and an average of 250 working days per year, the yearly delay saving can be valued at $47.3 million in 1999. This can be translated into a $3.9 million per rail mile in the Midway Airport-Chicago Corridor. The summary table shows that 55% of the savings are for the highway common segment users while only 8% of the savings are for the CTA Orange Line users. These results illustrate the significant contribution of transit in reducing congestion on highways near transit lines.

Table A 2.7 Club Benefits for the Midway Airport-Chicago Corridor

	Distance (miles)	Avg Daily Traffic Volume	Daily Savings (hours)
Common Segment			
I-55	8	167,100	2,274
I-90/94	4	300,400	3,270
Access Segment (on average)	3	138,100	1,409

Table A 2.8 Spillover Benefits for the Midway Airport-Chicago Corridor

Highways in the corridor	Distance (miles)	Average Daily Traffic Volume	Daily Savings (hours)
Ogden	3	18,700	183.20
Cermak	4	13,800	135.20
Archer	8	20,000	522.50
Pershing	2	17,900	132.98
47th Street	5	20,900	170.63
55th St. (Garfield)	6	12,600	246.88
51st St.	6	12,600	154.30
I-90/94	3	313,300	2,302.00
Ashland	2	30,100	147.44
Michigan	3	18,000	132.26
Halsted	3	20,000	195.94
Canal	1	20,000	48.98
Cicero	1	57,200	175.12
Total			4,547.42

Table A 2.9 Benefits Summary

Benefit Category	Daily Savings In Hours	Daily Savings In Dollars	Yearly Savings In Dollars
Market	1,116	$ 16,735	$ 4,183,761
Club	6,953	$ 104,294	$ 26,073,520
Spillover	4,547	$ 68,211	$ 17,052,831
Total	12,616	$ 189,240	$ 47,310,111

The methodology implies that in the absence of major infrastructure improvements or strong growth in volume of traffic the performance metric will remain stable. So, it should suffice to gather corridor travel time—degree of convergence—once every several years. In the case of major infrastructure improvement or a change in the transit service, however, door-to-door travel time data should be collected to estimate an accurate performance metric.

