CONFERENCE PROCEEDINGS 13

Decennial Census Data for Transportation Planning: Case Studies and Strategies for 2000

Volume 1

TRANSPORTATION RESEARCH BOARD

NATIONAL RESEARCH COUNCIL

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To James J. McDonnell

The Conference on Decennial Census Data for Transportation Planning: Case Studies and Strategies for 2000 is dedicated to the memory of James J. McDonnell, who passed away in January 1996. Jim was the leading spokesperson in the U.S. Department of Transportation for improvements in census data for transportation planning, and his colleagues will never forget his many accomplishments in that regard.

Even in retirement, he was an active participant in the Transportation Research Board activities and in various other professional activities. It was at the 1994 conference at the Beckman Center that Jim was the first to recognize the need for this conference in 1996, and while at the 1994 conference, Jim had already lined up the U.S. Department of Transportation financial support for the succeeding conference.

You are remembered, Jim, and we are pleased to dedicate this conference to your memory.

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WORKSHOP REPORTS

Introductory Remarks

Charles L. Purvis, *Metropolitan Transportation Commission*

The U.S. decennial census is a centerpiece national effort that provides critical data needed by transportation planners at the local, metropolitan, state, and national levels. Transportation planners have been vocal in advocating that the decennial census be maintained and in recommending changes and improvements to future censuses. It is this keen interest in preserving and improving on the census that has prompted the transportation community to reunite in the mission to understand the use of census data in transportation planning and to recommend strategies for Census 2000.

These proceedings document the second Conference on Decennial Census Data for Transportation Planning to be held since the 1990 census. This conference was held April 28 through May 1, 1996, at the National Academy of Science's Arnold and Mabel Beckman Center in Irvine, California; it is the fifth in a series of related conferences; earlier ones were in 1970 in Washington, D.C. (*1*); in 1973 in Albuquerque, New Mexico (*2*); in 1984 in Orlando, Florida (*3*); and in 1994 in Irvine, California (*4*). The short time between the 1994 and 1996 conferences was prompted by the uncertainty at the 1994 conference in terms of the plans by the Census Bureau for Census 2000. Various alternatives to the census long form, including continuous measurement, matrix sampling, and a reduced long form, were discussed at the 1994 conference.

The overall objectives of the current conference were to

1. Assess the uses of the 1990 census data, including case studies of applications by large metropolitan planning organizations (MPOs), small MPOs, state departments of transportation, transit operators, and the private sector;
2. Review the current plans for Census 2000 and assess the impacts on the transportation program;
3. Review and assess data needs for the future and recommend methods and products to improve Census 2000;
4. Assess alternative data collection options if Census 2000 does not include items needed by transportation planners; and
5. Develop an action agenda for federal, state, and regional agencies.

The conference opening session included a presentation by Martha Farnsworth Riche, Director of the Bureau of the Census, on plans for Census 2000. Also included in the opening session were presentations related to use of and national experience with the 1990 census data and data needs and requirements.

For the case studies portion of the conference, more than two dozen case studies on the uses of census data in transportation planning were solicited and developed as a resource for conference participants. Many of these case studies are compiled in Volume 2 of these proceedings. The case study papers are summarized in the second section of Volume 1.

After the morning plenary session on Monday, April 29, conference participants selected one of five concurrent workshops to discuss three main topics:

- Uses of 1990 census data,
- Needs and improvements in data quality, and
- Alternatives to Census 2000.

Summaries are provided for these three main topic areas rather than individual reports for each of the five concurrent workshops.

The conference concluded on Wednesday, May 1, with a plenary session to discuss workshop summaries and conference recommendations. A conference summary and recommendations were prepared by Alan Pisarski in consultation with the steering committee for this conference and on the basis of the workshop and plenary session discussions.

Conference participants were generally concerned yet intrigued with the notion of continuous measurement as a parallel process to the traditional, yet improved, census long form. Important to note was a general endorsement of the recommendations and findings from the Bureau of Transportation Statistics study on continuous measurement and transportation planning (*5*). Participants were supportive of the Census Bureau goals for a Census 2000 that is "faster, less costly, and more accurate." They were mindful of the fiscal considerations for planning Census 2000 and the implications for transportation data collection budgets given the number of different alternatives suggested for the coming census.

The conference would not have been a success without the hard work and contributions of members of the conference steering committee, staff of the Transportation Research Board, colleagues at the U.S. Department of Transportation and the Bureau of the Census, case study authors, and conference attendees. Our thanks to all. A special thanks and remembrance go to our late friend and colleague J.J. McDonnell, to whom this conference is dedicated.

REFERENCES

1. *Special Report 121: Use of Census Data in Urban Transportation Planning.* TRB, National Research Council, Washington, D.C., 1971.
2. *Special Report 145: Census Data and Urban Transportation Planning.* TRB, National Research Council, Washington, D.C., 1974.
3. *Special Report 206: Proceedings of the National Conference on Decennial Census Data for Transportation Planning.* TRB, National Research Council, Washington, D.C., 1985.
4. *Conference Proceedings 4: Decennial Census Data for Transportation Planning.* TRB, National Research Council, Washington, D.C., 1995.
5. *Implications of Continuous Measurement for the Uses of Census Data in Transportation Planning.* Bureau of Transportation Statistics, U.S. Department of Transportation, April 1996.

Summary and Recommendations

Alan E. Pisarski, *Falls Church, Virginia*

In March 1994 a conference was held at the Beckman Center of the National Academy of Sciences to review the status of products from the 1990 decennial census developed to date and to address the plans for the 2000 census as then perceived by the Bureau of the Census. The proceedings of the 1994 meeting have been published as Transportation Research Board *Conference Proceedings 4: Decennial Census Data for Transportation Planning* (1995).

History and Context

The 1994 and 1996 conferences followed a pattern that has evolved since the 1970 census of reviewing the preceding census and planning for the next. Never in that series of conferences on the decennial census has there been such uncertainty about a prospective census. As the year 2000 approached, it appeared that the United States would greet the new millenium without a national census or without one that did more than make a simple count of the populace. Rather than the usual lack of interest in Congress for the upcoming census that was 6 years away, there appeared to be much concern about the high costs and lack of timeliness of the 1990 census and a sense of substantial weaknesses in the census products and their timely delivery.

In response to congressional criticism and financial constraints, the Bureau of the Census has developed a series of alternative approaches to the traditional census. The one most favored, and that causes the greatest alarm in the transportation community, is an approach called *continuous measurement*, which effectively reduces the long-form census to a very large, continuing monthly survey, with results detailed enough to equal those obtained with the long form when cumulated over a period of 3 to 5 years. The short-form census, the basic count of the population used for congressional redistricting, was to be unchanged.

