Census Data Use in Illinois by a Large Metropolitan Planning Organization

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This paper is the second in a series of four that document the uses of census data by the transportation community in Illinois. It focuses on the use by the largest metropolitan planning organization (MPO) in the state—the Chicago Area Transportation Study (CATS)—of the Census Transportation Planning Package. The other papers in this series discuss the uses of the census data by smaller MPOs, transit planners, and the research and academic community. CATS has had a rich history working with the census data, specifically the journey-to-work data. However, unlike smaller MPOs, CATS has used the census data as an adjunct to supplement its own travel surveys. In general terms, these uses have included factoring and adjusting other surveys, producing descriptive reports, conducting special studies and analyses, and developing models.

Planners and scholars have now used the census transportation planning packages in the Chicago area for almost 30 years. The 1970 Urban Transportation Planning Package (UTPP) was utilized extensively by the staff of Northeastern Illinois Planning Commission (NIPC) and particularly by a large metropolitan planning organization (MPO), the Chicago Area Transportation Study (CATS). It was also intensively used by several local universities that produced a variety of different analyses at the request of public agencies. In fact, the transportation agencies in northeastern Illinois contracted with a local university to enhance and modify the 1970 census data base to make it more readily usable.

Stemming from the momentum created by the 1970 work-related questions and fueled by the prospect of a separate journey-to-work tabulation, CATS purchased the 1980 UTPP. Since the agency already had conducted its own travel survey for modeling purposes in 1970, the 1980 UTPP was used primarily for the production of transportation statistics for northeastern Illinois. As soon as the package was received, in 1985, CATS staff began the publication of data bulletins entitled *Transportation Facts* (T-Facts). The 1980 UTPP was also used for a variety of planning studies.

As the decade of the 1980s advanced, so did CATS staff expertise with the use of the package. Toward the end of the decade when funding for the MPO's activities was in short supply, CATS staff devoted their time to providing and charging for the production of custom tabulations serving a variety of different types of outside clients. The most commonly sought-after products were summaries of the daytime population as well as the commuting patterns of workers. This information was solicited by banks, loan institutions, and prospective business entrepreneurs. The package was also used to a lesser degree in support of a 1979 effort of CATS staff to update the agency's 1970 Home Interview Survey.

Presented in this paper is a review of the CATS use of the 1990 package, which is now called the Census Transportation Planning Package (CTPP). As is evi-

dent, the 1990 package has received more use than the 1980 package, which in turn was used more than the 1970 package. In effect, the journey-to-work data are becoming more widely used and their application for planning-related questions is growing.

CATS has had a substantial history with the use of all the census planning packages. The uses of the 1990 CTPP are summarized in the following sections, which cover factoring and adjusting surveys, descriptive reporting, special studies, and model development.

It should also be pointed out that when the 1990 CTPP was first received by CATS, the data were examined and checked against other local data. The purpose of this step was to determine the validity of the package. CATS staff specifically checked the data on employment in Chicago's central business district (CBD) for various levels of geography against other known sources of employment. The employment levels were also checked in terms of trends (1980 to 1990). As a result of these checks, which are documented in internal agency memorandums, it was concluded that the CTPP was valid and indeed usable.

Factoring and Adjusting Surveys

A basic but many times overlooked use of the census data is to factor and adjust other surveys. A prime example of this is the factoring that was done with the CATS 1990 Household Travel Survey. The CATS factoring, which has been described by Kim et al. (*1*), was a two-tiered process. The first tier consisted of an adjustment for the response rate followed by the development of weights based on the 1990 census. The census variables included were persons per household or household size and the number of vehicles available. Although these variables were used because of their consistency with CATS travel demand models, other variables could be used as well. For example, with its household travel survey conducted in the fall of 1995, the Northwestern Indiana Regional Planning Commission used age and income from the census as their adjustment variables.

Aside from their use in direct factoring and adjusting, the census data have also played an important role in conducting reasonableness checks of locally collected survey data. Local agencies are continually collecting data to answer specific questions. As a result, CATS staff have been strong proponents of including on every survey one or two control questions that match the data collected by the census. In this way the survey administrator can compare the data from the control question with the census data and make a determination as to the quality or reasonableness of the survey.

Descriptive Reporting

After receiving the CTPP and assessing its reasonableness, CATS undertook the publication of summary reports for the Chicago metropolitan area (*2–8*) and for the state of Illinois (*9–11*). One-page statistical bulletins were produced such as the one shown in Figure 1 for each of the approximately 250 census places in the metropolitan area. The tabulations were also produced for the 77 community areas that make up the city of Chicago. The statewide package was used to produce a similar one-page summary for each of 102 counties in Illinois. Two Illinois county reports were produced, one by place of residence and the other by place of work. Figure 1 summarizes the data by place of residence for residents of the city of Chicago.

Many of these reports also include maps such as the one in Figure 2, which effectively illustrates the wide regional variations in travel times. From Figure 1 it is apparent that the median travel time to work in the city of Chicago is 31.5 min; the areas with the lightest shading in Figure 2 largely represent areas where the local median is lower than the city median. This map clearly indicates that most of these communities with short travel times are in the northern two-thirds of the city. The University of Chicago/Hyde Park area (Community Area 41) is unique. Of greatest concern to local planners is the large area of minority residents on the far south side, which lacks local jobs and therefore has unusually high median travel times. A map such as the one in Figure 2 is particularly informative and underscores the utility of the CTPP.

CATS has also produced county-level work-trip flow tables for northeastern Illinois (Table 1). Using data from the last three censuses, Table 1 is a concise summary of the county-to-county work-trip flows and how they have changed. It clearly shows the growth of reverse commuting during the last 20 years by the increase in trips from Cook County (the central county). In particular, it should be noted that the number of reverse trips to DuPage County has grown from approximately 32,000 in 1970 to almost 117,000 in 1990. The number of trips to all collar counties has grown by more than 120,000.