Annex A 2.1 Views of Chicago Midway Orange Line Corridor

Figure A 2.4 Map of the Residential Area, Midway Airport Vicinity

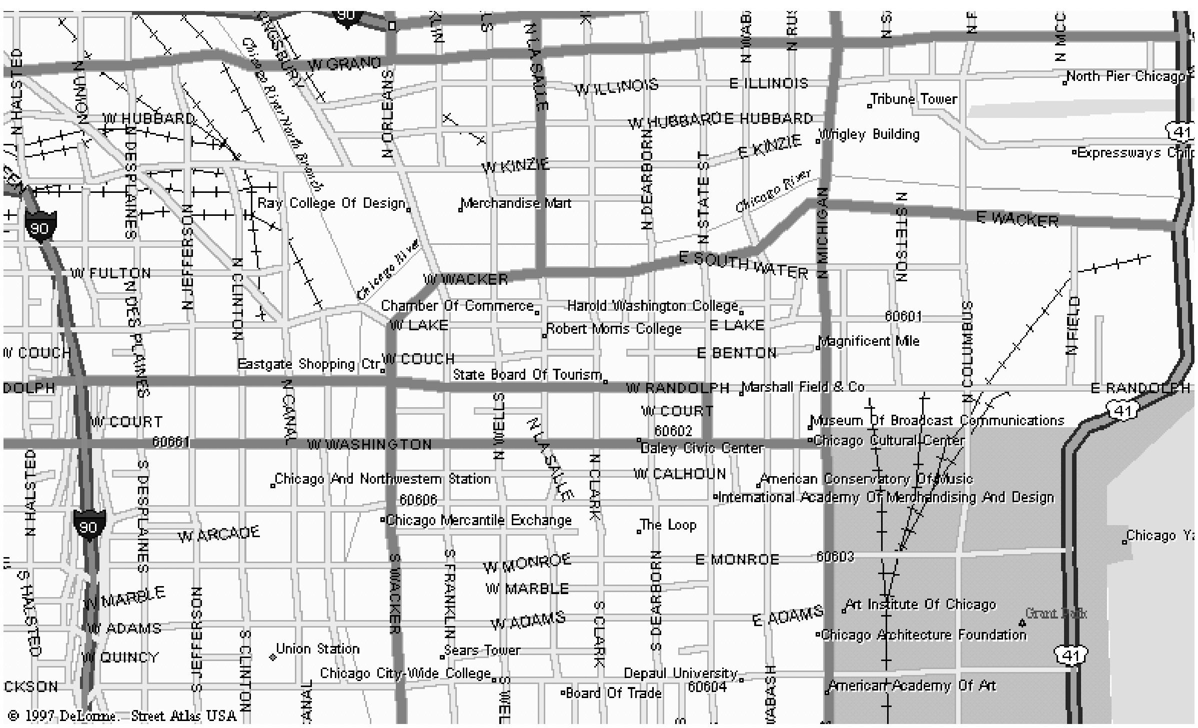
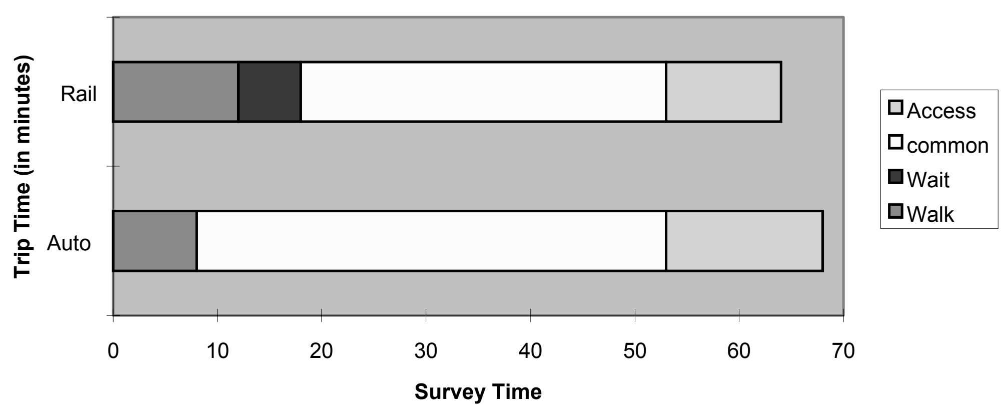


Figure A 2.5 Map of Loop Business District, Downtown Chicago

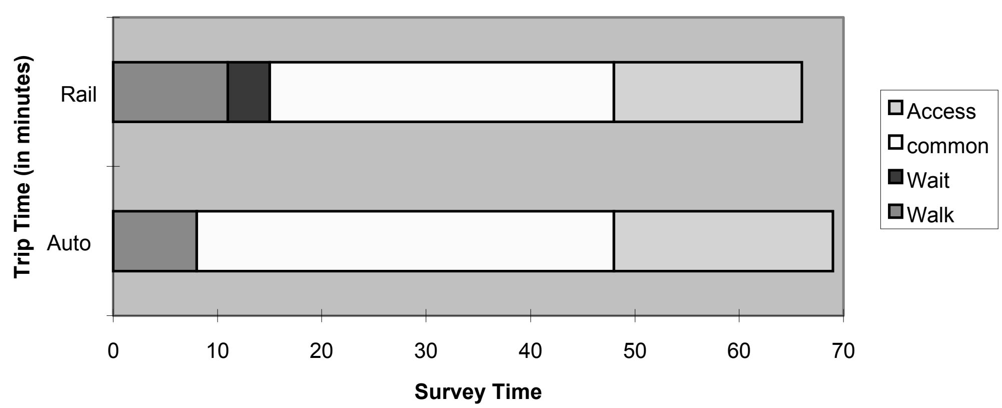
Annex A 2.2 The survey findings by route

CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE A-1:
W. Madison & N. Clark St. - 62nd & Karlov

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	68	64
In Common Segment	45	35
Outside Common Segment	15	11
Wait Time	0	6
Walk Time	8	12
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	11.5	11.7
In Common Segment	11.1	17.1
Outside Common Segment	18.8	13.6