Using continuous measurement, the decennial census would still collect a 100 percent population and housing unit count with basic demographics, such as age, race, ethnicity, sex, and household relationships. But the traditional sampling conducted with the 100 per-

cent count and covering about one-sixth of the population, in which the transportation items and the whole range of social, economic, and housing statistics were obtained, would not be collected by means of a one-time census but by using the continuous measurement system.

This approach, untested and vague in its characteristics, was perceived as a serious threat to the critical materials from the census on which transportation planners depend. In the view of transportation planners and analysts at that time, the census was not perceived as "broken"; rather it was a critical component in the planning data set of states, local governments, and metropolitan planning organizations that produced very valuable—in fact irreplaceable—data. Certainly there was a sense that substantial improvements to the traditional approach were both necessary and possible but that the techniques existed to effect these improvements. Many of these techniques were discussed within the framework of the 1994 conference.

Reflecting these concerns, the 1994 conference participants called on the Bureau of the Census to critically evaluate its plans for the year 2000 census. The recommendations restated strong support for the long-form questionnaire used with the decennial census. The potentially attractive attributes of continuous measurement were recognized, and to better evaluate the proposal, an extensive program parallel to the census was called for. Essentially, the key view of the conference attendees was that the census was too important—too critical to the nation, particularly at the start of a new millenium—to be entrusted to a new and untested procedure.

Given the strong uncertainties during that conference, the participants believed that preparation for the next census should be closely monitored during the next two years and that another meeting be held then if events suggested the utility of such a meeting.

In response to the recommendation from the 1994 conference, the Bureau of Transportation Statistics (BTS) sponsored a study of continuous measurement. The 1996 conference participants thank BTS and endorse the findings of that study and incorporate them by reference in the findings of this meeting.

The overall objectives of the current conference were to

1. Assess the uses of the 1990 census data, including case studies of applications by large metropolitan planning organizations (MPOs), small MPOs, state departments of transportation, transit operators, and the private sector;
2. Review the current plans for Census 2000 and assess the impacts on the transportation program;
3. Review and assess data needs of the future and recommend methods and products to improve Census 2000;
4. Assess data collection options if Census 2000 does not include items needed by transportation planners; and
5. Develop an action agenda for federal, state, and regional agencies.

The discussions of the 1996 conference are summarized in the accompanying box, sharply punctuating the value of and context for the meeting.

SUMMARY

From the foregoing synopsis of the last 2 years, a number of conclusions can be elicited about the context of the present meeting. Additional, detailed recommendations regarding other agencies are provided in the next section.

- **The central role of census journey-to-work data is unchanged.** The participants reiterated their strong support for the Bureau of the Census and its decennial program. They emphasized the strong dependence of their planning programs on the decennial census long-form data products.

SUMMARY OF MEETING CONTEXT

After two years, what is unchanged? What is different or new? What can we conclude now?

What is unchanged?

Support for continuing needs of states and MPOs:

–For the census generally
–For the 2000 decennial census
–For the long-form census
–For the Census Transportation Planning Package (CTPP)

Interest in expansion of the decennial census:

–Access data
–Multimodal journey-to-work data
–Multiple-job data
–Variability of work trip data
–Non-work-related travel data

Need for greater quality:

–Small-area geographic identification
–Small-area allocation

Need for greater timeliness:

–Speedier delivery of all census products
–Speedier delivery of CTPP

What is new or changed?

Some planning needs have changed—focus is on small-area data

Funding context has evolved in

–Bureau of the Census
–U.S. Department of Transportation

There is new information:

–BTS/TRB continuous measurement study
–Census content tests
–Census Bureau strategic plan
–Continuous measurement now parallel with the decennial long-form survey

- **A key factor is small-area data.** It is at the local level that data needs are most critical to meet the requirements of the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) and the Clean Air Act Amendments (CAAA). These data must be available for very small areas of geography such as census tracts, block groups, and even blocks and block faces for aggregation to traffic analysis zones. Sampling densities must be sufficient to meet these needs.
- **Prospective changes to the census are a serious threat.** Participants saw the prospect of attempts to substitute continuous measurement for the long-form approach to the decennial census as a serious threat to planning capabilities at all levels of government.
- **There was strong support for a plan to use the long-form data collection method in parallel with a continuous measurement pilot program.** The participants recognized the potential value of continuous measurement, but they could not support an untested approach as a replacement for such a critical element in their planning programs.

- **The U.S. Department of Transportation (DOT) and the transportation community still need to work in close coordination with the Census Bureau.** The Bureau should recognize the need for a real partnership among its various constituents. The census depends on the transportation community, particularly the MPOs and the DOT agencies that fund the review and revision of census geographic materials; this process requires closer coordination between the MPOs and the DOT agencies.
- **Full funding of the decennial census is crucial to state and MPO planning processes.** The value of the decennial census for the nation's economic and social health in general and for support of the nation's transportation planning process in particular was reemphasized. To be sure, there is room for greater efficiency and cost improvement in the present census process, but ultimately the cost of the census is minor considering the critical questions relating to public investment and public policy that the census data support and the responses to which the nation has depended on for a decade.
- **Continuous measurement is not a viable alternative to the long-form census at this time.** At this critical stage, particularly at the beginning of a new millenium, it is essential that the census be sound and accurate. The promise of continuous measurement is still uncertain. Its alleged cost savings are unsubstantiated and appear particularly fragile when considered in the light of the total costs that users will have to absorb to adjust to the new system. Far greater experience is needed, with detailed parallel comparisons between the traditional and the proposed approaches, before conversion to the new method can be supported. Continuous measurement should replace the traditional census when it has been shown to produce a better product, not because it is asserted to be a cheaper approach. If an equal product could be obtained for less through an alternative procedure, certainly that would be acceptable.
- **Development of the continuous measurement system is encouraged and supported.** The participants see great promise in the continuous measurement process in the future after pilot testing against the traditional census. Implementation at the transportation planning level would require extensive research, restructuring of programs, and changed modeling and analysis procedures. Training costs would be substantial. The need for transportation agencies to maintain continuing geographic systems updates for the census alone would be a major cost increase, which would generate great expense to the transportation process that can be borne in a properly structured program.

The structure of the 1996 meeting on the 2000 census took a different tack than in past meetings, in which the group was divided into separate clusters that followed different tracks, utilizing workshops oriented around the issues of interest to the participants, such as the states, large metropolitan areas, small metropolitan areas, transit agencies, the private sector, and so on.

This second meeting on the 2000 census, because it had had the benefit of the earlier meeting's conclusions, was able to spend less time on fact finding and focus more on key areas: updating experience with the 1990 census, refining quality improvements needed, and then focusing strongly on alternatives facing the transportation profession for the year 2000.

Findings and Recommendations

General Findings

- *The Bureau of the Census should conduct a year 2000 census with a strong long-form component.*

The current Census Strategic Plan for 2000 cites this intent, and the agency must adhere to that strategy.