This work-trip flow table is from the bulletin *Transportation Facts* (*6*), which includes a multitude of other information. Figures 3 and 4 are typical of the data presented in this bulletin. Figure 3 shows the substantial shift from carpooling to driving alone. The greatest percentage increase in driving alone is predictably in the smallest county (McHenry), but the percentage increases in driving alone are in excess of 20 percent for all suburban counties. Conversely the carpooling declines in all collar counties exceed 20 percent.

Persons 2,783,726 Households 1,020,911 Workers 1,181,677

Where Residents Work

In Chicago city	900,550	(76.2%)
Worked outside place	281,127	(23.8%)
Total Workers	1,181,677	(100.0%)

Total Households by Vehicles Available

0 Vehicle Households	340,460	(33.3%)
1 Vehicle Households	421,276	(41.3%)
2 Vehicle Households	200,495	(19.6%)
3 Vehicle Households	45,025	(4.4%)
4 or more Vehicles	13,655	(1.3%)

Vehicles per Household = 0.98

Mode Used to Travel to Work

Car, Truck, or Van	721,983	(61.1%)
Drive Alone	546,955	(46.3%)
Carpool	175,028	(14.8%)
Public Trans	342,737	(29.0%)
Bus	228,222	(19.3%)
Streetcar/Trolley	2,932	(0.2%)
Subway or Elevated	93,824	(7.9%)
Railroad	17,759	(1.5%)
Other	96,968	(8.2%)
Taxicab	8,289	(0.7%)
Bicycle	3,307	(0.3%)
Motorcycle	593	(0.1%)
Walked	76,041	(6.4%)
Other Modes	8,738	(0.7%)
Work at Home	19,989	(1.7%)
Work at Home	19,989	(1.7%)
Total Workers	1,181,677	(100.0%)

Occupancy of Private Vehicles (Car, Truck, or Van) Used for the Work Trip

Vehicles with 1 Worker	546,955	(87.7%)
Vehicles with 2 Workers	62,716	(10.1%)
Vehicles with 3 Workers	9,401	(1.5%)
Vehicles with 4 Workers	2,923	(0.5%)
Vehicles with 5 Workers	864	(0.1%)
Vehicles with 6 Workers	384	(0.1%)
Vehicles with 7 or more	439	(0.1%)

Workers per Private Vehicle = 1.16

Population Summary

Urban Area		
Urbanized	2,783,726	(100.0%)
Non-Urbanized	0	(0.0%)
Male	1,332,653	(47.9%)
Female	1,451,073	(52.1%)

Spatial Summary

	Sq. Mi.	Sq. Km.
Land Area	227.2	588.5
Water Area	6.8	17.7

Travel Time to Work (Workers not Working at Home)

0 - 4 Minutes	16,853	(1.5%)
5 - 9 Minutes	59,007	(5.1%)
10 - 14 Minutes	98,565	(8.5%)
15 - 19 Minutes	128,656	(11.1%)
20 - 24 Minutes	151,754	(13.1%)
25 - 29 Minutes	62,387	(5.4%)
30 - 34 Minutes	227,716	(19.6%)
35 - 39 Minutes	40,828	(3.5%)
40 - 44 Minutes	63,618	(5.5%)
45 - 59 Minutes	160,602	(13.8%)
60 - 89 Minutes	117,958	(10.2%)
90 or more Mins	33,744	(2.9%)
Total	1,161,688	(100.2%)

Mean Travel Time to Work = 31.4 Minutes

Median Travel Time to Work = 31.5 Minutes

Time Leaving Home to Go to Work (Workers not Working at Home)

12:00 a.m. - 4:59 a.m.	36,441	(3.1%)
5:00 a.m. - 5:29 a.m.	41,407	(3.6%)
5:30 a.m. - 5:59 a.m.	53,395	(4.6%)
6:00 a.m. - 6:29 a.m.	121,119	(10.4%)
6:30 a.m. - 6:59 a.m.	113,543	(9.8%)
7:00 a.m. - 7:29 a.m.	177,508	(15.3%)
7:30 a.m. - 7:59 a.m.	140,233	(12.1%)
8:00 a.m. - 8:29 a.m.	141,091	(12.1%)
8:30 a.m. - 8:59 a.m.	59,751	(5.1%)
9:00 a.m. - 9:59 a.m.	56,958	(4.9%)
10:00 a.m. - 10:59 a.m.	24,618	(2.1%)
11:00 a.m. - 11:59 a.m.	12,591	(1.1%)
12:00 p.m. - 3:59 p.m.	103,087	(8.9%)
4:00 p.m. - 11:59 p.m.	79,946	(6.9%)
Total	1,161,688	(100.0%)

Notes: 1. Workers include those persons 16 years old and over.
2. Percentages may not add up exactly to 100 due to rounding.

Data Sources: 1990 Census of Population and Housing; Summary Tape File (STF3A) and Census Transportation Planning Package (CTPP).
Prepared by Chicago Area Transportation Study (CATS) October 1993.

FIGURE 1 1990 transportation facts for residents of Chicago city.