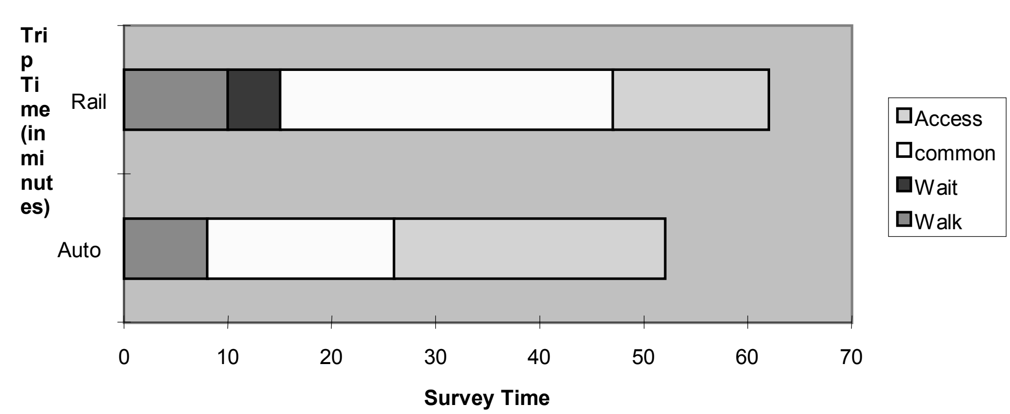


CORRIDOR: Midway Station - Chicago SUMMARY TABLE FOR ROUTE B-2: W. Quincy & LaSalle - Marquette & Kilpatrick	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	69	66
In Common Segment	40	33
Outside Common Segment	21	18
Wait Time	0	4
Walk Time	8	11
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	11.3	11.4
In Common Segment	12.5	18.2
Outside Common Segment	13.4	8.3



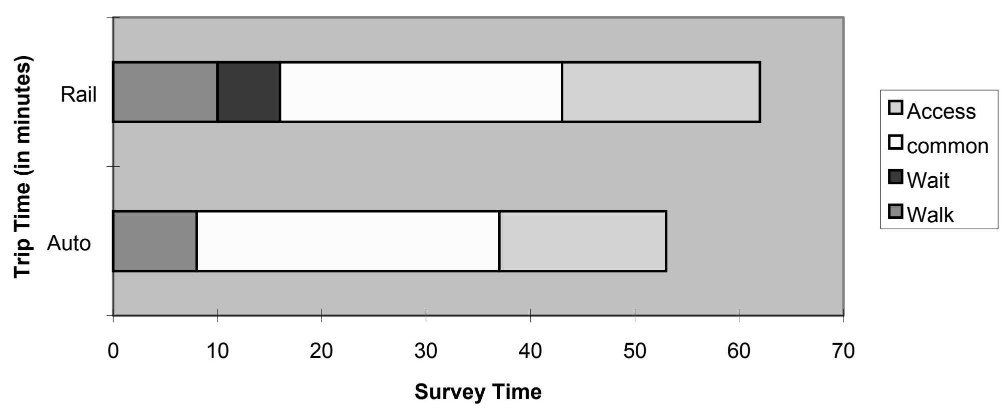
CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE C-3:
W. Monroe St. & Dearborn St. - 53rd & Mulligan

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	52	62
In Common Segment	18	32
Outside Common Segment	26	15
Wait Time	0	5
Walk Time	8	10
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	15.0	12.1
In Common Segment	27.7	18.8
Outside Common Segment	10.8	10.0



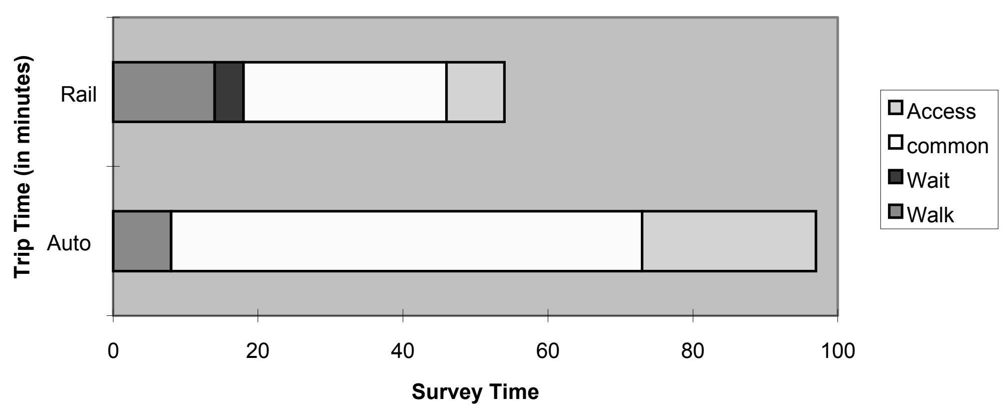
CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE D-4:
W. Randolph St. & N. State St. - 51st & Knox