- *The decennial census long-form data are the statistical centerpiece of the metropolitan planning process.*

Both the general socioeconomic data and the specific transportation journey-to-work data contained in the long form are key.

- *It is critical that the decennial census process be adequately funded to ensure a quality, full-scale undertaking.*

Relative to the scale of the decisions to be made based on these data and the immense public investment involved, census costs are at an appropriate level.

- *The Bureau of the Census should enact its strategy for 2000 and adopt all other appropriate procedures to ensure efficient, low-cost, cost-effective, timely products that act as a force for national unity.*

The Bureau has identified key improvements and changes that can be made to the traditional process using statistical techniques, new technologies, and other tools to improve the cost, speed, and quality of the decennial products. That strategy is endorsed, and the Bureau must be permitted to implement that strategy.

- *Small-area data form the main element of the census that is crucial to transportation.*

These data, available in sample sizes adequate for small units of geography, permit transportation planning that is responsive to the congressional mandates of ISTEA and CAAA.

- *All elements of transportation at all levels benefit from the census products.*

National policy is strengthened, states benefit from commonly defined and collected data, large metropolitan areas are capable of using these highly complex data to meet their challenges, but perhaps the greatest beneficiaries are small metropolitan areas that do not have the sophistication or resources to collect such essential statistics on their own. Functionally, the less heavily used modes of transportation benefit most from the extensive sample sizes; these are the modes that are most often the object of public policy decisions: carpooling, public transit, walking, bicycling, telecommuting, and so forth.

- *Continuous measurement should be supported as an experimental, pilot program with potential for the future, but in no way should it impede the 2000 decennial census activity.*

There is real concern that on the basis of the untested promise of potential cost savings, the continuous measurement system might be seen as a potential substitute for full-scale census activity in 2000. It would be irresponsible to replace so important an activity with an untested process. If funding constraints dictate that cuts are to be made, continuous measurement should be delayed.

- *A research effort should parallel the 2000 census keyed to potential implementation of continuous measurement in the first decade of the new century and for the 2010 census.*

A carefully constructed set of representative sample areas can be developed to test the new approach against the 2000 long-form census. This research effort can be less extensive than that now envisioned by Bureau personnel and less expensive. Parallel research will need to begin in the transportation sector to make the changes to planning tools, investment models, forecasting systems, and so on, that will need to be made responsive to the new data structure.

- *A Memorandum of Understanding should be drawn up between the Bureau of the Census and DOT.*

This understanding would specify the interests, responsibilities, and obligations of both agencies in the upcoming decennial census, incorporating the concerns of the states, MPOs, and other local entities.

• *The transportation community should consider the creation of a Census Technology Center to monitor events.*

The transportation community needs to closely track events in the census planning and development process. It needs to understand the implications of these plans and keep practitioners and affected institutions informed of key developments, research needs, and other implications.

Specific Findings

The following findings focus on detailed aspects of the activities surrounding the census—its planning, development, tabulation, use, and follow-on activities.

• *The Census Bureau is currently field testing a number of changes in the transportation area that are under consideration for implementation in 2000.*

These changes need careful evaluation. Field tests should be closely monitored, and changes that reduce detail, particularly aggregation in the transit modes, need careful scrutiny and discussion before implementation.

• *As the journey to work evolves, the census should consider the broader needs of transportation.*

The identification of trip itineraries using multiple modes, multiple jobs, and occasionally used modes has been cited elsewhere and is a valuable potential addition to the census data.

• *The decision in the Census Strategic Plan that there will be no telephone or field follow-up activities for the long form needs to be evaluated.*

This cost-saving measure needs careful consideration and review by transportation authorities to assess the impacts on prospective planning data products in terms of reliability and other factors.

• *The implications of the Data Access and Dissemination System (DADS) program for timely, effective, and comparable products to transportation authorities need close scrutiny.*

The Bureau intends the DADS program to create on-call data tabulations from the next census, substituting electronic media for paper. The delays and high costs of similar tailor-made systems forced transportation agencies to establish the standardized Census Transportation Planning Package (CTPP) files. The transportation community needs to reconsider the entire CTPP strategy in the light of changing technologies, changing Census Bureau procedures, and changing transportation needs.

• *Census transportation data from 1970 on should be structured in data files using media that will ensure their permanence and utility for trend analyses.*

The census data have great value for historical applications and trend analyses. Their use should not be impeded by failure to properly preserve files and enhance their potential use.

• *Extensive research needs are associated with new census procedures.*

These research needs include (*a*) the reliability implications of sampling and other procedural changes, (*b*) the impacts of the use of administrative records such as drivers'license files and vehicle registrations as census tools, and (*c*) establishment of research designs for comparison of the transportation census long form and continuous measurement.

• *The transportation community needs definitive yearly cost and planning information on the continuous measurement process.*

The transportation planning profession intends to closely monitor the pilot continuous measurement program to better understand the kinds of changes that will be required in professional practice.

• *Plans by the Census Bureau to implement continuous measurement generate an additional series of longer-term but still critical research needs.*

These research needs include studies of (*a*) the geography of continuous measurement sampling plans and their impacts on transportation, (*b*) the specific implications for transportation of the multiyear averaging approaches of continuous measurement, (*c*) the changes needed in the state metropolitan and local planning processes to accommodate continuous measurement, and (*d*) the cost consequences for transportation of changes required in the modeling, forecasting, and training programs of states and MPOs.

• *Study is needed of the implications for local agencies of the new Census Bureau authorization (Public Law 103-430) to better use local capability for updating census geography.*

The Census Bureau will make substantial demands on MPOs and their federal sponsors to meet the needs for geographic updating with local expertise. This area needs clarification. States will need to play a role in defining state-related geography, dealing with such issues as "rest-of-county areas." Part of this problem is the delineation of the boundaries of the Public Use Microdata Sample (PUMS). The continuous measurement system will require continuous updating of geographic information. The technical, institutional, and cost implications for transportation need identification and explication.

Recommendations

The Bureau of the Census should

- Conduct a full census in the year 2000 including the long form with comprehensive transportation elements.
- Incorporate the best technological, statistical, and institutional modifications to ensure a reliable, rapid, cost-effective census consistent with its year 2000 strategy.
- Share its pretest experiences with the transportation community and consult them regarding prospective modifications.
- Plan for a dual activity in which a continuous measurement pilot program would be tested in parallel with the traditional decennial process.
- Continuously provide the user community with greater details on development aspects, research, and costs of the continuous measurement process.
- Ensure that the concept of the Data Access and Dissemination System (DADS) is better developed and realized as a substantial resource.

The U.S. Department of Transportation should

- Develop and coordinate a memorandum of understanding (MOU) with the Bureau of the Census spelling out reciprocal responsibilities and actions to be taken, specifically focusing on geographic systems developments.
- Produce a model MPO–Census Bureau arrangement as part of the MOU.
- Develop contingency plans to respond to various census development scenarios. The costs and other implications of these alternatives need to be fully defined.
- Plan for and support MPO and state geographic systems development for census use.

