INSTITUTO MUNICIPAL DE INVESTIGACION Y PLANEACION
Benjamín Franklin 4185 y Estocolmo. Circuito Pronaf. Cd. Juárez, Chih. Tels. 13-65-80 13-65-30 13-65-46 13-64-96

Tech Memo

DATE: February 3, 1998.

PROJECT: **Estudio Integral de Transporte (II)** / Juarez Data Analysis and Model Development (TTISL#40733)

TO: Ken Mora, Project Director / TxDOT
Zack Graham / TxDOT
David Pearson / TTI

FROM: Salvador Gonzalez-Ayala

SERIAL: EITII-02

SUBJ: Progress under Task 1:
Editing/analysis of the household survey database.

Overview

Information from the 1996 Juarez travel survey has been stored in four main databases:

1. On-board transit count
2. Household survey
3. Workplace/special generator survey
4. External station survey

The present Tech Memo summarizes the procedures developed for data editing and preliminary analysis of the household survey database.

Background

The household travel survey was conducted during the months of October and November of 1996 through an innovative process originated by a very limited budget, but instead requiring extensive use of the local school system, and thus the full support of local school authorities. In general, the process consisted of taking the travel surveys to households all over the city by way of school children (middle level). Random selection of households through telephone numbers was discarded since the service is still unavailable to most low-income families.

Two weeks prior to the start of the survey, one 6th grade group from every primary school and one 2nd grade group from every secondary school (equivalent to 6th and 8th grades in the U.S.) were selected, and a teacher responsible for each group was trained to handle the survey. The teacher was then required to train his or her students and to monitor their progress during the survey period. During the survey period, students were instructed to take survey forms to two of their next door neighbor households and conduct the required interviews. Two telephone hot-lines were placed in service to aid teachers and students with the surveys, and to answer related questions to those being interviewed. The general public was informed about the survey through public service spots in local television, radio and newspapers. In the end, over 300 schools citywide were anticipated to participate in the project with over 11,000 students; thus close to 23,000 survey forms were printed[1]. These forms were given to the heads of the twenty-four school zones in the city, and they in turn distributed these to the schools in their jurisdiction. After the survey period, the forms returned to IMIP through the same channels.

Of the 23,000 survey forms sent, 15,000 made their way back to IMIP. From February to May of 1997, IMIP personnel worked on an initial screening and validation process of the returned surveys, with the objective of selecting those fitted for data entry in the electronic database. From this process, around 7,000 forms were labeled as incorrect (incorrectly filled or not filled at all) and dismissed for data entry, and close to 4,000 were labeled as incomplete (missing information) thus placing on hold their editing and use until

[1] A pilot exercise with a 6th grade group from a primary school and a 2nd grade group from a secondary school was implemented prior to the main survey. The purpose being to estimate response levels and thus number of forms required, polish the survey instrument design, and in general detect potential logistic and strategic problems.

required. Both incorrect and incomplete forms are being stored for future reference. Therefore, about 4,000 forms were labeled as correct or had minor errors that were eventually corrected by contacting the source household.

As part of the validation process, on each correct form IMIP personnel geocoded the household location and the reported trip-ends using closest intersection criteria. For this task, the IMIP team previously generated a GIS node coverage identifying all of the street intersections in the city (close to 14,000), which in turn was used to develop an electronic look-up table. With this table in operation, the process of finding the node number of a given street intersection was simplified considerably.

During the months of June and July of 1997, the 4,000 correct and later geocoded forms were entered into the electronic database.

Database design

The base household survey database is composed of a principal table, and three detail tables:

	Table name in english
1. Table {Datos de la vivienda}:	{general household information} principal table
2. Table {Informacion de vehiculos disponibles}:	{vehicle records}
3. Table {Residentes del hogar}:	{resident records}
4. Table {Informacion de viajes}:	{trip records}.

In addition a fifth table was included to provide details on geocode information:

5. Table {Interseccion}:	{intersection}

A general layout of the database and its component tables and fields is shown in Figure 1. A description of each of the fields is given in Appendix A.

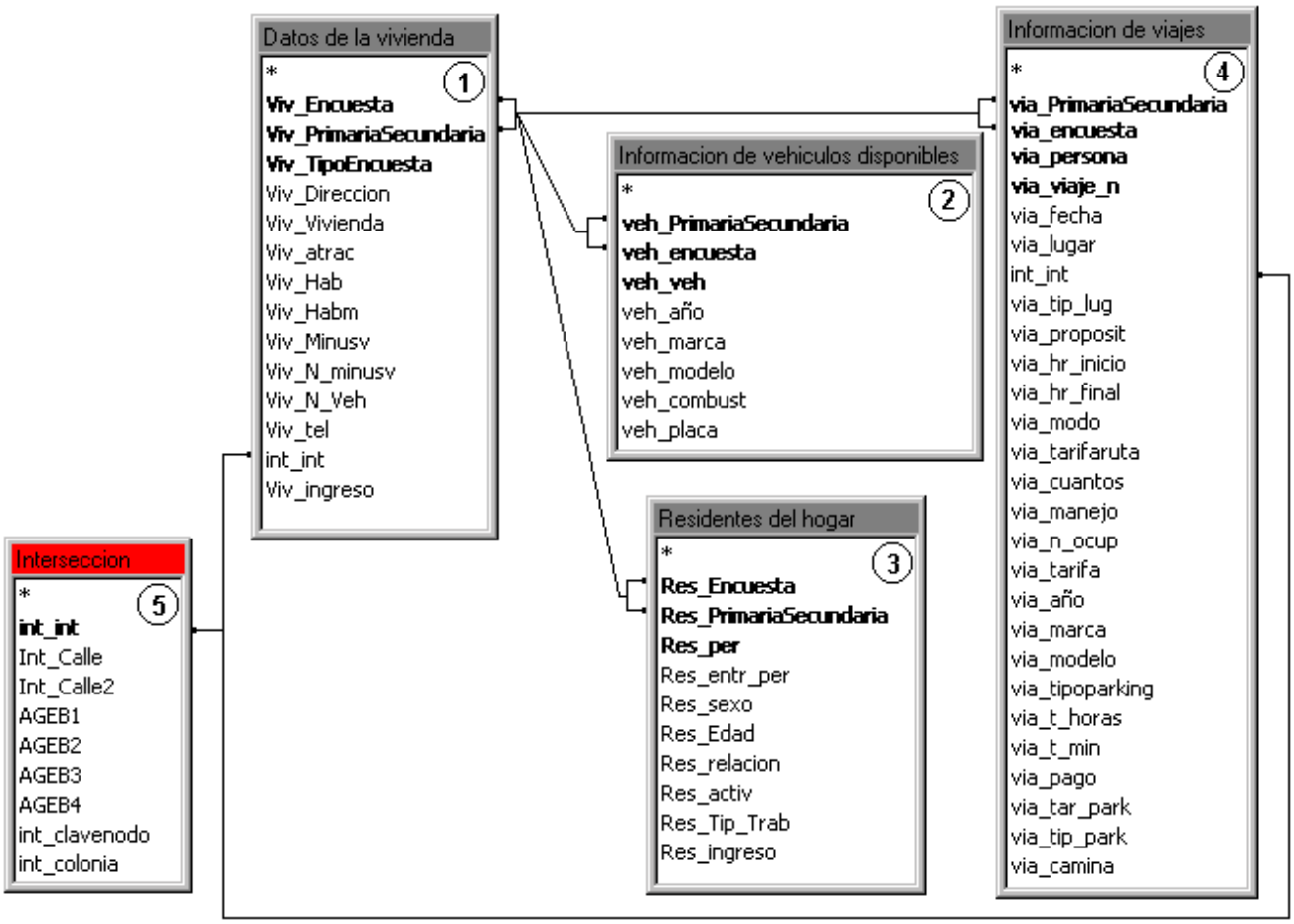

Figure 1. Household survey database layout.