	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	53	62
In Common Segment	29	27
Outside Common Segment	16	19
Wait Time	0	6
Walk Time	8	10
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	14.7	12.1
In Common Segment	17.2	22.2
Outside Common Segment	17.6	7.9



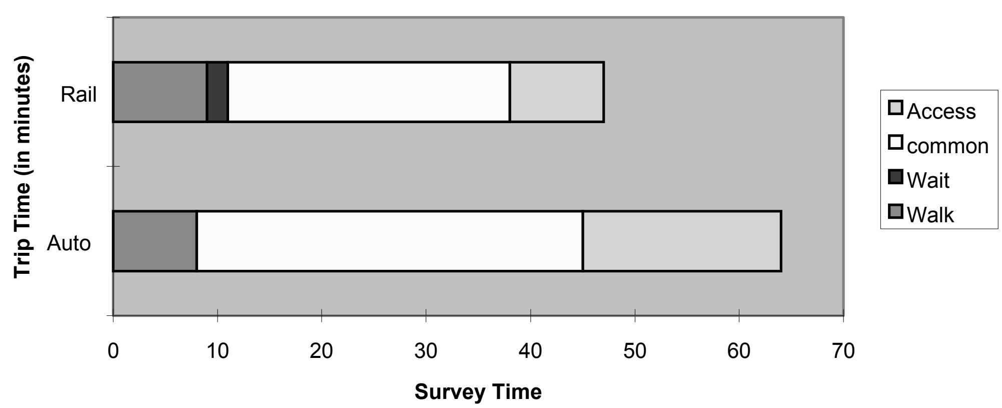
CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE E-5:
115 S. LaSalle & Monroe St. - 64th St. & Major

	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	97	54
In Common Segment	65	28
Outside Common Segment	24	8
Wait Time	0	4
Walk Time	8	14
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	8.0	13.9
In Common Segment	7.7	21.4
Outside Common Segment	11.8	18.8



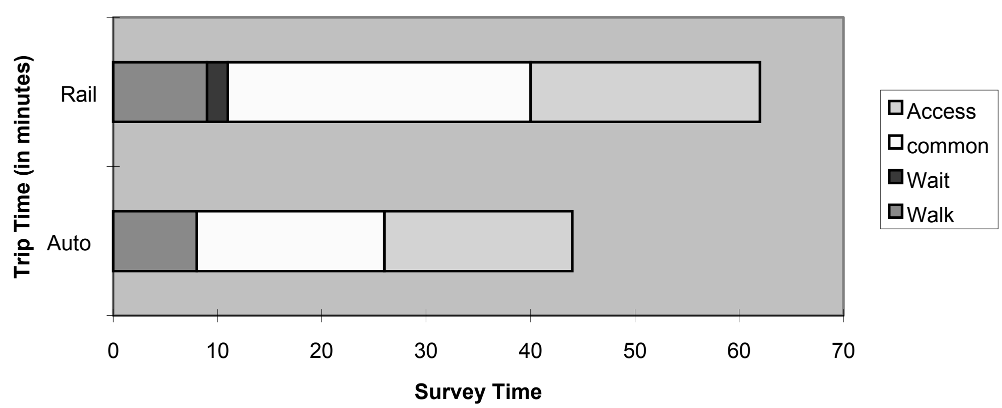
CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE F-6:
E. Adams St. & S. Michigan Ave. - 58th & Parkside