- Begin to plan for a new Census Transportation Planning Package for the 2000 census.
- Develop training materials for the better understanding and use of Census 2000 materials.
- Closely monitor and report on development of the census 2000 program on a continuing basis.
- Begin planning for development of skills and methods for use of continuous measurement.
- Transmit these recommendations to the Bureau of the Census.
- Consider funding a TRB-based Census Technology Center similar to the one developed for the Strategic Highway Research Program to monitor, evaluate, and develop responsive tools for census-based products.

States and MPOs should

- Be prepared to cooperate in sharing needs and capabilities regarding the census.
- Organize to articulate their respective data needs.
- Consider producing and using tutorial devices such as videos to inform upper management of census data issues and their implications.

States should

- Produce a better definition of state traffic and planning zones for census summary use.
- Produce their views on appropriate state PUMS boundaries.
- Assist smaller MPOs with data needs and development.
- Consider producing statewide commuting summaries.

MPOs should

- Articulate the extensive costs and other implications generated by the loss of census data and identify and quantify new tools that will need to be developed and procedures that will need to be revised.
- Be prepared to be the center of geographic review of census coding tools.

The Transportation Research Board data committees should

- Remain informed of census developments. As the nexus of information and communication on census developments, these committees bring together federal, state, local, and private-sector players.
- Monitor, review, report on, and discuss the nature of changes in census programs and their implications for other professional sectors of transportation—planning, policy, investment—as well as for the transportation data sector.

The private sector should

- Inform others via data-related associations, professional societies, consulting firms, and other groups of the consequences of this public change, both for others in the private sector and for other government entities.
- Ensure that others in the private sector are kept informed of the consequences of decisions regarding the census transportation data.

Congress should

- As the ultimate location where census and transportation needs are synthesized, be aware of the implicit trade-offs for transportation involved in decisions about the census.
- Hold hearings focusing on future transportation planning needs at the national, state, and local levels.
- Be aware of the cost implications for states, MPOs, and DOT of census budget cuts.
- Be better informed regarding transportation data needs and the census role in meeting those needs.

OPENING SESSION

Summary of 1990 Census Data Uses and National Experience

Elaine Murakami, *Federal Highway Administration*

There were two important outcomes from the 1994 conference. The first is the *Census Mapbook for Transportation Planning* (*1*). This document began to be developed at the 1994 conference. The Census Mapbook is a collection of examples from state, regional, and transit operators of how census data are used in geographic information systems (GIS); it has been used in GIS-T training sessions by FHWA, the National Transit Institute, and some universities. It is also intended to provide ideas for presenting information during the public involvement process in transportation planning. This document is very rapidly becoming out of date.

The other direct outcome from the last conference was the Bureau of Transportation Statistics study on the continuous measurement alternative to the long form. Copies of that study were handed out to participants; Phil Fulton will discuss the project later in this conference.

Journey-to-work travel still represents the largest segment of daily long-distance trips, excluding vacation trips. In 1990, the Nationwide Personal Transportation Survey (NPTS) estimated that the average work trip was 9.5 miles and accounted for 36 percent of the vehicle miles of travel in urbanized areas. Thus, understanding the journey to work is still very important in transportation planning, even if the census questionnaire does not include all daily travel.

In terms of uses of census data at the national level, three come to mind: national consistency, household travel surveys, and transit markets.

National Consistency

National consistency has really benefitted from having a consistent method and a consistent question on journey-to-work travel across the country. First and foremost in using this information from the census is Alan Pisarski's *Commuting in America II* (*2*). The first *Commuting in America* was completed after the 1980 census and provided the ability to look at commuting trends and flows at the national level. Table 1 shows the commuting flow by metropolitan areas in the United States. It documents the importance of suburban-to-suburban flow, which is now the largest, with 35.4 million commuters.

TABLE 1 Commuting Flow (in millions)

		To	
		Central City	Suburbs
From	Central City	24.3	5.9
	Suburbs	15.2	35.4

Another project that benefitted from the consistency of the census is the *Handbook on Conversion Factors for the Use of Census Data* (3) that COMSIS is currently completing for FHWA, basically as a training activity. This handbook shows how areas that have limited or outdated regional household survey data can use census data as the seed for estimating their home-based work trips and for their travel demand models. Since some models use home-based work trips to estimate non-home-based trips, this makes estimation of home-based work trips even more important.

Some other projects have also benefitted from the ability to compare information over time. Texas Transportation Institute (TTI) completed a project for FHWA on travel speeds (4). For metropolitan areas in which traffic analysis zones could be made comparable between 1980 and 1990, TTI looked at the reported trip times and calculated speeds in terms of three geographic patterns: suburbs to central cities, which are radial flows; central cities to suburbs, which are reverse flows; and suburb-to-suburb flows, which are circumferential. Their report showed that there was an overall improvement in travel speed and indicated that it was a reflection of suburban employment growth. As Pisarski has discussed in some of his work, this improvement also reflects the shift from transit and carpooling to driving alone.

Finally, another FHWA project, with Norfolk State University, considered commuting patterns by race, ethnicity, and gender using the 1980 and 1990 Public Use Microdata Sample (PUMS) to look at the question of spatial mismatch. More than 25 years ago, Kain hypothesized that the growing suburbanization of jobs and continued racial segregation in the inner cities would limit African-Americans from access to employment in suburban locations. The census data support the spatial mismatch hypothesis for three metropolitan areas and particularly for women. African-Americans and Hispanic-Americans, particularly women, use transit much more frequently than do white Americans, but even after controlling for travel mode and considering only those who were using private vehicles for their travel, African-American women are traveling longer than poor white women. Those in the service industry and those with low incomes are traveling longer than both white men and white women, which contradicts some of the generalities about men traveling longer than women. The data need to be disaggregated to ensure that the transportation needs of diverse groups are being met.

Household Travel Surveys

The next use of census data at the national level is for household travel surveys. FHWA has sponsored a research project through Battelle with Penn State University to work with the Puget Sound Transportation Panel (PSTP) data. The PSTP is important at the national level because it represents the first test of a general-purpose longitudinal transportation panel, and it can assist in the evaluation of alternatives to traditional transportation survey methods.

One of the first steps in this project was to develop weights for the first four waves (1989 to 1993), accounting for sample stratification, pre-wave self-selection, missing data, and panel attrition.

Other components of this project include analysis of mode transitions over time and analysis of travel and activity over time. The PSTP suffered from sample bias similar to problems experienced in other regional household travel surveys. Households with low incomes, large

household size, and fewer than two cars were the most likely not to participate. Using the PUMS was a critical component in calculating the weights to adjust for these problems. When metropolitan case studies are discussed, the topic of sample bias will come up again.