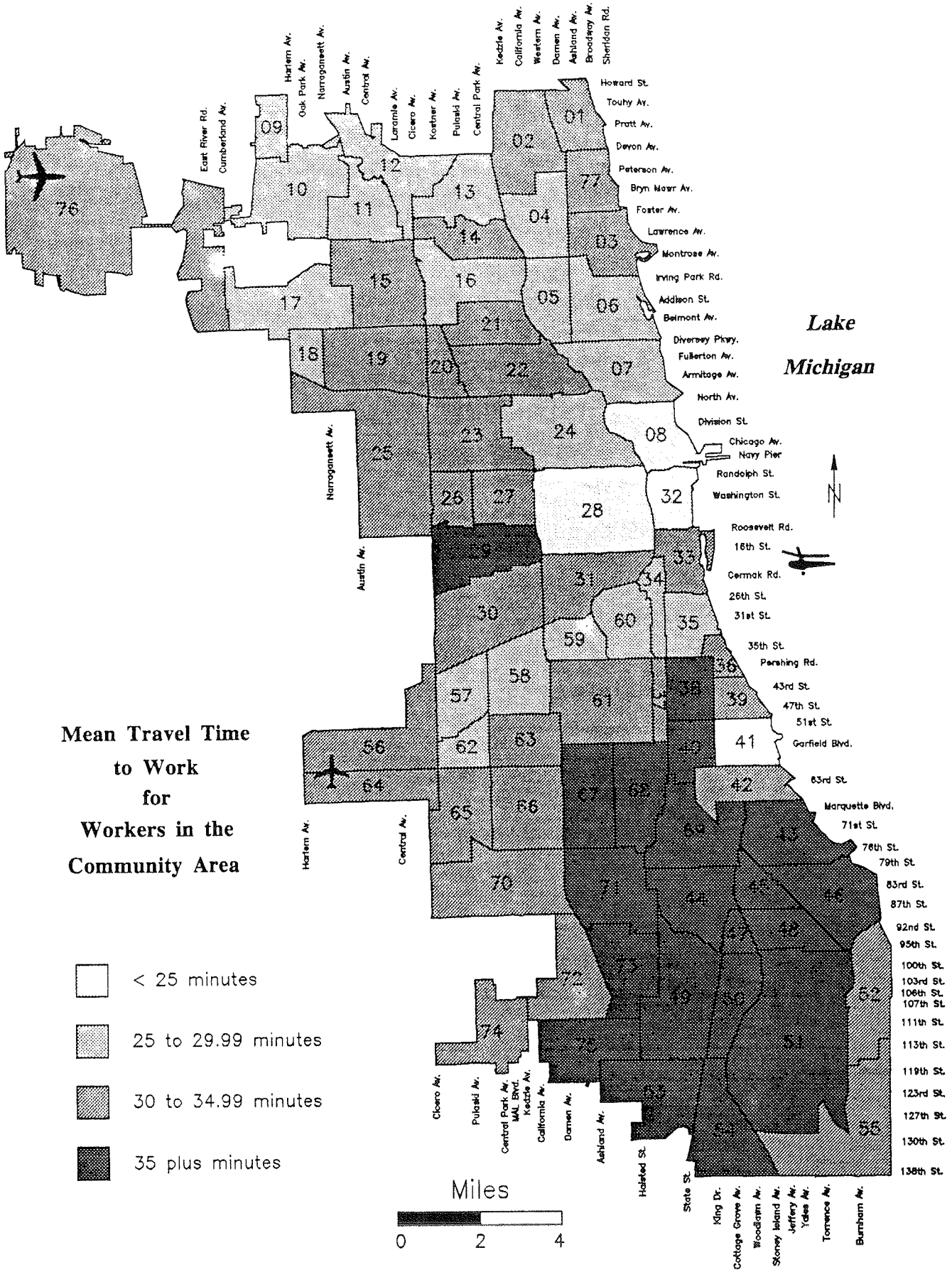

FIGURE 2 Chicago community areas: mean travel time to work (source: 1990 Census STF 3A).

TABLE 1 Census Work-Trip Summary (County-to-County): 1970 to 1990

		Place of Work						
		Cook County	*DuPage County*	*Kane County*	*Lake County*	*McHenry County*	*Will County*	*Outside Six County Region*
County of Residence	**Cook County**							
	1990	2,147,598	116,776	16,107	39,641	3,283	15,806	30,413
	1980	2,150,111	60,197	8,389	19,760	1,506	9,441	31,446
	1970	2,105,178	32,624	9,056	18,624	951	4,299	43,076
	DuPage County							
	1990	155,655	244,898	10,805	3,655	566	4,092	5,613
	1980	142,824	178,473	6,705	1,270	353	1,835	3,500
	1970	90,663	97,226	3,670	960	76	1,092	3,589
	Kane County							
	1990	28,017	24,325	94,614	1,548	3,193	1,018	4,767
	1980	19,952	11,649	90,702	832	2,118	437	3,100
	1970	14,956	5,505	76,982	1,532	803	294	3,863
	Lake County							
	1990	82,767	5,771	1,423	171,535	3,514	425	4,809
	1980	57,067	1,834	328	145,550	2,346	48	4,300
	1970	37,180	1,040	891	121,183	1,345	72	3,963
	McHenry County							
	1990	24,599	2,899	5,196	10,942	47,757	161	2,322
	1980	16,078	1,147	3,007	5,797	40,354	24	1,500
	1970	9,192	469	1,785	3,366	28,076	41	1,676
	Will County							
	1990	55,224	26,333	2,361	613	50	78,614	7,050
	1980	40,975	12,177	1,627	78	26	75,175	5,300
	1970	20,273	3,533	1,133	247	7	63,957	3,073
	Outside Six County Region							
	1990	78,493	12,248	13,255	17,231	6,635	10,115	N/A
	1980	29,000	2,500	10,100	5,900	3,000	5,500	N/A
	1970	27,329	1,264	8,510	4,961	2,001	4,395	N/A
	Total Work Trips to County of Work							
	1990	2,572,353	433,250	143,761	245,165	64,998	110,231	N A
	1980	2,456,007	267,977	120,858	179,187	49,703	92,460	N A
	1970	2,304,771	141,661	102,027	150,878	33,259	74,150	N A

** Trips from outside the region were rounded to the nearest 100 for the year 1980.*

The changes in public transportation use are shown in Figure 4. Regionwide bus use is declining more rapidly than for all the rail modes combined, and both experienced declines in market share. The greatest bus use declines are in the areas closest to Chicago, and conversely there are increases in three counties distant from the metropolitan core. The percentage increases appear impressive (e.g., almost 40 percent in Will County), but in light of their small base levels in 1980, these increases are small in contrast to the declines in the closer-in large counties. Regionwide the decline in bus use is more than 10 percent.