The survey information tables (No.1 to No.4) are related by the common fields **[***tag***]**_Encuesta and **[***tag***]**_PrimariaSecundaria which together form the survey unique code. Note that the prefix tag on the names of these two fields vary depending on the source table. The georeference information table (table No.5) is related to the principal table and to the trip records table through the field int_int. With over 1.3 million information cells from 60,000+ combined records (table No.5 not included), the household survey is the largest and most complex database of those generated from the 1996 travel study.

Edit checks

To identify logical or numerical errors or inconsistencies in the household survey database, forty-nine different checks were developed using the powerful query capabilities of MS-Access. Table 1 provides a description of these checks. The checks were designed to run in 8 separate groups or stages to avoid excessive repetition of error detection. Queries for one group at a time were programmed, and until the detected records were edited, the next group queries were generated.

Table 1. MS-Access queries developed for error checking.

Group	Serial	Description	Records detected	Records modified	Surveys re-coded	Surveys erased
1	HH-01	Surveys entered in **{vehicle records}** table, but not registered in **{general household information}** table.	11	11	0	0
	HH-02	Surveys entered in **{general household information}** table, but not registered in **{vehicle records}** table.	59	58	0	0
	HH-03	Surveys entered in **{resident records}** table, but not registered in **{general household information}** table.	14	14	0	0
	HH-04	Surveys entered in **{general household information}** table, but not registered in **{resident records}** table.	10	10	0	0
	HH-05	Surveys entered in **{trip records}** table, but not registered in **{general household information}** table.	31	31	0	0
	HH-06	Surveys entered in **{general household information}** table, but not registered in **{trip records}** table.	93	31	1	0
2	HH-07	Surveys with trip 0 missing.	39	39	0	0
	HH-08	Surveys with a person reporting less than 2 trips/day.	204	183	0	0
	HH-09	Surveys where number of residents 5+ age do not agree with number of resident records with reported age of 5+.	305	282	0	1
	HH-10	Surveys where number of persons 5+ age do not agree with number of persons reporting trips.	1,743	287	123	4
	HH-11	Surveys where number of vehicles available do not agree with number of vehicle records input.	118	117	0	1

Table 1. (Continued)

Group	Serial	Description	Records detected	Records modified	Surveys re-coded	Surveys erased
3	HH-12	Surveys with invalid or unusual sample number (<1 or >5680).	333	0	0	0
	HH-13	Surveys with invalid sample code	0	0	0	0
	HH-14	Surveys with invalid intersection geocode for HH location.	1	1	0	0
	HH-15	Surveys with invalid residence type code.	4	4	0	0
	HH-16	Surveys with invalid or unusual household size (<1 or >8).	19	0	0	0
	HH-17	Surveys with number of persons 5+ age greater than total persons in household.	0	0	0	0
	HH-18	Surveys with invalid number of handicapped persons.	73	72	0	0
	HH-19	Surveys with invalid fuel type code.	13	13	0	0
	HH-20	Surveys with invalid license plate type code.	30	30	0	0
	HH-21	Surveys with invalid HH income code.	82	50	0	0
4	HH-22	Surveys with invalid or unusual number of resident records (<1 or >9 or null).	5	0	0	0
	HH-23	Surveys with invalid or unusual person number in **{trip records}** (<1 or >6 or null).	57	7	0	0
	HH-24	Surveys with invalid gender code.	8	8	0	0
	HH-25	Surveys with invalid or unusual resident age (<1 or >80 or null).	96	29	0	0
	HH-26	Surveys with invalid resident relationship code.	6	6	0	0
	HH-27	Surveys with invalid resident activity code.	9	9	0	0
	HH-28	Surveys with invalid resident work type code.	12	12	0	0
5	HH-29	Surveys where number of vehicles is invalid or unusual (<1 or >4 or null).	18	0	0	0
	HH-30	Surveys where vehicle year is invalid or unusual (<60 or >97 or null).	17	9	0	0
	HH-31	Surveys with a blank vehicle make field.	3	3	0	0
	HH-32	Surveys with a blank vehicle model field.	60	39	0	0

Table 1. (Continued)

Group	Serial	Description	Records detected	Records modified	Surveys re-coded	Surveys Erased
6	HH-33	Surveys with invalid intersection geocode at reported trip-ends.	26	26	0	0
	HH-34	Inconsistent intersection geocode for HH location and HH trip-ends.	1,045	1,039	0	0
	HH-35	Surveys where trip-end reports HH geocode but place type is not home.	336	122	0	0
7	HH-36	Surveys where trip 0 does not start at home (according to place type code).	186	27	0	0
	HH-37	Surveys with invalid code for place type.	16	16	0	0
	HH-38	Surveys with invalid code for trip purpose.	38	37	0	0
8	HH-39	Surveys with unusual or illogical combination of reported place type and trip purpose.	450	355	0	0
	HH-40	Surveys with invalid or unusual travel times (<0 or >90min or null).	290	244	0	0
	HH-41	Surveys with invalid code for trip mode.	23	23	0	0
	HH-42	Surveys where bus trips indicate an invalid or unusual number of buses boarded for the trip.	86	75	0	0
	HH-43	Surveys where auto, motorcycle, or commercial vehicle trips indicate an invalid or unusual number of ocupants.	97	39	0	0
	HH-44	Surveys where auto, motorcycle, or commercial vehicle trips indicate an invalid code for parking type.	47	47	0	0
	HH-45	Surveys where auto, motorcycle, or commercial vehicle trips indicate an invalid or unusual number of parked hours.	163	162	0	0
	HH-46	Surveys where auto, motorcycle, or commercial vehicle trips indicate an invalid or unusual number of parked minutes.	48	36	0	0
	HH-47	Surveys where auto, motorcycle, or commercial vehicle trips indicate an invalid or unusual parking fee.	4	3	0	0
	HH-48	Surveys where auto, motorcycle, or commercial vehicle trips indicate an invalid or unusual parking fee type.	5	5	0	0
	HH-49	Surveys where final walking distance on a trip-end is of invalid or unusual length.	713	711	0	0

Using these queries, the errors and inconsistencies detected were corrected. In many instances, the errors were originated at the time of the electronic data entry (input typos) where the system did not have validation rule from its design. Several of the errors detected were inconsistencies registered in the field, thus to correct them the IMIP team was required to contact the source household. Whenever the information could not be verified, the sample was eliminated from the database. In this regard, an exception was made whenever the survey information appeared consistent and logical, but trip information for any household member was missing. In these cases the information was kept in the electronic database, but the survey was given a special code to identify it, and discretely include it only in specific analyses.