The next concern is households without phones. Using the PUMS data, the University of Michigan Population Studies Lab conducted a project to see what the impact of doing a telephone survey would be for conducting the 1995 NPTS. Although this project was completed before the 1994 conference, I wanted to discuss it again because FHWA has become very concerned about nonresponse to these travel surveys, and a whole series of work related to nonresponse has begun in the last few months. In the 1995 NPTS, people were asked if they had been without a telephone in the last 12 months because those who have been recently without a telephone are likely to be more similar to those who currently do not have a telephone, particularly in urban areas. Table 2 and Figure 1 show that by not interviewing households without telephones, the samples are biased by not well representing those without vehicles. Nationwide, 5 percent of households are without telephones. When measuring travel behavior for a regional area and trying to improve transportation services, researchers can add some bias into the information by not accounting for households without telephones.

TABLE 2 Households Without Phones: 1990 Census 1 Percent PUMS

Characteristic	Total Hhlds	No Phone	% No Phone
All households	910,770	48,445	5.3
Region			
Northeast	186,902(20.8)	6,035(14.1)	3.6
Midwest	216,109(24.2)	9,647(20.1)	4.4
South	308,741(34.2)	24,160(49.5)	7.6
West	183,415(20.8)	7,799(16.3)	4.1
County of residence			
Central city	149,019(19.6)	8,629(23.3)	6.3
Suburbs	410,493(47.3)	12,584(28.6)	3.2
MSA - entire	77,986 (8.7)	4,299 (9.3)	5.7
Mixed area	27,382 (2.9)	1,485 (2.9)	5.2
Outside MSA/PMSA	245,890(21.5)	21,448(36.0)	8.8
Poverty Tenure			
Below poverty	115,789(12.9)	21,977(45.4)	18.6
At or above poverty	794,981(87.1)	26,468(56.6)	3.3
# Vehicles Available			
None	94,980(11.6)	16,392(37.1)	16.8
One	297,775(33.7)	20,991(42.2)	6.6
Two or more	518,015(54.7)	11,062(20.7)	2.0
Race of Householder			
White	778,182(83.8)	31,540(62.3)	3.9
Black	84,172(10.7)	11,462(26.4)	13.0
Asian	18,356 (2.1)	402 (1.0)	2.4
Native American	6,841 (0.7)	1,681 (3.0)	23.6
Other	23,219 (2.7)	3,360 (7.4)	14.6
Head Hispanic Origin			
Non-Hispanic	856,190(93.7)	41,851(85.3)	4.8
Mexican	31,812 (3.6)	4,332 (9.1)	13.4
Puerto Rican	6,575 (0.9)	1,010 (2.6)	16.3
Cuban	3,681 (0.4)	140 (0.3)	4.0
Dominican	1,173 (0.2)	230 0.6)	20.3
Other Hispanic	11,339 (1.3)	882 (2.0)	7.9

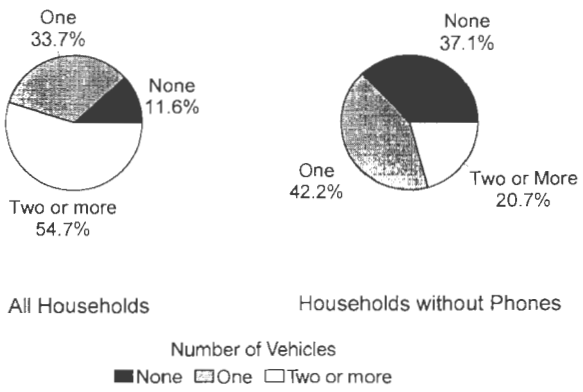

FIGURE 1 Vehicle availability by telephone availability: 1990 census 1 percent PUMS.

The last project related to travel surveys is the Travel Model Improvement Program (TMIP). Track C of TMIP is the TRANSIMS project at Los Alamos, where a combination of STF3 for small geographic units and the individual records from PUMS is being used to develop a microsimulation of households, and the individual records from a PUMS are applied back to the smaller geographic units, in this case, census tracts. Microsimulation at the household level holds promise for improvements in current travel forecasting procedures.

Transit Markets

I was quite surprised at all the work that has been done on the transit side with census data. Right now the census data are the best data available on characteristics of current and potential transit users.

Another reason that the census data are best for transit analysis is that the census provides information on households without vehicles. It is commonly thought that there aren't that many households without vehicles anymore, and nationwide it is something like 11 percent. However, if the data are compared by race, 30 percent of African-American households have no vehicle compared with 8.7 percent of white households. Further, if one looks at households in which the head of the household is under age 25 or at African-American households, the proportion without a vehicle is 46 percent (Figure 2).

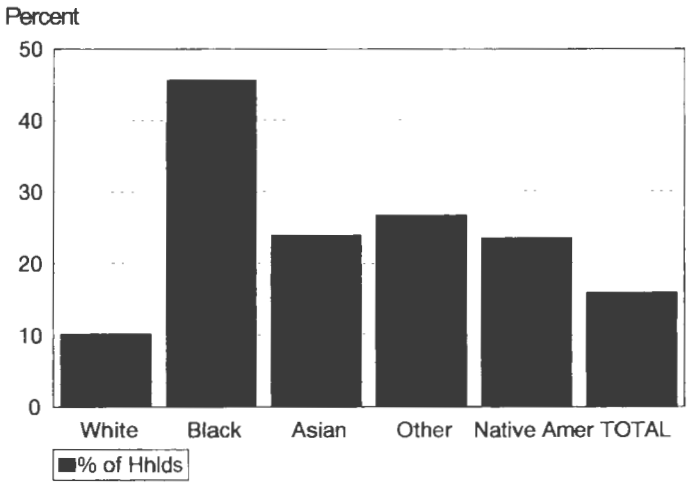

FIGURE 2 Households without vehicles where head of household is under age 25: 1990 census 1 percent PUMS.

To me, this was an astounding number. At the other end of the age range, the proportion of African-American households with a householder age over 65 was 43 percent in 1990. Between 1980 and 1990, those proportions have not shifted very much (Table 3).

Many reports have used the census data to describe those who currently use transit for their journey to work. The Joint Center for Political and Economic Studies just completed a report for FTA (*5*), Sandra Rosenbloom is working on a Transit Cooperative Research Program project (*6*), and Betty Deakin and Chris Porter at the University of California, Berkeley, are also working on a project for FTA related to land use development and rail (*7*). The census provides a large enough sample to distinguish those riding the bus from those riding commuter rail; these populations are very different. To no one's surprise, bus riders are most likely to be women; many are African-American and Hispanic, and many do not have a car available. Those who ride commuter rail are more likely to be men with higher incomes who travel very far.