Special Studies

CATS is frequently presented with requests regarding information in the CTPP. It is not always feasible to meet these requests, but Figures 5 and 6 are typical of what is uniquely available in the CTPP and how requests for information can be packaged. Both maps portray the job destinations of workers residing in designated study regions. Figure 5 shows that most of the workers residing in the Austin Community Area (Area 25 in Figure 2) work in one of two general areas—in the vicinity of Austin and in the Chicago downtown. Since the down-

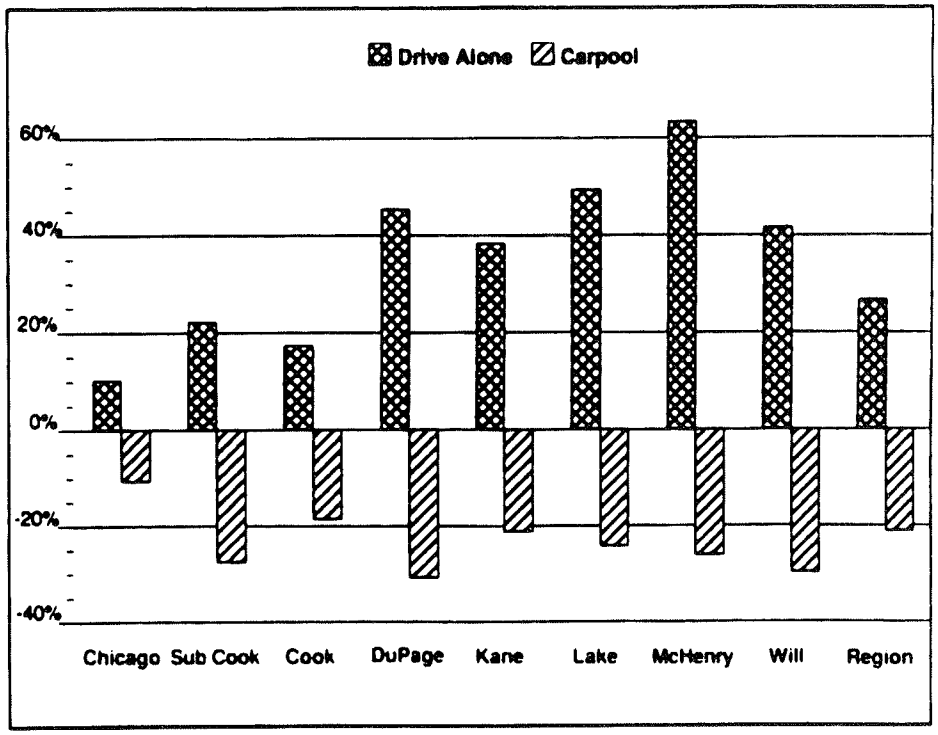

FIGURE 3 Change in private passenger vehicle trips, 1980 to 1990, by mode.

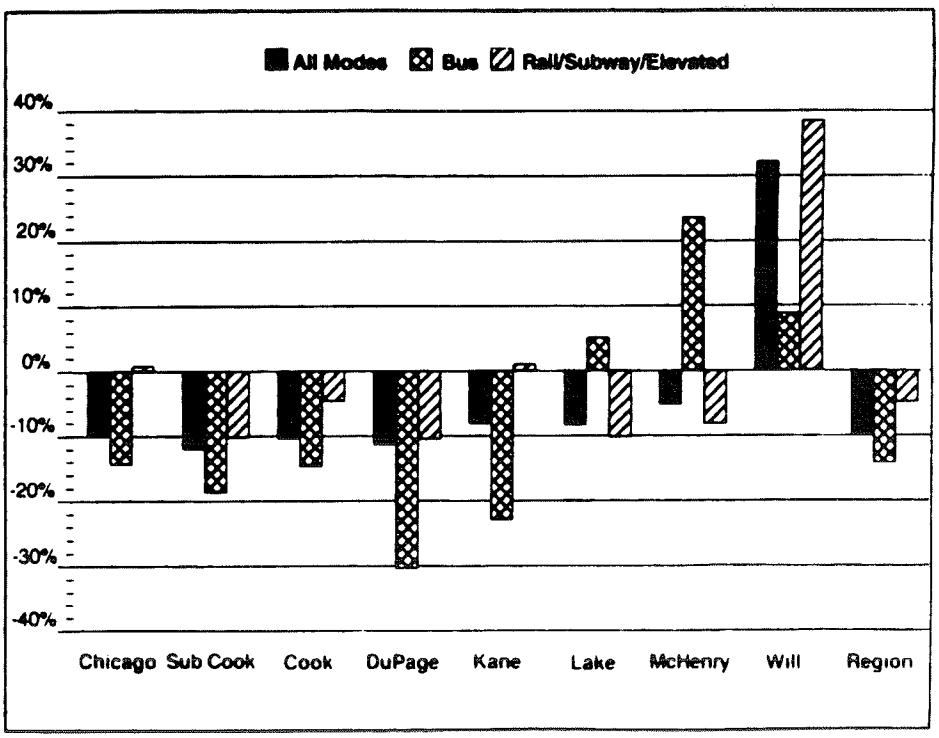

FIGURE 4 Change in census work trips via public transportation, 1980 to 1990, by mode.