Finally, summary reports were programmed in Visual Basic for MS-Access. Tables 2 to 6 provide a summary of the frequency of surveys obtained under different ranges of household size, household income and number of vehicles in the household.

Table 2. Distribution of surveys by HH size.

HHsize	#	pct
1	226	5.6%
2	542	13.5%
3	770	19.2%
4	1133	28.2%
5	949	23.6%
6	274	6.8%
7	78	1.9%
8	25	0.6%
9	15	0.4%
10	3	0.1%
11	1	0.0%

Table 3. Distribution of surveys by HH income (monthly).

HH income range (pesos)	HH income code	#	pct
$ 0	1	43	1.1%
Up to $ 687	2	291	7.2%
$ 688 to $ 1,374	3	671	16.7%
$ 1,375 to $ 2,748	4	889	22.1%
$ 2,749 to $ 4,122	5	617	15.4%
$ 4,123 to $ 5,496	6	381	9.5%
$ 5,497 to $ 6,870	7	256	6.4%
$ 6,871 to $ 8,244	8	216	5.4%
$ 8,245 to $ 9,619	9	98	2.4%
$ 9,620 to $ 10,993	10	141	3.5%
$ 10,994 to $ 12,367	11	79	2.0%
$ 12,368 to $ 13,741	12	49	1.2%
$ 13,742 to $ 15,115	13	47	1.2%
$ 15,116 to $ 16,489	14	37	0.9%
$ 16,490 to $ 17,863	15	26	0.6%
$ 17,864 to $ 19,237	16	25	0.6%
$ 19,238 to $ 20,611	17	27	0.7%
$ 20,612 to $ 21,985	18	21	0.5%
$ 21,986 to $ 23,359	19	15	0.4%
> $ 23,359	20	52	1.3%
non-response	21	35	0.9%

Table 4. Distribution of surveys by HH vehicles.

HHveh	#	pct
0	1195	29.8%
1	1568	39.0%
2	954	23.8%
3	235	5.9%
4	46	1.1%
5	18	0.4%

Table 5. Distribution of surveys by HH size and income.

HH income code	HHsize 1		2		3		4		5		6		7		8		9		10		11	
	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct
1	16	0.4%	8	0.2%	11	0.3%	3	0.1%	5	0.1%												
2	43	1.1%	64	1.6%	72	1.8%	65	1.6%	33	0.8%	12	0.3%			2	0.0%						
3	61	1.5%	113	2.8%	149	3.7%	186	4.6%	116	2.9%	34	0.8%	9	0.2%	3	0.1%						
4	41	1.0%	135	3.4%	178	4.4%	244	6.1%	220	5.5%	44	1.1%	20	0.5%	2	0.0%	5	0.1%				
5	20	0.5%	74	1.8%	104	2.6%	190	4.7%	165	4.1%	45	1.1%	12	0.3%	5	0.1%	2	0.0%				
6	13	0.3%	35	0.9%	78	1.9%	106	2.6%	105	2.6%	28	0.7%	8	0.2%	4	0.1%	3	0.1%	1	0.0%		
7	11	0.3%	34	0.8%	50	1.2%	74	1.8%	53	1.3%	24	0.6%	8	0.2%	1	0.0%			1	0.0%		
8	6	0.1%	24	0.6%	27	0.7%	74	1.8%	65	1.6%	16	0.4%	2	0.0%	1	0.0%	1	0.0%				
9	4	0.1%	10	0.2%	19	0.5%	31	0.8%	17	0.4%	13	0.3%	2	0.0%	1	0.0%	1	0.0%				
10			8	0.2%	26	0.6%	35	0.9%	47	1.2%	17	0.4%	4	0.1%	2	0.0%			1	0.0%	1	0.0%
11	1	0.0%	6	0.1%	14	0.3%	23	0.6%	23	0.6%	8	0.2%	3	0.1%	1	0.0%						
12	1	0.0%	7	0.2%	9	0.2%	14	0.3%	9	0.2%	4	0.1%	3	0.1%	1	0.0%	1	0.0%				
13			3	0.1%	4	0.1%	21	0.5%	14	0.3%	4	0.1%	1	0.0%								
14			2	0.0%	5	0.1%	13	0.3%	16	0.4%			1	0.0%								
15			2	0.0%	6	0.1%	3	0.1%	7	0.2%	5	0.1%	3	0.1%								
16	1	0.0%	1	0.0%	3	0.1%	11	0.3%	7	0.2%	1	0.0%			1	0.0%						
17			2	0.0%	2	0.0%	10	0.2%	7	0.2%	5	0.1%	1	0.0%								
18	1	0.0%	1	0.0%	1	0.0%	5	0.1%	8	0.2%	3	0.1%	1	0.0%	1	0.0%						
19	1	0.0%	2	0.0%	2	0.0%	1	0.0%	6	0.1%	2	0.0%					1	0.0%				
20	1	0.0%	6	0.1%	7	0.2%	15	0.4%	16	0.4%	7	0.2%										
21	5	0.1%	5	0.1%	3	0.1%	9	0.2%	10	0.2%	2	0.0%					1	0.0%				

Table 6. Distribution of surveys by HH size and HH vehicles.

HHveh	HHsize 1		2		3		4		5		6		7		8		9		10		11	
	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct	#	pct
0	124	3.1%	233	5.8%	237	5.9%	292	7.3%	212	5.3%	63	1.6%	21	0.5%	9	0.2%	4	0.1%				
1	92	2.3%	215	5.4%	323	8.0%	443	11.0%	356	8.9%	101	2.5%	27	0.7%	5	0.1%	4	0.1%	1	0.0%	1	0.0%
2	9	0.2%	85	2.1%	177	4.4%	307	7.6%	279	6.9%	67	1.7%	21	0.5%	5	0.1%	3	0.1%	1	0.0%		
3	1	0.0%	8	0.2%	29	0.7%	74	1.8%	81	2.0%	27	0.7%	9	0.2%	3	0.1%	2	0.0%	1	0.0%		
4			1	0.0%	2	0.0%	14	0.3%	14	0.3%	13	0.3%			1	0.0%	1	0.0%				
5					2	0.0%	3	0.1%	7	0.2%	3	0.1%			2	0.0%	1	0.0%				

Preliminary summary of travel behavior

From the edited household survey database, several thematic maps were generated to summarize travel behavior from a geographic reference. This exercise was also undertaken as an aid in detecting inconsistencies and potential biases in the household survey information from visual inspection of the maps. For this task, a preliminary zoning structure was created aggregating AGEBs (mexican census tracts) according to homogeneous socioeconomic data. Survey information was expanded for each zone by the rate of total zone households to those surveyed in the zone. Citywide, in 1995 INEGI[2] reported a total count of 238,770 households, and by the end of 1996 when the survey was in place, IMIP estimated a total of 255,780 households. Thus, the 4,016 surveys entered in the database represent 1.57% of the universe of households.