Finally, another transit market is immigrant households. Figure 3 is a graph from the Drachman Institute showing transit use for the journey to work and the number of years since immigration. For those who immigrated between 1985 and 1990, 20 percent of trips for journey-to-work travel are by transit, and for those who immigrated between 1975 and 1984, the transit share was 14 percent. Several papers have been done for FTA and TCRP that are really looking at the impact of immigrant populations and transit use.

In summary, all the projects mentioned that used census data have occurred in the last 2 years, reflecting a growing use of census information in the transportation field. These projects show how census data are used for evaluating transportation investments and understanding employment access and vehicle availability. Many states are currently changing their welfare requirements and limitations on obtaining welfare benefits. An understanding of who is currently driving alone and who is using transit is particularly relevant for a look at the limitations the states have on their assets and at the development of alternatives to driving alone.

TABLE 3 Households with Zero Vehicles by Age of Householder

1980 Census PUMS (1% sample)

	<25 Yrs	25-34	35-44	45-64	65+
White	11.6	7.2	5.5	7.8	29.0
Black	43.9	29.5	25.3	29.1	51.5
Asian	21.8	14.5	9.9	13.7	40.1
Other	29.4	23.5	23.3	28.1	51.2
Native Am	24.6	19.7	16.5	22.4	39.4
TOTAL	16.0	10.5	8.3	10.4	31.2

1990 Census (PUMS 1% sample)

	<25 Yrs	25-34	35-44	45-64	65+
White	10.2	5.4	4.0	5.2	20.0
Black	45.6	30.7	23.9	26.0	42.6
Asian	24.0	13.1	9.8	10.6	33.8
Other	26.8	18.6	16.6	21.2	42.1
Native Am	23.6	16.0	9.5	14.1	29.9
TOTAL	15.9	9.2	6.9	8.0	22.4

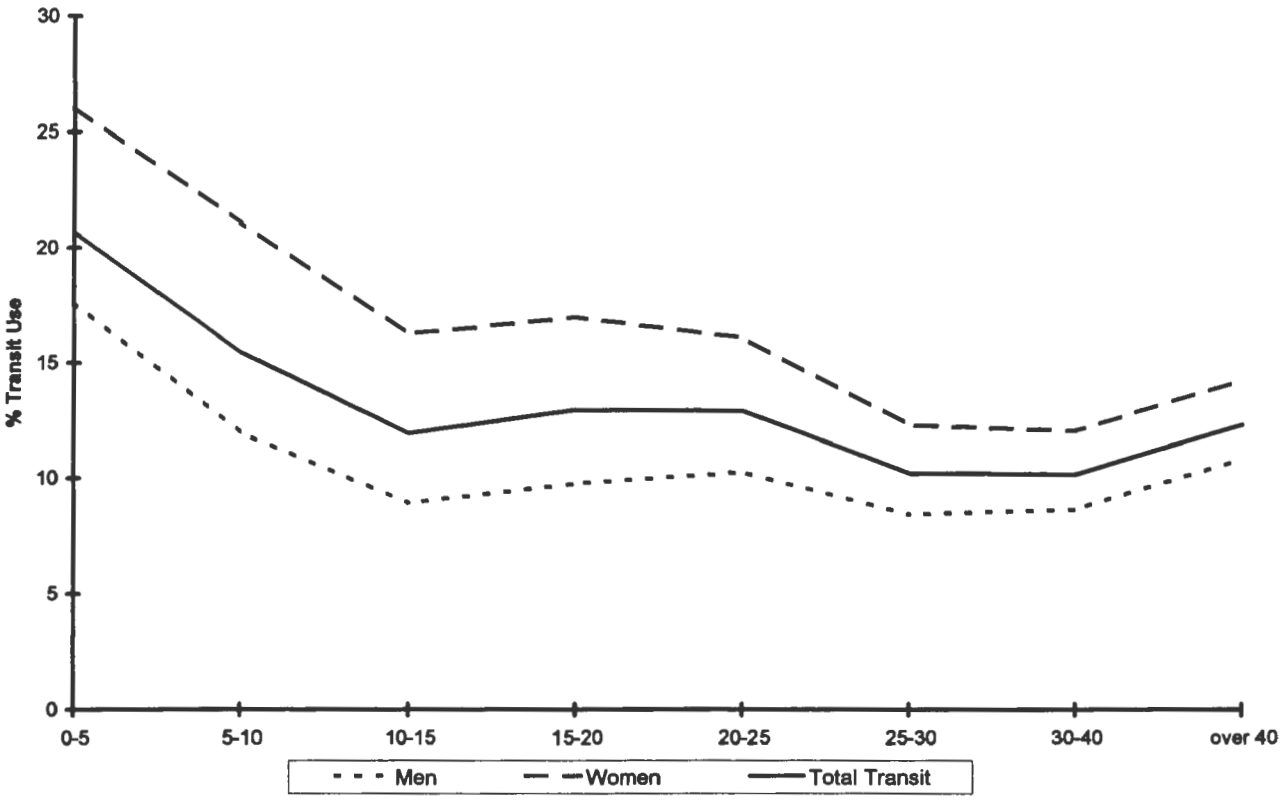

FIGURE 3 Transit use to work by immigrants by sex and number of years in the United States (Drachman Institute from unpublished tape-readable data, 1990 U.S. census).

REFERENCES

1. *Census Mapbook for Transportation Planning.* FHWA, U.S. Department of Transportation, Dec. 1994.
2. Pisarski, A. *Commuting in America II.* Eno Foundation, Landsdowne, Va., 1996.
3. COMSIS Corporation. *Transportation Planner's Handbook on Conversion Factors for the Use of Census Data.* FHWA, U.S. Department of Transportation, forthcoming.
4. Williams, T.A., and G.A. Shunk. *Transportation System Performance Changes, 1980–1990, Based on the Decennial Censuses.* Texas Transportation Institute, Aug. 1994.
5. Joint Center for Political and Economic Studies. *The Trip to Work.* FTA, U.S. Department of Transportation, May 1995.
6. Drachman Institute. *Transit Markets of the Future: The Challenge of Change.* TCRP Project H-4B. TRB, National Research Council, Washington, D.C. (forthcoming).
7. Porter, C., and E. Deakin. *Journey-to-Work and Vehicle Availability Data: A Compendium for 16 U.S. Cities with Rail Transit and Subway Systems.* Institute of Urban and Regional Development, University of California, Berkeley, December 1995.

Census Future Program

Martha Farnsworth Riche, *Bureau of the Census*

It is good to have this opportunity to talk to the transportation planning community as the countdown to Census 2000 begins. At least 8 years have been spent in planning it, and the transportation community has had representatives at the table from the beginning. At the next meeting of the Secretary's Advisory Committee, the umbrella committee that advises the Census Bureau on census issues, the move from planning to implementation will begin.

This broad outline of the census plan begins with the reason why a census is taken, because it is actually not to produce journey-to-work data. First, as the Constitution requires, a count of the population of each state is the basis for apportioning representation in Congress, and state legislatures use census data to draw congressional, state, and local legislative districts.