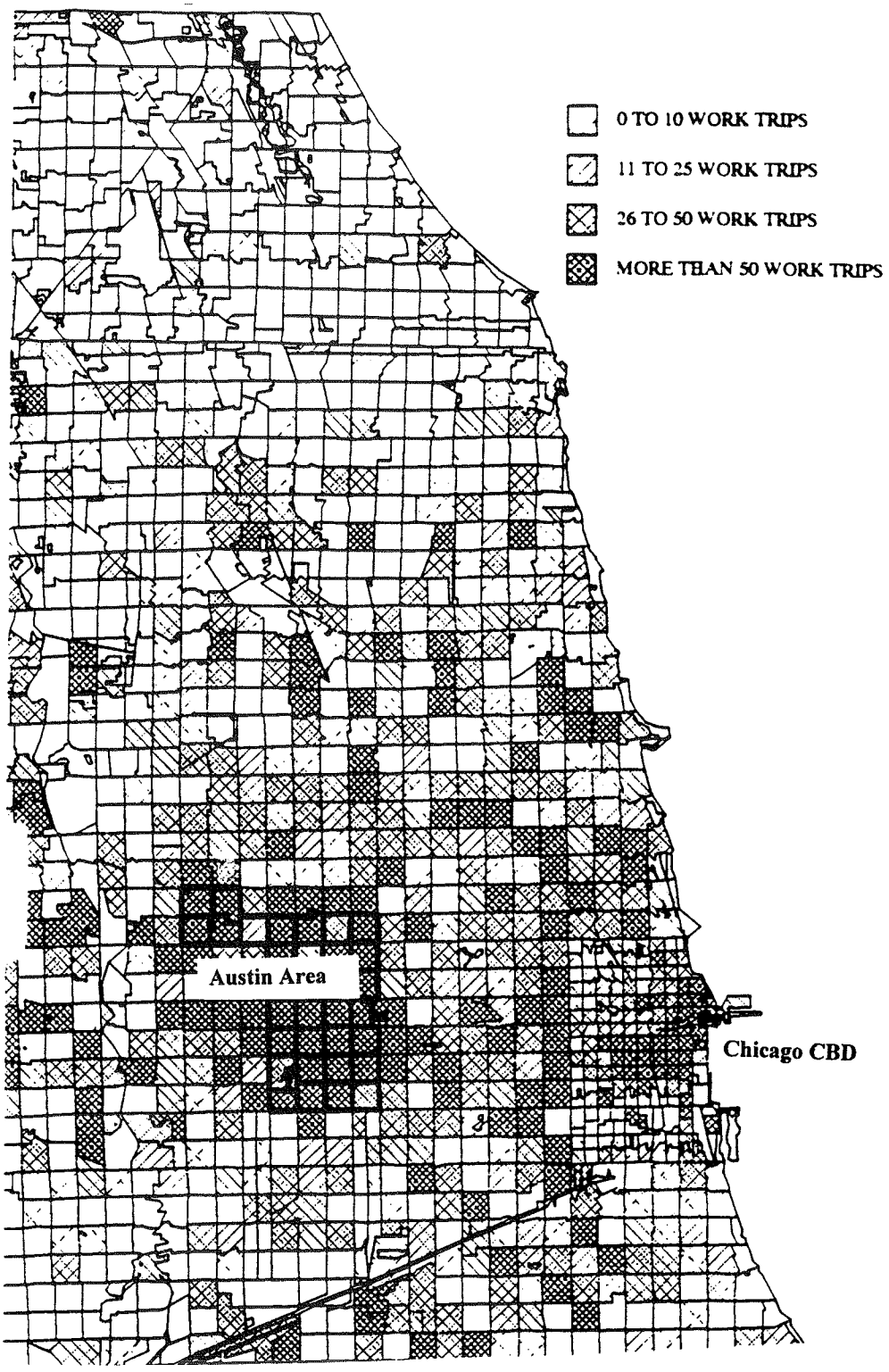

FIGURE 5 Work-trip flows from Austin area by TAZ.