As reference to the thematic maps, Figure 2 shows the current street grid of Juarez, which provides somewhat of a visual indication of development intensity. Thus, for example, the closely tight grids of the east and northeast sectors, as well as some sectors just north of the airport, very well coincide with known high population densities and low-income households. On the other hand, looser grid patterns in the north sector are a true indication of current lower population densities, and higher income levels.

Using this street network as a base map, Figure 3 presents the actual location of those households surveyed and entered in the electronic database. Since the household location was referred to the nearest street intersection, several intersections show the reported location of more than one household.

[2] Instituto Nacional de Geografía, Estadística e Informática, "Conteo de Población y Vivienda", (1995)

From Figure 3 it appears that overall the sample was well distributed within the urban area. From visual inspection of this map, it seems that the concentration of surveys in the urban space is somewhat consistent with current population concentration.

Figure 2. Current street network.

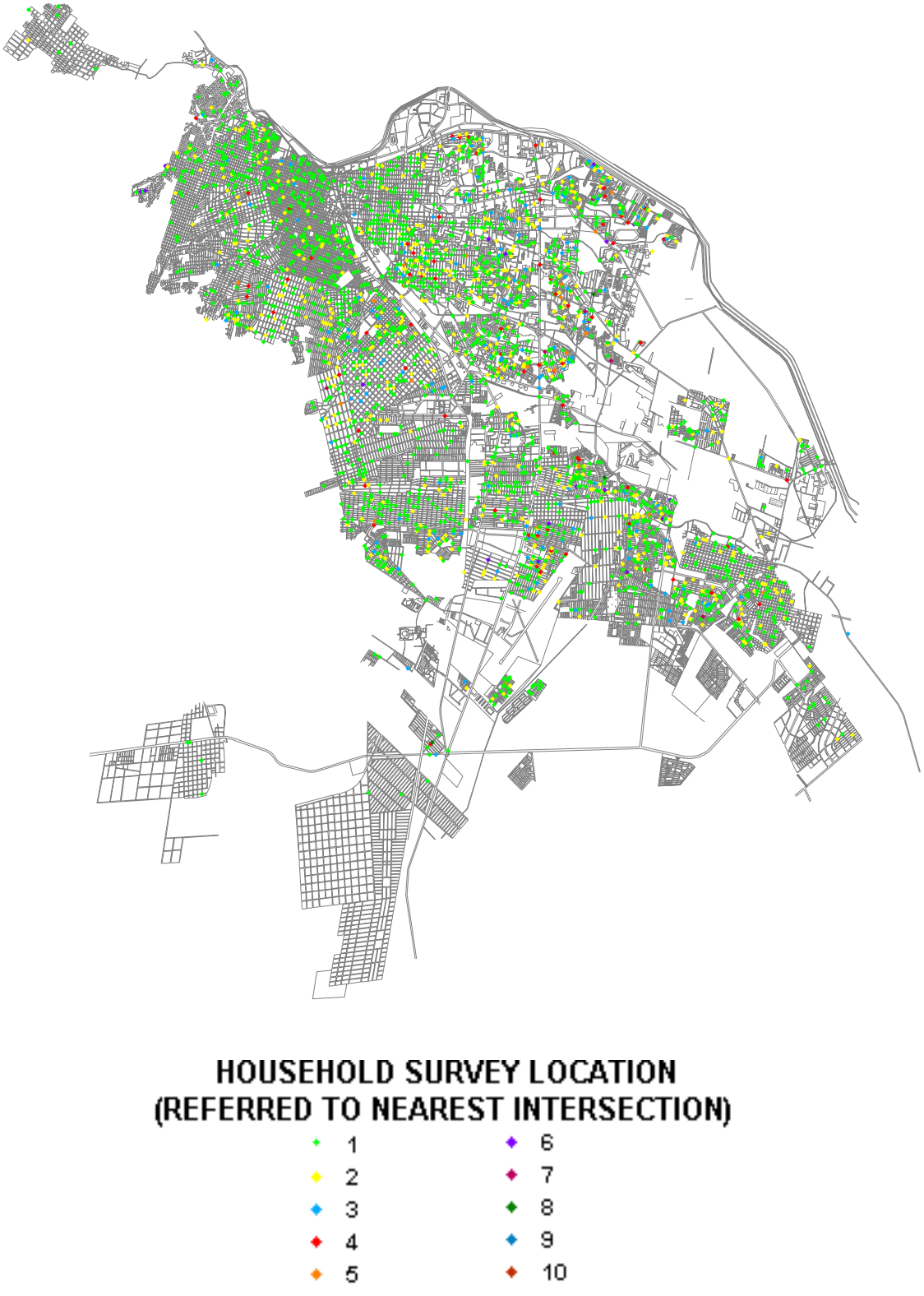

Figure 3. Location of correct household surveys.

Finally, using the preliminary zoning scheme, Figure 4 shows on one hand the average number of motorized person-trips/day by local residents of different sectors of the city. In this regard, it was expected that as resident income increases in a zone, so would the number of motorized trips. Visual inspection of Figure 4 in general confirms this behavior, since those zones with lower income per capita coincide with the areas reporting the fewest trips per person and vice versa. That is, the zones in different shades of blue and green are in fact the poorest areas in the city, while the zones in pink are the ones with highest income residents. On the same map, there is also a pie chart on each of the zones indicating the proportion of the motorized trips that are done using transit (red fraction) and private vehicles (yellow fraction). Again as expected, the low-income areas are the ones showing the highest proportion of transit use (up to 75% of all motorized trips), while in the high-income areas this proportion gets inverted.