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	64	47
In Common Segment	37	27
Outside Common Segment	19	9
Wait Time	0	2
Walk Time	8	9
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	12.2	16.0
In Common Segment	13.5	22.2
Outside Common Segment	14.8	16.7

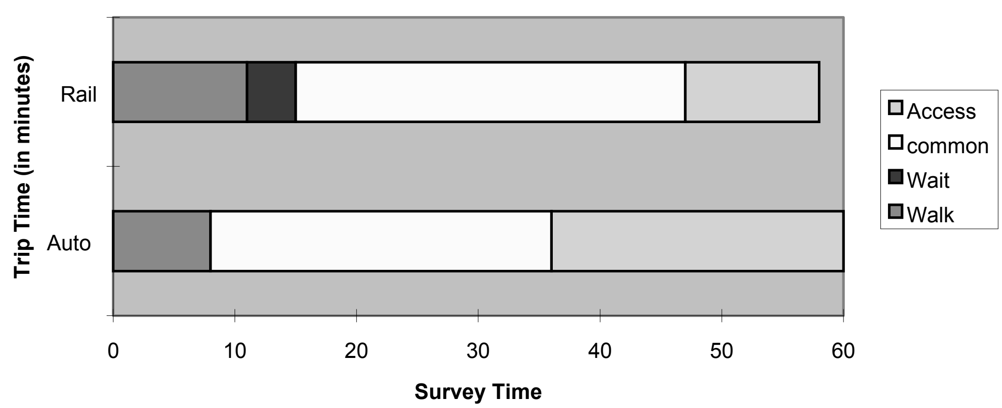


CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE G-7:
180 N. Wabash Ave. & W. Lake St. - 54th & Sayre

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	44	62
In Common Segment	18	29
Outside Common Segment	18	22
Wait Time	0	2
Walk Time	8	9
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	17.7	12.1
In Common Segment	27.7	20.7
Outside Common Segment	15.7	6.8

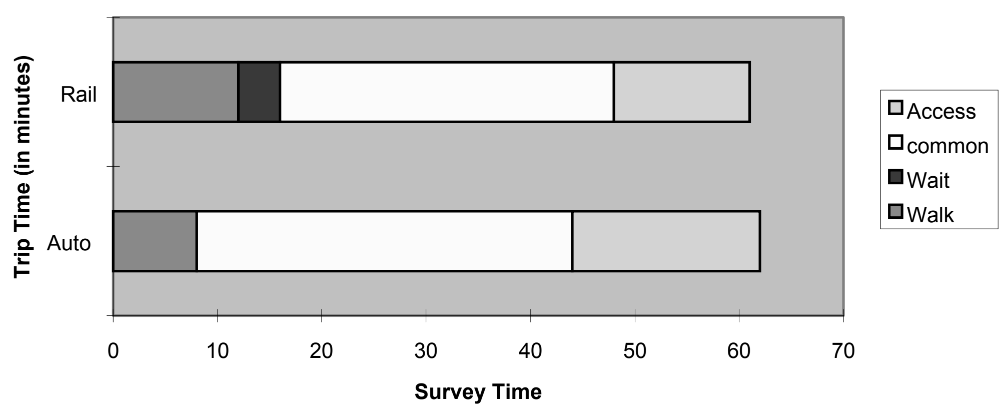


CORRIDOR: Midway Station - Chicago SUMMARY TABLE FOR ROUTE H-8: 69 W. Washington Blvd. & N. Dearborn St. - 49th & Lotus	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	60	58
In Common Segment	28	32
Outside Common Segment	24	11
Wait Time	0	4
Walk Time	8	11
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	13.0	12.9
In Common Segment	17.8	18.8
Outside Common Segment	11.8	13.6