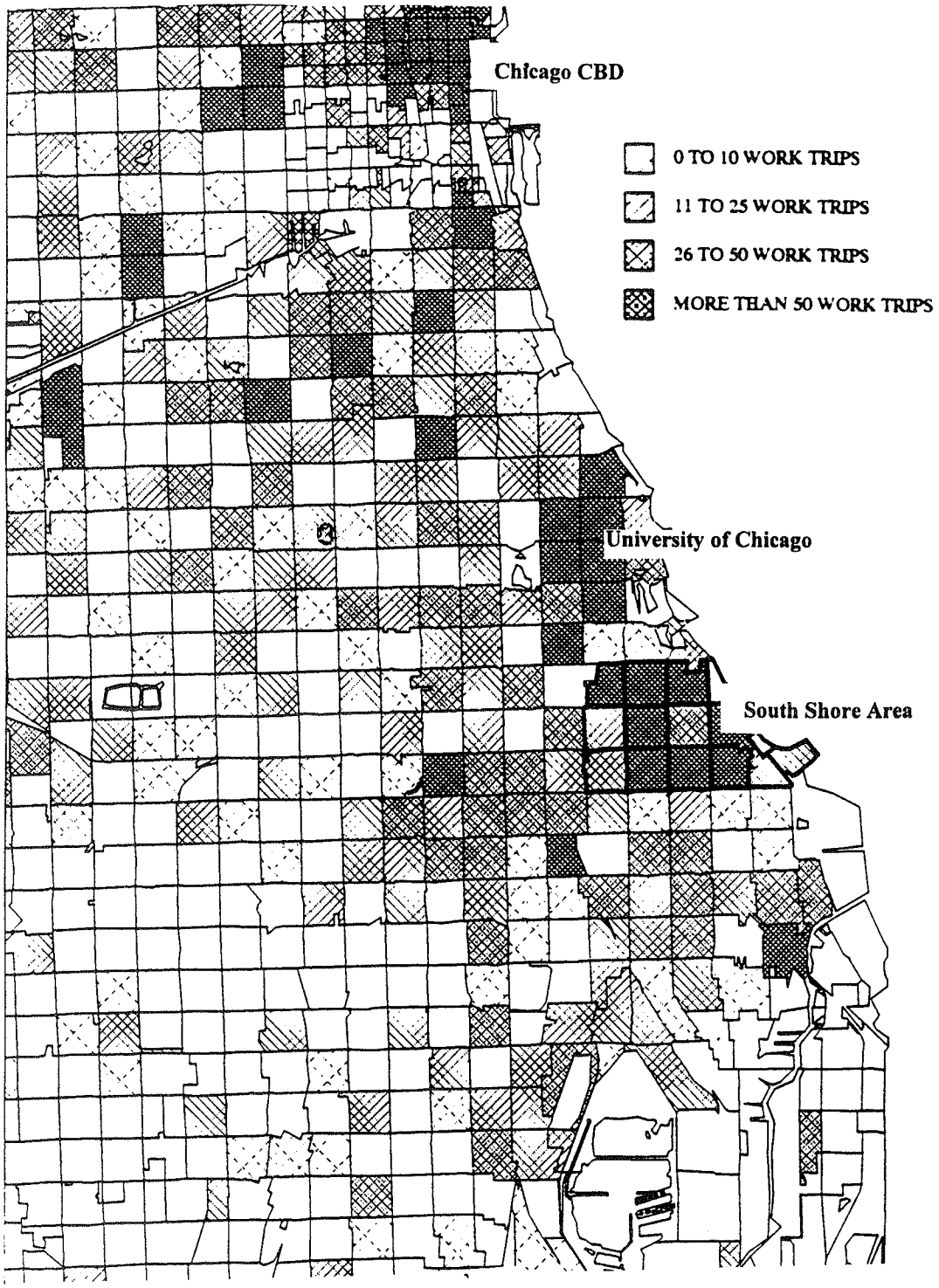

FIGURE 6 Work-trip flows from South Shore area by TAZ.

town traffic analysis zones (TAZs) are smaller than those in the rest of the study area, the pattern seems out of phase with the rest of the map. In addition, with a mapping convention such as this, it is impossible to tell how large the numbers are once they extend beyond the highest category, over 50 workers, as would be true for several CBD TAZs. Still, the map effectively shows the diverse work locations of Austin residents.

Figure 6 is an analogous map, but for the South Shore Community Area (Area 43 in Figure 2). Again the origin-destination (O-D) file, Part C of the CTPP, was used, but in this case 14 origin zones (quarter-square-mile

zones) were added into one residential origin. The job destinations (workplaces) were kept at the original zonal level. The scatter of workplaces includes three basic areas: the home community of South Shore, the University of Chicago/Hyde Park area to the north, and the Chicago downtown on the northern perimeter of the map. By contrast it is remarkable how few workplaces there are in zones immediately to the south and north.

Only the CTPP is capable of presenting data on such a fine level of geography. Even the CATS Household Travel Survey, extensively used for travel modeling, cannot provide the detail shown in Figure 6. The nearly 20,000 households in the CATS Household Travel Survey would only average 2 per TAZ. Even though the number of responses is higher in the city than in the suburb TAZs, they still are inadequate except in very limited cases.

CATS has also used the Indiana portion of the CTPP, in which the TAZs follow a different geography. Figure 7 provides an indication of traffic generation by combining the number of households and employment by TAZs. It shows where residential populations are concentrated and where employment dominates. This work was undertaken to help with the development of a new zone system for modeling Indiana trips.

Model Development

The CTPP and other census products play a varied but important role in CATS modeling and model development. Their use ranges from providing direct inputs for CATS trip generation rates to producing work-trip flows and descriptive statistics used to check the data model quality. Presented in this section is a brief overview of some instances in which the CTPP is used in the CATS modeling process.

With the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), the Clean Air Act Amendments (CAAA), and subsequent regulations, CATS has embarked on a series of efforts to redefine and enhance its travel forecasting process. This effort has drawn from a variety of data sources, including the family of census products. The process itself is ongoing, and the enhancements will be brought online as they are fully developed, tested, and validated.

Throughout this paper and within the transportation planning community, references are routinely made to the need for the CTPP and its specialized geography in transportation planning. There is also a need for locally collected travel survey data. CATS is currently in the almost ideal situation of having both products to draw from. One of the areas in which these two products most clearly come together is the trip generation process. Figure 8 is a flow diagram of this process. As can be seen, the CTPP plays an important role at the beginning of the process. Working in concert with the CTPP is the CATS Household Travel Survey. According to the process, the actual trip rates are derived from the CATS survey, whereas the classification cells for each zone use the demographic data from the CTPP. How these two data sources come together within trip generation is detailed elsewhere (*12*).

The CTPP data are also used in the CATS process in many other ways. Table 2, created as part of a developing document that details the current CATS enhancements within its modeling applications, identifies many of the specific variables from the package that are used for different components of the trip generation process. At this point the documentation is composed as a series of in-house memorandums that will be published as part of future air-quality conformity analyses.

The last item in Table 2 pertains to a vehicle ownership model, which is one of the latest improvements to the CATS process. Like the trip generation model improvements, the vehicle ownership model is still under development and will be documented as part of future conformity analyses. The model uses two variables from the CTPP: the average automobile work-trip mode share and what CATS staff has dubbed the "pedestrian environmental factor."

In the development of the vehicle ownership model, a measure was needed as a surrogate for pedestrian and bicycle facilities in each zone. Since there was no existing measure, CATS staff created the pedestrian environmental factor. The number of census blocks in a zone was used as the surrogate. Since census blocks are, for the most part, bounded by streets and each time a street intersects another street a new block is formed, CATS staff reasoned that the more blocks that are located in a particular zone, the more streets it had and the more conducive it would be to both walking and bicycling. Although this exercise was not a direct application of the CTPP output, the equivalency file used to generate the TAZs was most useful.

Besides its use in the CATS trip generation process, the CTPP also provides data that are used with the mode split process. Supporting the mode split models is a zonal-level data base containing many of the variables used by the process. The CATS files that contain the relevant data are known as MO1 and MO23. Although these files contain many of the transit-related infrastructure variables like route miles, parking costs, and bus wait times, they include two CTPP variables—automobile occupancy and median income. The documentation for this file can be found in a CATS Working Paper (*13*).