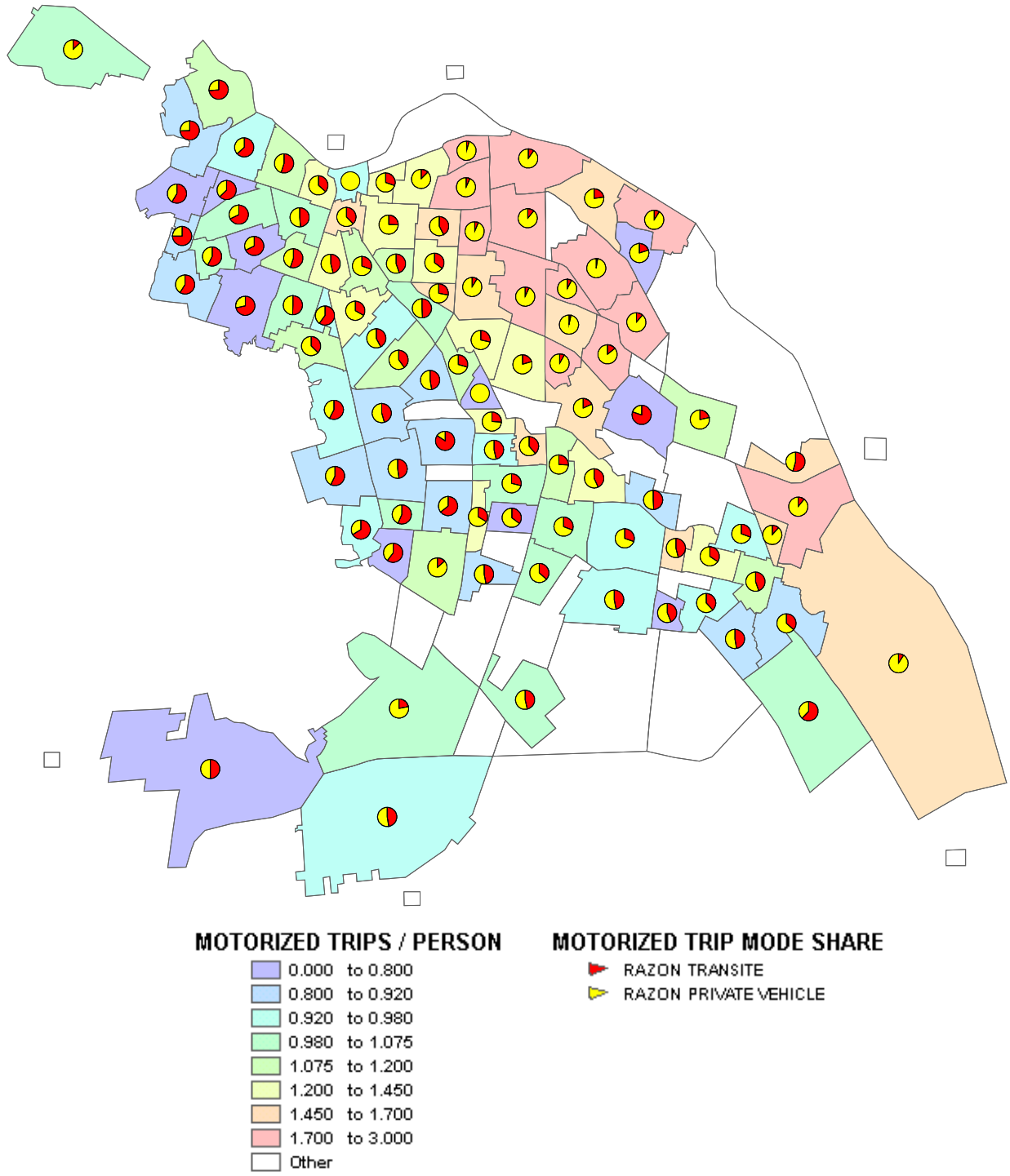

Figure 4. Average motorized person-trips/day, and transit-auto use rate by zone.

As complement to the thematic maps, the following graphs and statistics were generated from the household survey database to summarize transportation conditions in the city.

In first place, Figure 5 presents a graph depicting typical mode choice in Juarez, according to the household survey. Expanding the total number of trips from the survey population to that of the entire city (1'065,200 by late 1996), it was estimated that by the end of 1996, over 2 million trips were generated daily in the city. By a good margin, the private automobile was the preferred mode of transportation, with 51% of all daily person-trips, representing just over 664,000 vehicle-trips per day, considering the average occupancy rate of 1.56 pax/veh. Walking followed second with a 25% share of all daily person-trips; this is not entirely surprising for a city where half of its streets are not paved.

As previously underlined, transit is a very important mode of transportation in Juarez, despite its poor state. It is estimated from the household survey that close to 23% of all daily person-trips are done using transit, either through the normal bus service, or through maquiladora contracted services known as "special trips" (viajes especiales). Thus normal service accounts for close to 442,000 daily passengers[3], considering that each trip requires an average 1.25 bus transfers (each transfer is charged as a new passenger).

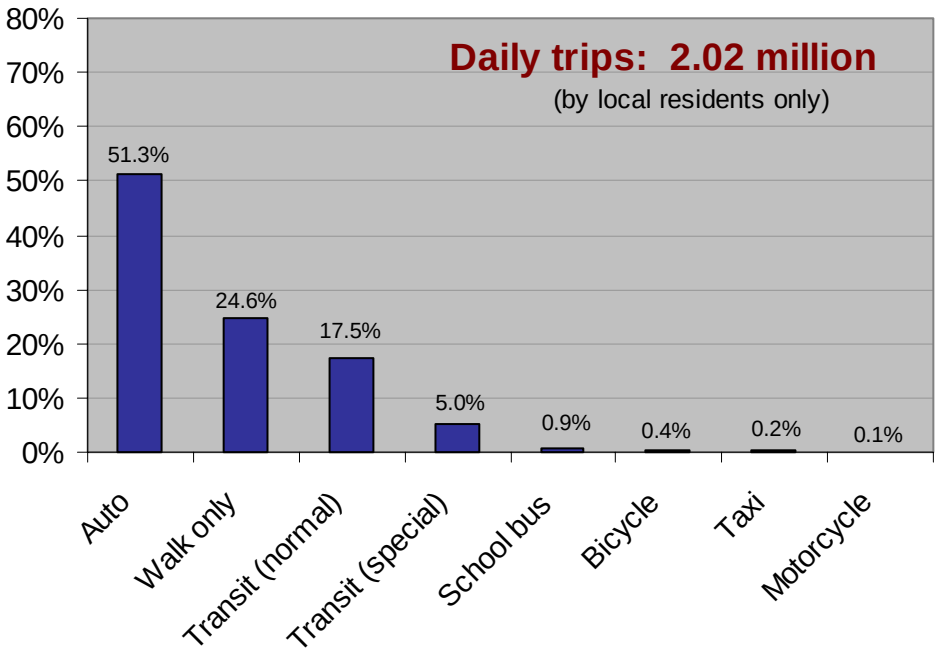

Figure 5. Trips by mode of transportation.

For these three main modes of transportation, Figures 6, 7 and 8 show their respective travel time frequency distributions, also obtained from the household survey. Only those trips having a destiny within the city where considered. The average travel times obtained for each mode are 15.8, 36.8 and 23.2 minutes respectively for walking, transit, and auto.

This type of plots with further characterization by trip purpose will eventually be used for model calibration.

[3] This number obtained by expanding the reported bus trips from the household survey, though on the low side, is in fact consistent with the confidence interval estimated for daily transit passengers from the on-board transit survey (refer to Tech Memo EITII-01, App. B).