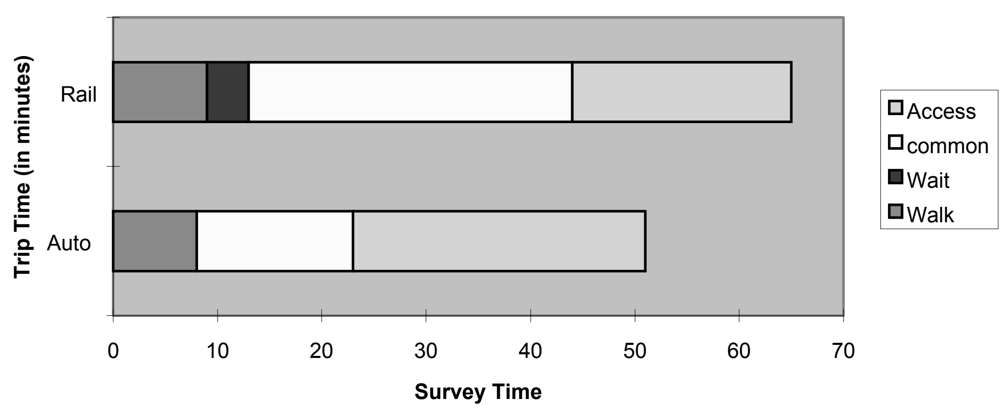
CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE I-9:
W. Randolph St. & N. Wells St. - Midway Airport (US Air Departures)

	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	62	61
In Common Segment	36	32
Outside Common Segment	18	13
Wait Time	0	4
Walk Time	8	12
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	12.6	12.3
In Common Segment	13.8	18.8
Outside Common Segment	15.7	11.5



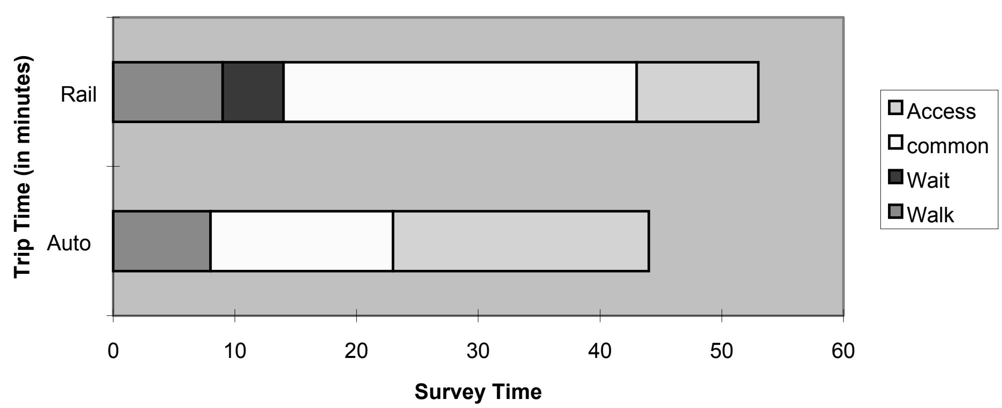
CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE 1-B:
62nd & Karlov - W. Quincy St. & LaSalle

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	51	65
In Common Segment	15	31
Outside Common Segment	28	21
Wait Time	0	4
Walk Time	8	9
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	15.3	11.5
In Common Segment	33.2	19.4
Outside Common Segment	10.1	7.1



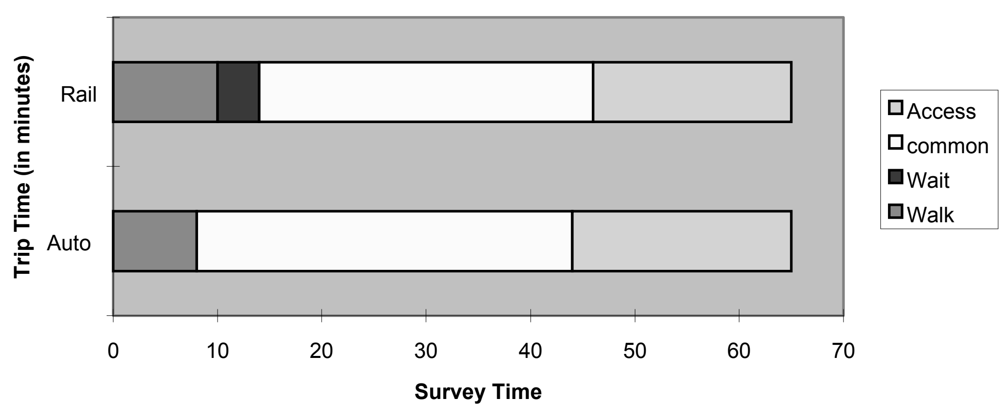
CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE 2-C:
Marquette & Kilpatrick - W. Monroe St. & S. Dearborn St.