The foregoing are just some of the areas in which the CTPP is a necessary and vital component in the CATS forecasting process. The CTPP also plays a less-than-subtle role in the modeling process since it is a good independent source of information on mode split,

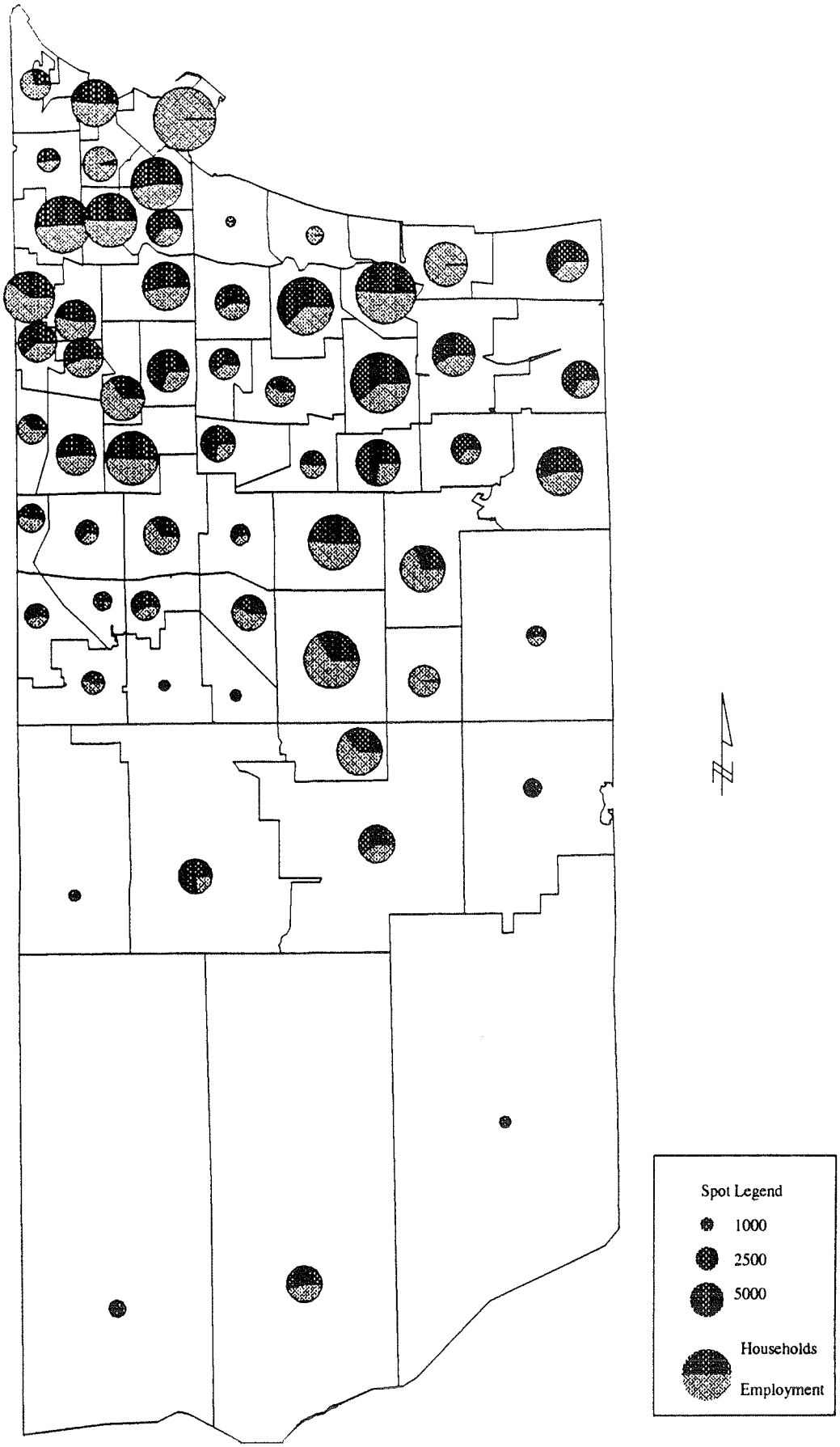

FIGURE 7 Distribution of households and employment by combined Northwestern Indiana Regional Planning Commission TAZs for proposed 1995 CATS zones for Indiana.

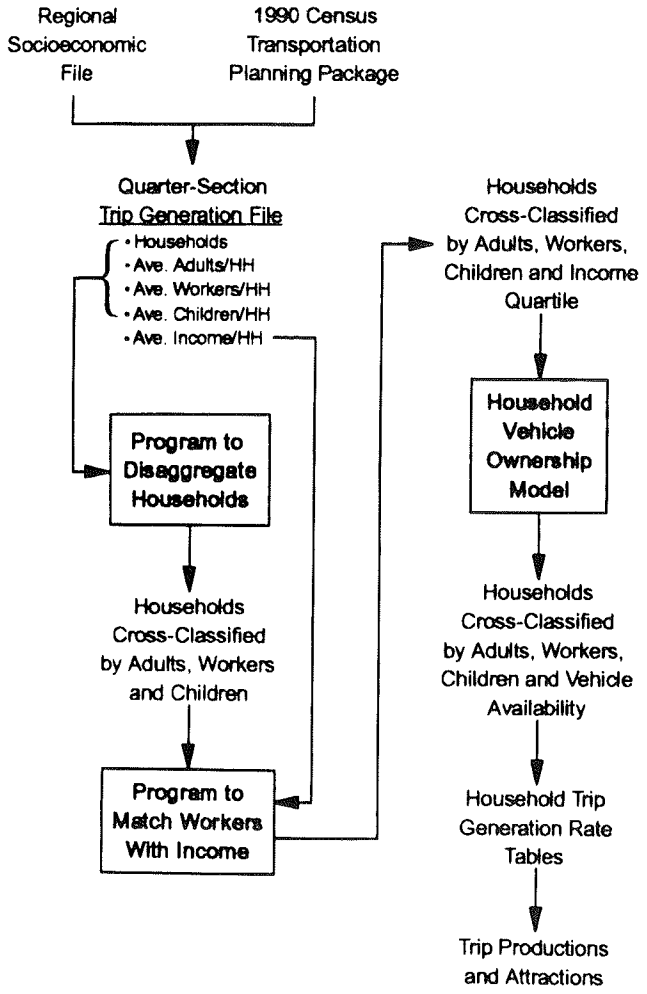

FIGURE 8 Overview of CATS household trip generation process.

travel time, and O-D information. Also, as CATS continues to improve its modeling and forecasting ability, it is certain that the CTPP will be considered a vital source of new data items. The fact that the CTPP is aggregated down to the geography used in the model process makes it an invaluable source.