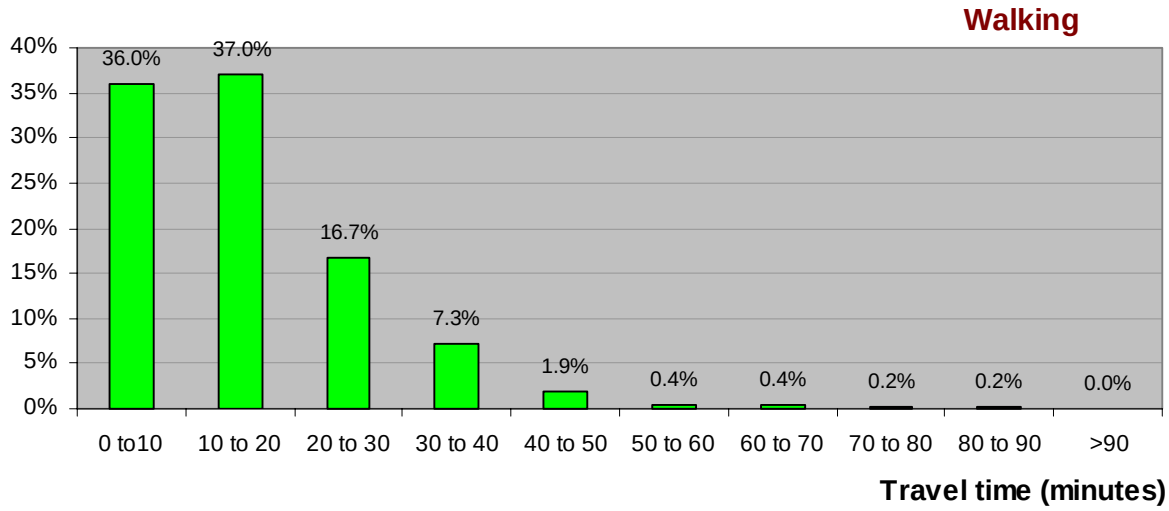

Figure 6. Travel time frequency distribution for walking trips.

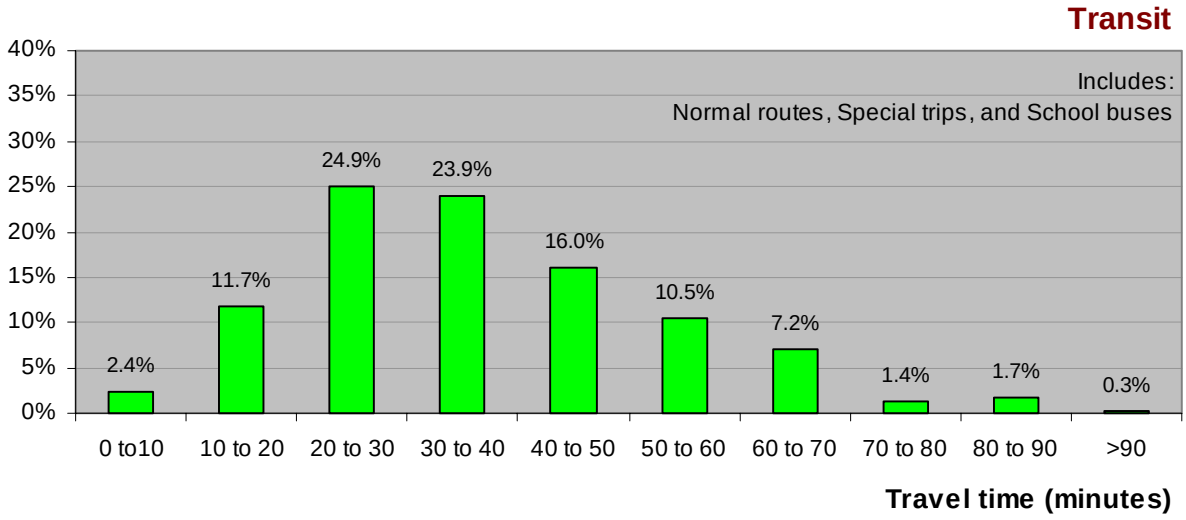

Figure 7. Travel time frequency distribution for transit trips.

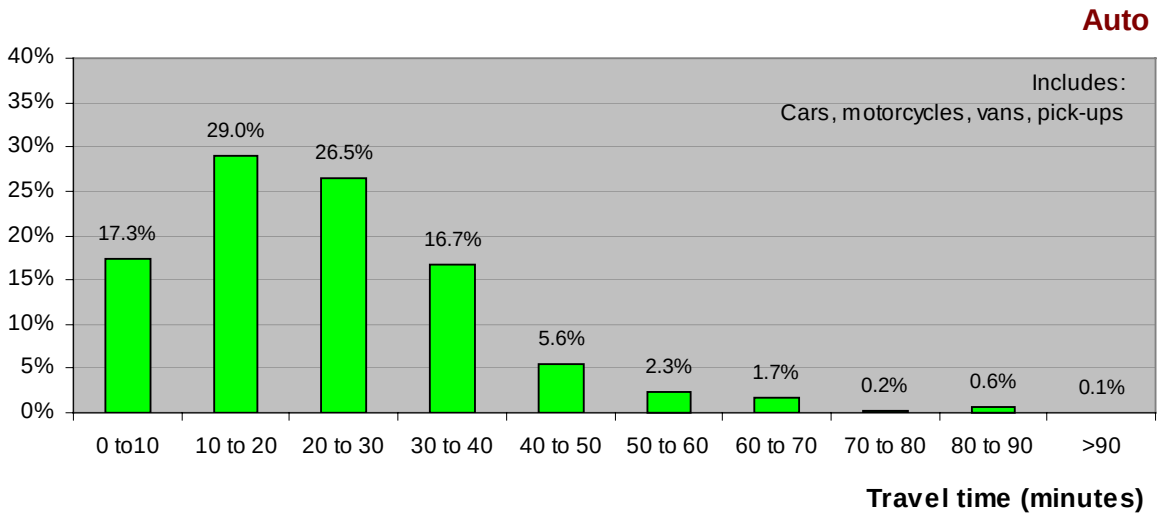

Figure 8. Travel time frequency distribution for auto trips.

A very interesting reference to transit-auto mode choice patterns and trip generation behavior is Figure 9, which shows automobile ownership by household. Overall, the 1996 household survey yielded an average ownership rate of 1.11 vehicles/household. Almost 70% of the households have at least one motorized vehicle available, in contrast to other major non-border mexican cities, where this percentage hardly goes over 50%[4]. This could be explained in part by the ease in the border to own cheap used cars bought in the U.S., the result of a mexican customs law that allows car imports with a specially low tax authorized only for border regions. Unfortunately for the environment, to protect the mexican auto industry, this law only allows cars of more than 4 years of age. As a result of this measure, together with Mexico's economic hardships, in 1996 Juarez had an old vehicle fleet as depicted by Figure 10, with an average vehicle age of 12.7 years.