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	44	53
In Common Segment	15	29
Outside Common Segment	21	10
Wait Time	0	5
Walk Time	8	9
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	17.7	14.2
In Common Segment	33.2	20.7
Outside Common Segment	13.4	15.0

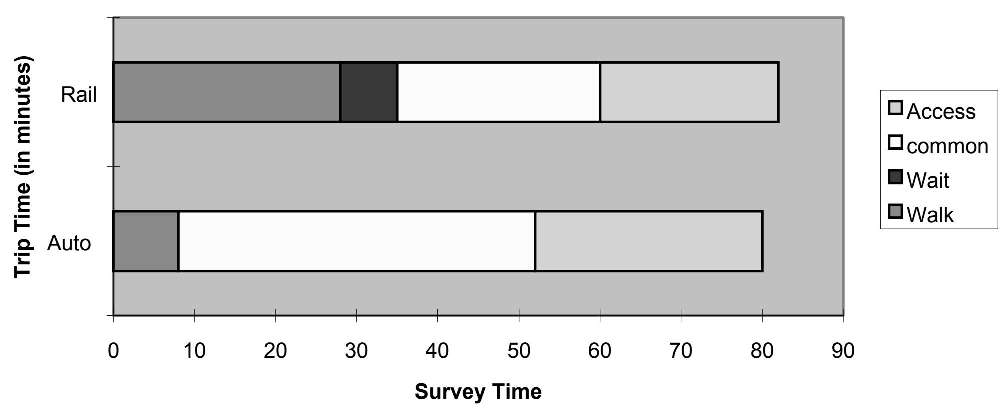


CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE 3-D:
53rd & Mulligan - W. Randolph St. & N. State St.

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	65	65
In Common Segment	36	32
Outside Common Segment	21	19
Wait Time	0	4
Walk Time	8	10
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	12.0	11.5
In Common Segment	13.8	18.8
Outside Common Segment	13.4	7.9

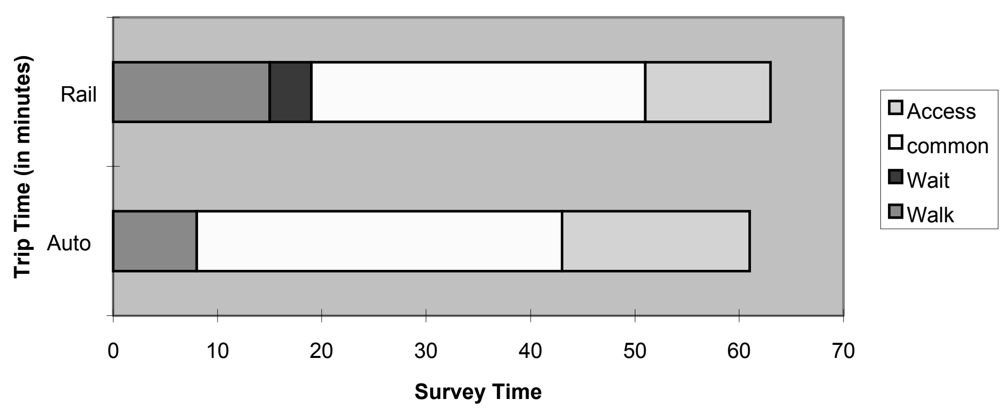


CORRIDOR: Midway Station - Chicago SUMMARY TABLE FOR ROUTE 4-E: 51st & Knox - 115 S. LaSalle & Monroe St.	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	80	82
In Common Segment	44	25
Outside Common Segment	28	22
Wait Time	0	7
Walk Time	8	28
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	9.8	9.1
In Common Segment	11.3	24.0
Outside Common Segment	10.1	6.8