Second, the federal government uses the population counts to annually dispense more than $100 billion in hundreds of programs to the states. So these counts become more important as more responsibility and funds are passed along to the states.

Third, all levels of government, as well as private organizations, use information from the census to address concerns from housing to health care to employment and education, as well as transportation.

Finally, and perhaps most important, the census is a vital political ritual in which all Americans have the right to be counted equally. It is the place where the doctrine of "one person, one vote" becomes a reality and where it is demonstrated at the most fundamental level that the diversity in this country has a commonality, the American commonality.

Therefore the census really goes to the heart of understanding who we are and where we are going and that is why some of America's best thinkers have concerned themselves with the census. It was Postmaster General Benjamin Franklin who first called for a census, requesting that if Secretary of State Jefferson had any extra copies of census data lying around, the Postmaster General thought that they could be very useful in planning.

Thomas Jefferson was the first Director of the census, and it was Jefferson and George Washington who held the first colloquy about a familiar subject—the perennial undercount in the census. In fact, a historian friend of mine turned up for me the cover letter that Thomas

Jefferson used to send the 1790 census to George Washington; it said, "Here are the census results. The official results are written in black, and the true results, so far as we know them, are written in red."

Unfortunately, he didn't leave any details as to his methodology. At any rate, that is why it is vital that the census be not only accurate but also open and fair. A census that gives every American the right to be counted fairly and to receive a just share of the political and economic rewards that follow census data is an act of public trust. With those perspectives in mind, I want to describe how we intend to conduct Census 2000.

Let me begin by saying that I am very proud of the work of the Census Bureau. Taking the 1990 census was hard, and it was expensive. Our career employees and over 300,000 temporary employees worked for many months to get the job done. No matter what you might have read in the paper, the census was extremely accurate. We counted more than 98 percent of the population—a sterling record for a census in any country in any age—but you know as well as anyone that a good job wasn't good enough.

The Census Bureau spent literally hundreds of millions of dollars tracking down hard-to-reach respondents. In many cases our temporary employees made up to six visits to a housing unit, and they still didn't find everyone. In spite of heroic efforts, we estimate that we missed over 4 million people. They were disproportionately from minority racial and ethnic groups. Our costs climbed to more than $2.5 billion, and it has taken 6 years for the Supreme Court to resolve all the litigation. But we think that we can do better; we must do better, and we will do better.

Our experience in 1990 taught us that our overarching goals for Census 2000 had to be a census that is simpler, less costly, and more accurate, and at first glance those goals might sound mutually exclusive, but we think we can meet them with four basic objectives:

- We must make every effort to count every resident of the United States, using simple, easy-to-read forms as well as new ways to respond that respect people's convenience.
- We must implement an open process that diverse groups and interests can understand and support.
- We must eliminate the differential in the count of racial and ethnic groups.
- We must produce a "one-number census," one that is right the first time.

Now, that is a big job, and that is why we will conduct Census 2000 in partnership with America, with state and local governments, with business, with community leaders and ordinary citizens all across the country, and, I hope, with you.

During the last census we spent too much money and still didn't count all the people. At the end of it all we were mired in conflict and confusion, and I think this time there is time to do it right if we do it together, starting today.

So I am here today to ask you to work in partnership to produce a census that is both as accurate and as cost-effective as possible; a census that meets your needs, your community needs, and your country's needs; a census that will describe and define America and will unite America.

We have a strategy for a census that will be less expensive than the old strategy by nearly $1 billion. It will be the most comprehensive in history and faster for you to complete. It will be more useful for people and organizations depending on reliable information about America. Last year we successfully tested the new methods and procedures that will enable us to put this strategy in place. Today I want to tell you about the four elements of our strategy—partnership, simplicity, technology, and statistical methods—so I can ask your help in putting them together and making it work.

First, and most important, we want to build partnerships at every stage of the process. We cannot do everything alone. We need to reach out to find partners to help us get the job done.

We want to work in partnership with state, local, and tribal governments and with community groups. In short, we want to do the 2000 census not for you or to you but with you.

Partnership is key to perhaps the most important innovation we are planning. This is where you come in, so I am going to spend a good bit of my time talking about it.

The most accurate and cost-effective data are obtained when a form is mailed to a housing unit, and someone who lives there fills it out and mails it back in. We don't have to pay an interviewer to go out and ask questions, and our research shows that the data are more accurate if the individual involved fills out the form. The better the address list, the closer we get to this ideal.

Local officials, people like you, and our colleagues in the U.S. Postal Service are our most essential partners because we are asking you to help us create a computerized address list so that we can get a form to every housing unit in America.

Last time, for instance, 5 million of the forms that were mailed out to the housing units were returned as undeliverable by the Postal Service, and our census takers found another million that were undeliverable. This time we want to have them all.

The first step to enabling partnerships took place in the last Congress in the enactment of the Census Address List Improvement Act of 1994, which essentially allows us to share the address list with others outside the Census Bureau and allows the Postal Service to share their address list with us. In the past the Census Bureau bought an address list from a direct mail company, one of those that sends out mail addressed to "Current Resident." This time, instead of spending time and money taking one of those lists and making it usable, we are starting with the Postal Service list. We are going to work with them so that we both avoid the cost of duplication of effort and we get the benefit of their up-to-date knowledge.

Now, also thanks to this legislation, for the first time all designated local officials will have access to this address list, subject to the laws that safeguard confidentiality, so that they can check the list's accuracy, update it, and tell us the kind of changes we need to make. We tried this last year in the 1995 test. It worked well, and I think it is a firm demonstration of our commitment to partnership.

The second step will take place during the next few years, when we are asking each local government to designate someone who will be responsible for reviewing the address list for their community. During the third and final step, for a 2- to 3-month period ending early in 1999, we will ask each of those local liaisons to check the addresses and street pattern we have for their community and tell us what further changes they think we should make.

The only way we could make this important innovation happen is with the help of state and local governments. We already have written commitments from virtually every state—in fact, from every state but Florida, in which the state government thinks it can do better on its own.

We need your help in ensuring that local officials take full advantage of this opportunity. If you have any ideas as to how to make this happen, I hope you will talk to Bob LaMacchia, who is here at this meeting.

We would like the help of the transportation community and the help of your colleagues in three specific ways: first, to improve the address-matching capability of the Topological Integrated Geographic Encoding and Referencing (TIGER) data base; second, to correctly locate the many unassignable addresses that we receive from the Postal Service, many of which are for businesses and industrial facilities where people work (I believe you have great interest in projecting rush-hour traffic flows); and third, to encourage local governments in the areas under the jurisdiction of each metropolitan planning organization (MPO) to provide our local regional offices with their complete address list in a format that is described in the *Federal Register*. That will help us improve the completeness of our address list.