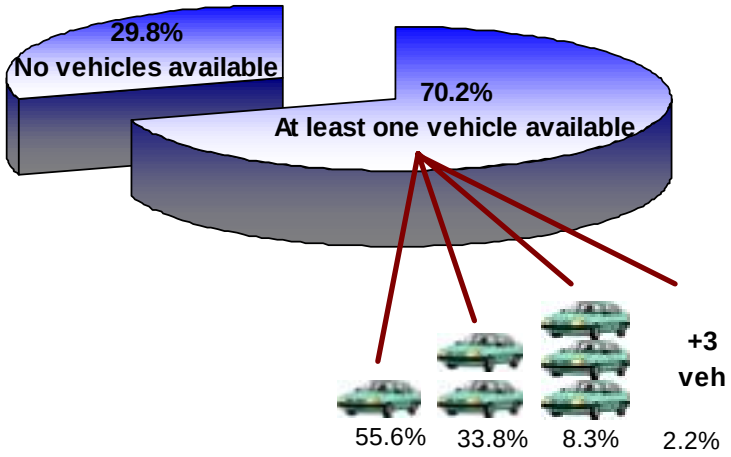

Figure 9. Households with vehicles available.

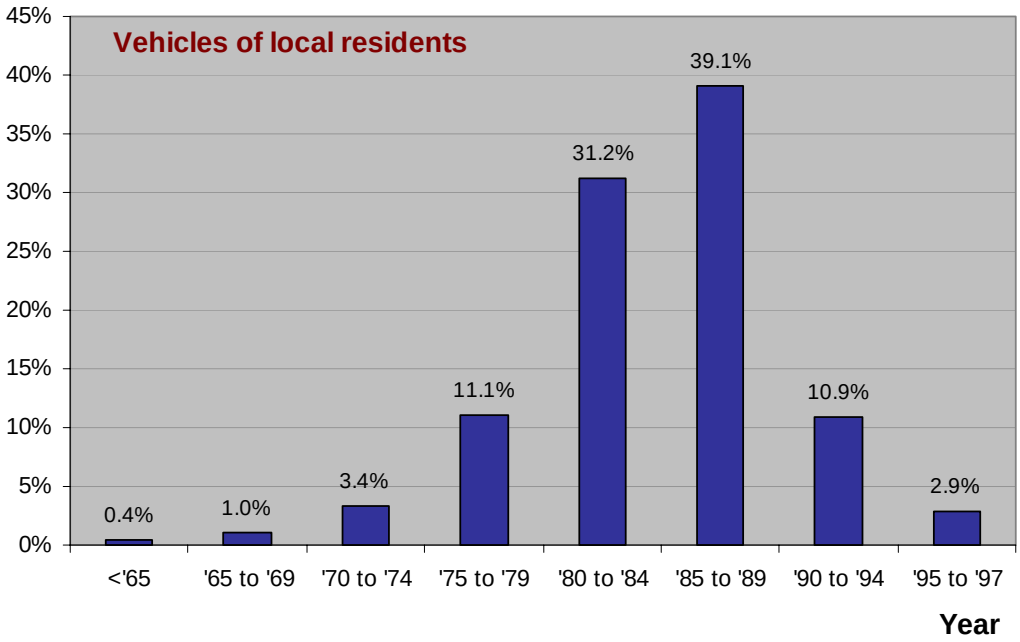

Figure 10. Composition of vehicle fleet by year.

[4] In Mexico City for example, only 40% of the households have a vehicle available (Source: "1994 OD Study for the Mexico City Metropolitan Area", INEGI).

From the household survey, it was estimated that by the end of 1996 Juarez had a vehicle fleet size of 307,000, only from local residents. Of these, close to 10% had U.S. license plates or were not even registered with the local authority, as depicted by Figure 11. In this regard, vehicles identified as "Foreign (USA)", are considered those registered and current with their tax payments in the U.S. (usually vehicles owned by U.S. residents living in Juarez). Unregistered vehicles are those with original U.S. registration but not current with their tax obligations in the U.S., and without registration in Mexico as well.

According to State and local authorities, by the end of 1996 there were officially around 330,000 vehicles with legal registration. Yet, these same authorities estimate that this number inflates by about 20% the actual number of registered vehicles circulating in the city, since most owner- and state-residence changes have not been reported over the years.

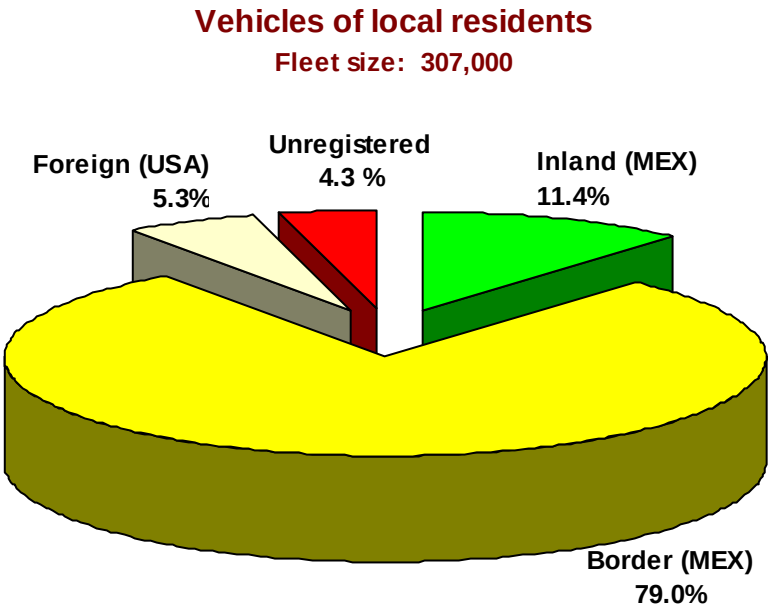

Figure 11. Composition of vehicle fleet by license plate type.

Concluding remarks

Even though in an initial stage the surveys where screened and verified one by one by IMIP personnel, computer program checks detected close to 4,300 inconsistencies that needed to be corrected (0.3% of the infromation cells). In addition, 136 of the 4,016 so-called correct surveys were given special codes that condition their inclusion on specific analysis due to missing trip information. This experience thus, underlines the importance of automated data checking.

Regarding preliminary data analysis of the household survey, visual inspections of the maps show in general that the gathered information followed expected patterns. Location of household surveys appears to follow current population concentration in the city, and travel behavior overall shows consistency across different sectors of the city, based on average socioeconomic characteristics.

Moreover, general statistics obtained from the survey are somewhat consistent with information obtained from other sources, as shown in Table 7.

Table 7. General information comparison.

Field	HH Survey	Other source	Other Source
Registered vehicles (in circulation)	277,500	264,000 (for 1996)	Vehicle Registration Office (State Government)
Person-trips/day	1.90	1.50 (for 1989)	BANOBRAS/World Bank/FOA, "Second Project of Urban Transport", 1989
Persons/household	3.85	4.16 (end of 1996)	IMIP, "socioeconomic projections for 1995 to 1998"

Yet, a slight survey bias might be interpreted from the lower value obtained from the household survey for average Persons/household, compared to that estimated in previous socioeconomic projections by IMIP. The IMIP value of 4.16 has been suggested with a 3% error, while the survey value represents a difference of 7% between both. A lower value could be the result of failing to sample the true proportion of lower income families, which usually are correlated with larger household sizes. This scenario cannot be entirely discarded, since at the end, the decision to interview a particular household was the responsibility of the school children conducting the survey. In this regard, it must be underlined that close to 15% of the surveys were conducted in the students own households despite specific instructions to do otherwise; in addition, for the other households surveyed there is a good chance that the children selected those where a school mate lived. Having a sample with a disproportional number of households with school children in itself could be a source of bias, since as household income decreases, so does the probability of having school age children in school.