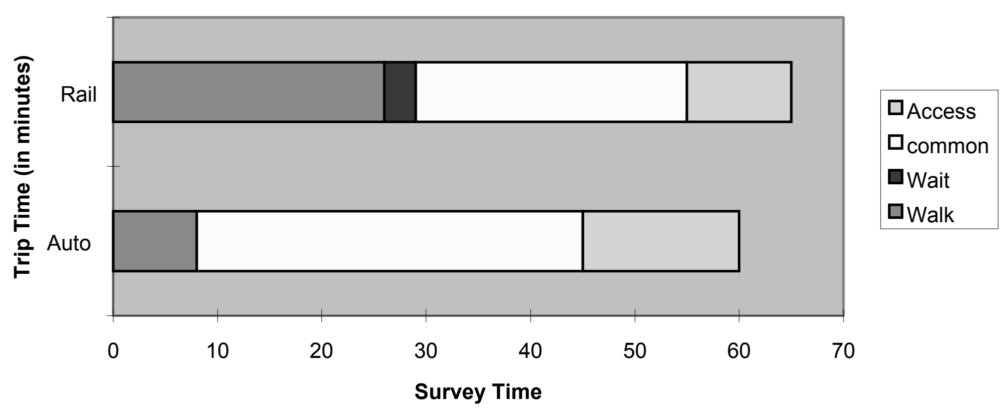
CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE 5-F:
64th & Major - E. Adams St. & S. Michigan Ave.

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	61	63
In Common Segment	35	32
Outside Common Segment	18	12
Wait Time	0	4
Walk Time	8	15
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	12.8	11.9
In Common Segment	14.2	18.8
Outside Common Segment	15.7	12.5



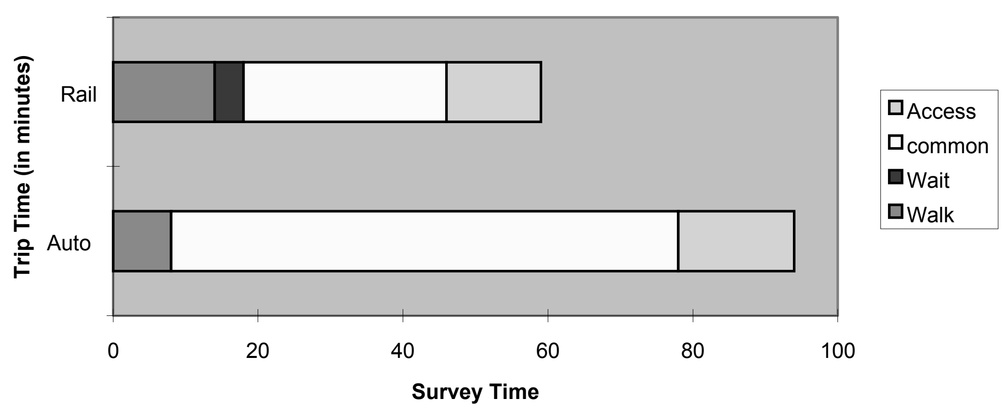
CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE 6-G:
58th & Parkside - 180 N. Wabash Ave. & W. Lake St.

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	60	65
In Common Segment	37	26
Outside Common Segment	15	10
Wait Time	0	3
Walk Time	8	26
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	13.0	11.5
In Common Segment	13.5	23.1
Outside Common Segment	18.8	15.0



CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE 7-H:
54th & Sayre - 69 W. Washington Blvd. & N. Dearborn St.

	SURVEY TYPE	
	Auto	Light Rail
TIME (minutes)		
Trip	94	59
In Common Segment	70	28
Outside Common Segment	16	13
Wait Time	0	4
Walk Time	8	14
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	8.3	12.7
In Common Segment	7.1	21.4
Outside Common Segment	17.6	11.5



CORRIDOR: Midway Station - Chicago
SUMMARY TABLE FOR
ROUTE 8-I:
49th & Lotus - W. Randolph St. & N. Wells St.

	SURVEY TYPE	
TIME (minutes)	Auto	Light Rail
Trip	61	50
In Common Segment	34	27
Outside Common Segment	19	7
Wait Time	0	4
Walk Time	8	12
DISTANCE (miles)		
Route Distance	13.0	12.5
Common Segment Distance	8.3	10.0
SPEED (mph)		
Trip	12.8	15.0
In Common Segment	14.6	22.2
Outside Common Segment	14.8	21.4