Concluding Remarks

Within CATS there is a great deal of activity surrounding the use of the CTPP. There has been a long tradition of CTPP use, starting with extensive utilization of the 1970 UTPP. The 1980 UTPP was used more extensively, and now the 1990 CTPP is used in addressing a wide variety of questions. CATS has the opportunity to use the census packages in longitudinal studies. Several studies just now getting under way will examine the changes in travel patterns from 1970 to 1980 to 1990.

TABLE 2 Variables Required for Trip Generation: Census CTPP Variables

Variable	Description
Persons	
Total	Table 1-1
in Households	Table 1-11
in Group Quarters	Table 1-12
Households	Table 1-4
Workers	
in Households	Table 1-49
in Group Quarters	Table 1-50
Non-Workers 16 Years and Older	
in Households	Table 1-11 Minus Table 1-49
in Group Quarters	Table 1-12 Minus Table 1-50
Children in Households	
Total Younger Than 16	Table 1-11
Only Ages 12 Through 15	Table 1-8 (12 to 17 Years) Minus Table 1-11 (16 to 17 Years)
Mean Household Income	Table 1-16
Total Vehicles Available in Households	Table 1-17
Workers Commuting to TAZ	
Government	Table 2-3. Accumulated by SIC Code to Match NIPC Definitions
Manufacturing	
Retail	
Service	
TCUW	
Other	
Vehicle Ownership Model Variables	
Average Pedestrian Environmental Factor	Both Are Obtained From Vehicle Ownership Model Calibration Data Set
Average Auto Work Trip Mode Share	

In northeastern Illinois CATS has used the package in four distinct ways. First, it was used to provide the benchmark data from which to factor and adjust the CATS 1990 Household Travel Survey. The other uses include providing descriptive summaries that feed into a whole host of questions related to planning information; performing special studies; and supporting the modeling efforts of the region.

Although this paper has addressed the many uses of the CTPP, it should be acknowledged that this MPO could survive without the package. In fact, among CATS staff it is possible to find divergent opinions as to the absolute utility of the package. From a planning perspective, CATS has had a rich tradition of collecting localized data to support its travel demand modeling work. However, as the package gets easier to use and is more readily available, this perspective may change.

REFERENCES

1. Kim, H., J. Li, S. Roodman, A. Sen, S. Sööt, and E. Christopher. Factoring Household Travel Surveys. In *Transportation Research Record 1412*, TRB, National Research Council, Washington, D.C., 1993, pp. 17–22.
2. Christopher, E.J., J.J. Nam, and M.J. Rogus. *1990 Census Transportation Facts for Residents of Northeastern Illinois by Census Place*. Chicago Area Transportation Study, Chicago, Illinois, Nov. 1993.
3. Christopher, E.J., J.J. Nam, and M.J. Rogus. *CATS Traffic Analysis Zone Structure for the 1990 Census Transportation Planning Package*. Working Paper 94-01. Chicago Area Transportation Study, Chicago, Illinois, Dec. 1993.
4. Christopher, E.J., S.D. Mills, and M.J. Rogus. *1990 census Transportation Facts for Residents of the 77 Community Areas of Chicago*. Chicago Area Transportation Study, Chicago, Illinois, Jan. 1994.
5. Christopher, E.J., S.D. Mills, and M.J. Rogus. *1990 Census Transportation Facts for Workers Employed in Northeastern Illinois by Census Place*. Chicago Area Transportation Study, Chicago, Illinois, June 1994.
6. Christopher, E.J., and M. J. Rogus. A Focus on Census Work Trips for 1970, 1980 and 1990. *T-Facts* (newsletter), Vol. 10, No. 3, June 1993.
7. Christopher, E.J., and M.J. Rogus. Mode to Work for 1990. *T-Facts* (newsletter), Vol. 10, No. 5, Aug. 1993.
8. Christopher, E.J., and M.J. Rogus. Changes in Travel Modes to Work from 1980 to 1990s. *T-Facts* (newsletter), Vol. 10, No. 6, Oct. 1993.
9. Christopher, E.J., M.J. Mueller, and M.J. Rogus. *1990 Census Transportation Facts for Workers Employed in Illinois by County*. Chicago Area Transportation Study, Chicago, Illinois, Dec. 1994.
10. Berman, E., E.J. Christopher, W. Ma, J.J. Nam, and M.J. Rogus. *1990 Census Transportation Facts for Residents of Illinois by County*. Chicago Area Transportation Study, Chicago, Illinois, Oct. 1993.
11. Christopher, E.J., and M.J. Rogus. *1990 Work Trip Flows Between Illinois Counties*. Working Paper 93-05. Chicago Area Transportation Study, Chicago, Illinois, Sept. 1993.
12. *Transportation Improvement Program for Northeastern Illinois—FY1996 to 2000: Conformity Analysis Documentation,* Appendix B. Chicago Area Transportation Study, Chicago, Illinois, March 1996.
13. Fijal, A.R. *MO1/MO23 Data File Update; Description of Variables*. Working Paper 95-01. Chicago Area Transportation Study, Chicago, Illinois, June 1995.