Another preliminary result that deserves special attention is the estimated number of transit passengers per day under normal service, which according to the household survey is in the order of 442,000. This number actually falls within the less conservative of the confidence intervals of daily transit passengers obtained from the On-board transit count (437,000 to 695,000 daily passengers for a 90% confidence level). Yet, its position near the lower bound of the interval might be suggesting some under reporting of transit trips, or again, a slight bias resulting from lack of surveys from low-income households. Further analysis should confirm the existence of bias, and the procedure to correct it or adjust the results.

Appendix A

Household Survey database.
Component tables and description of fields.

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Component tables for Household Survey

TABLE NO.	TABLE NAME	FIELD NAME	DESCRIPTION	RELACION
1	Datos de la	Viv_Encuesta	Household sample no. (unique by Elementary or Jr High)	Via_encuesta(Tbl Información de viajes), Veh_encuesta(Tbl Información de vehículos, Res_encuesta (Tbl Residentes del hogar)
	vivienda	Viv_PrimariaSecundaria	Survey conducted by Elementary or Junior High	Via_PrimariaSecundaria(Tbl Información de viajes), Veh_PrimariaSecundaria(Tbl Información de vehículos, viv_PrimariaSecundaria (Tbl Residentes del hogar)
		Viv_TipoEncuesta	Survey conducted on neighbor or own household	A:Own HH, A1: Own HH/trips missing for 1 person, A2: Own HH/trips missing for +1 person, V: Neighbor HH, V1: Neighbor HH/trips missing fro 1 person, V2: Neigh HH/trips missing for +2
	(Household information)	Viv_Direccion	Household address	
		Viv_Vivienda	Type of household	
		Viv_atrac	Number of people that visited the household	
		Viv_Hab	Number of household residents	
		Viv_Habm	Number of HH residents 5 yrs age or older	
		Viv_Minusv	Handicaped in HH (Yes=1,No=0)	
		Viv_N_Minusv	Number of handicaped in household	
		Viv_N_Veh	Number of household vehicles	
		Viv_tel	Household phone number	
		int_int	Primary key for relating tables (intersection index)	
		Viv_ingreso	Household monthly income code	
2	Información de	veh_PrimariaSecundaria	Survey conducted by Elementary or Junior High	Note: Surveys have unique number only within school type (two households can have same number if one was done by elementary and the other by Jr. high).
	vehículos disponibles	veh_Encuesta	Household sample no. (unique by Elementary or Jr High)	A survey unique code it is formed by connecting fields: veh_encuesta + vehPrimaria Secundaria
		veh_veh	Household vehicle number	
	(Household vehicles)	veh_año	Year of the vehicle	
		veh_marca	Make of the vehicle	
		veh_modelo	Model of the vehicle	
		veh_combust	Type of fuel code for the vehicle	
		veh_placa	Type of license plate code for the vehicle	
3	Residentes del	Res_Encuesta	Household sample no. (unique by Elementary or Jr High)	Note: Surveys have unique number only within school type (two households can have same number if one was done by elementary and the other by Jr. high).
	hogar	Res_PrimariaSecundaria	Survey conducted by Elementary or Junior High	A survey unique code it is formed by connecting fields: Res_encuesta + ResPrimaria Secundaria
		Res_per	Household member number	
	(Household residents)	Res_entr_per	Code indicating if member was present	
		Res_sexo	Gender code of the household member	
		Res_Edad	Age of the household member	
		Res_relacion	Relationship code to the household head	
		Res_activ	Activity code of the household member	
		Res_Tip_Trab	Type of work code of the household member	
		Res_ingreso	Monthly income code of the household memebr	
4	Información de viajes	via_PrimariaSecundaria	Survey conducted by Elementary or Junior High	Note: Surveys have unique number only within school type (two households can have same number if one was done by elementary and the other by Jr. high).
		via_Encuesta	Household sample no. (unique by Elementary or Jr High)	A survey unique code it is formed by connecting fields: via_encuesta + viaPrimaria Secundaria
	(Trip information)	via_persona	Household member number	
		via_viaje_n	Trip number (0 for initial origin)	
		via_fecha	Date of trip dairy	
		via_lugar	Place name of trip end	
		int_int	Nearest intersection index of trip end	
		via_tip_lug	Trip end type code	
		via_proposit	Trip purpose code	
		via_hr_inicio	Trip starting time	
		via_hr_final	Trip ending time	
		via_modo	Trip mode of transportation code	
		via_tarifaruta	Bus/Taxi fare (only if these modes were used)	
		via_cuantos	Number of buses required for the trip	
		via_manejo	Code indicating if person was a driver	
		via_n_ocup	Number of passengers (only if person drove)	
		via_tarifa	This field was not used (completely blank)	
		via_año	Year of auto (if this mode was used & person drove)	
		via_marca	Make of auto (if this mode was used & person drove)	
		via_modelo	Model of auto (if this mode was used & person drove)	
		via_tipoparking	Parking type code	
		via_t_horas	Parking time (total parking hours)	
		via_t_min	Parking time (residual parking minutes)	
		via_pago	Code indicating if person paid for parking	
		via_tar_park	Parking fare (only if person paid for parking)	
		via_tip_park	Parking payment type code (only if paid for parking)	
		via_camina	Blocks required to walk (from parking or bus stop)	
5	Colonias	Colonias	Name of the subdivision (neighborhood)	This table feeds the intersection table
	(Subdivisions)	AGEB	AGEB (census zone) where the subdivision is located.	
6	Calle	Int_Calle	Name of streets	This table feeds the intersection table
7	Intersección	Int_Int	Primary key for relating tables (intersection index)	Int_Calle (Tbl Calle), int_int (Tbl Datos de la vivienda),Int_Calle(Calle_1)
	(Intersection info)	Int_Calle	Name of street 1	Int_Calle (Tbl Calle)
		Int_Calle2	Name of street 2 (intersecting street 1)	Int_Calle (Tbl Calle1)
		AGEB	AGEB (census zone) where the intersection is loctated.	
6	Calle	Int_Calle	Name of streets	This table feeds the intersection table
7	Intersección	Int_Int	Primary key for relating tables (intersection index)	Int_Calle (Tbl Calle), int_int (Tbl Datos de la vivienda),Int_Calle(Calle_1)
	(Intersection info)	Int_Calle	Name of street 1	Int_Calle (Tbl Calle)
		Int_Calle2	Name of street 2 (intersecting street 1)	Int_Calle (Tbl Calle1)
		AGEB	AGEB (census zone) where the intersection is loctated.	
		int_clavenodo	Transcad node code (for the intersection)	
		int_colonia	Subdivision where the intersection is located	
8	Calle1	Int_Calle	Name of streets	This table feeds the intersection table