I don't have to remind you that every work trip has two ends, one of which is the residence. If you can help in those three ways, you will help us add many new streets to the TIGER data base. You will help us fill in the address ranges along both the existing and the new streets and especially the address ranges in commercial and industrial areas that we have been missing for so long and the lack of which reduced the value of the 1990 Census Transportation Planning Package. You will help us develop a complete address list correctly linked to the TIGER data base for Census 2000.

I know that many of you and your MPOs are already working with us in the TIGER improvement program. This process is of overwhelming magnitude; there are 39,000 jurisdic-

tions in the United States. Getting local officials to work in this kind of serious partnership is really overwhelming to us, but we are moving ahead.

However, as we move ahead we are likely to be severely constrained by the budget process during the next year. Last week was when we finally got our budget, over 6 months into the year. If that happens to us next year, as some think is very likely, we will be working on a continuing resolution that keeps us spending in 1997 as if it were 1996, right at the time that our census budget is supposed to start doubling. That will endanger our project severely. I am sorry to say that the first thing we would need to drop given that kind of money would be resolving the locations of nonresidential addresses so that we could meet our goal of having a perfect residential address list by census time. So we really need your help to keep that work going.

Finally, in a few years we are also going to be asking your help, again thanks to the legislation that passed in the last Congress, in assigning every place-of-work address to its correct block and census tract in 2000. I know that our failure to do this, or to do better at this, in 1990 was a big disappointment to you. With your early help on the TIGER data base and address list improvement process and your later help with the uncoded place-of-work addresses for the census, I think we can make Census 2000 a big success for you as well as for our country.

Now, besides the address list, I want to talk about the partnership strategy in general, because it is predicated on a single theme: obtaining the Best in Class for every census activity from whatever source necessary. Naturally that is leading us into partnerships with business. Many business people provide services every day that we are only called upon to provide every 10 years. In particular many businesses stay on the cutting edge of new technology and new equipment, whereas our practice has been to undergo a long procurement process for machines that are out of date by the time we get them, and then we mothball them.

This time our plan is to let the taxpayer reap the advantage of the business world's learning curve. We plan to go to the private sector and work with data-processing companies to capture the data and to turn paper census forms into electronic files. We are also looking at partnerships to interview, hire, and train the hundreds of thousands of temporary employees working in the greatest peacetime mobilization in our society, and we are definitely planning to work with advertising and public relations companies to promote the census more visibly and more effectively.

In short, we believe that partnerships ensure that the best provider does the work while ensuring that the census retains the high level of accountability and integrity that only a public institution can deliver. If you have suggestions along the lines of private-sector partnerships or any other kinds of partnerships, please pass those on, too.

I have talked a long time about our partnership strategy, but that is what is most relevant here. I will go more briefly over the other three strategies.

The second strategy is to keep it simple. The simpler and easier it is for people to respond, the more likely they are to respond and that increases accuracy and lowers cost. Thus, we are building simplicity into the system every way we can.

First, we are working with private designers to create user-friendly forms that are easier to read and fill out. There are actually 17 prototype forms being tested right now. When I got all 17 forms in my mail one day, my favorite was one that stood out because of its unusual shape.

Our design constraints are not only that they be user-friendly, easier to read, and easier to fill out, but also that they be less costly for the Postal Service to handle and for us to process using machine processing.

For the last census, all people got in the mail was the census form, which looked sort of like the IRS form. There was no advance notification. There were no ads on television or in the papers because the Census Bureau was still relying on public service announcements. That type of notification worked fine when there were only three networks, but in 1990, as you may recall, the communications business fragmented, and public service announcements tended to air at 3:00 a.m.

Therefore, another strategy for Census 2000 will be to embed the forms into a direct-mail campaign that lets people know the census is coming and markets its benefits for them and

their community. It has never really been recognized or acknowledged before, but the U.S. census is the largest direct-mail campaign in the world, and we intend to treat it that way this time. There will be advertising, as I mentioned earlier, but there will also be letters to let people know it is coming.

This time we are buying ads, and you will see the ads. You will get the notification. The envelope will be a marketing package. We have held focus groups around the country where we did the census tests. Reapportioning Congress isn't what comes to their minds as something that they are really interested in, but they are very interested in their communities, their schools, their roads, their health care. Those concerns will be incorporated into the package so that people will understand what they get out of responding to the census.

You may recall that the census package used to include a long letter from the Director. I saw the ones from the last year's census tests, in small print with my name at the bottom, which assumed that everybody who was getting the letter had at least a year or two of college education. Oddly enough, our own data tell us that this isn't true.

The new form assumes an eighth-grade education. It is very simple, with just a little introduction called "Getting Started," giving the information needed with arrows that indicate where to look, and one page each for person 1, person 2, person 3, ending with person 5. It turns out we have got 98 percent of households by the time we have those with five people in them, but there is also a space to list persons 6, 7, and 8 for large households. If you fill out all of these saying that you have eight people living in your household, we will call you up just to make sure there isn't a ninth one there. This is a beginning. We have got more work to do. We found that by keeping things simple and by taking a direct-marketing approach, we are increasing the response rate, which in general continues to decrease.

In addition to that, we are offering people more ways to respond. In the past the form had to come to your mailbox. Our first priority is still the delivery of a form to every address, but we are also going to put extra forms in stores, malls, civic centers, community centers, and in other places where our local partners tell us that people tend to go. Extra forms could be placed in missions for people who probably don't have homes or addresses or places to go and who also might not trust anybody else but would trust the staff at the mission.

New matching software has been developed to detect duplicates in case people send in more than one form. We will also have a well-publicized 800 number to call, and as you can imagine, we are looking at the Internet. The problem there is the issue of confidentiality.

Our third strategy is to use technology intelligently. As you know, there have been dramatic advances in computing technology, and we are planning to use those also to make the process simpler, cheaper, and more accurate.

In 1990 forms were transferred to microfilm and then the written entries and the ones in which you check a box were entered by hand into a computer. As you can imagine, there is room for a lot of error there. In 2000 we will make a digital picture of completed forms, and we will use computers that read handwriting to go directly from the forms to computers ready for tabulation. You may think that is pie in the sky, but the state of Maryland has been using this technology for 3 years to process income tax returns. This technology is going to reduce a major source of human error because it eliminates the hours spent trying to read people's handwriting and type it into a machine, and it is obviously going to substantially reduce the number of temporary workers needed, something that Maryland found out as well.

As I said, we will use sophisticated matching software to spot duplications, and then finally, when the results are all ready, we will deliver them electronically.

Our fourth strategy is to make better use of statistical methods. As you know, sampling and statistical estimation are already an integral part of the census because the data that you really care about are taken from a sample. For the first 150 years of census history we asked every person for all the data the government wanted for making policies and managing programs as well as for reapportionment. In fact, history says that Herman Hollerith invented the punch card in 1890 because that was the only way the 1890 data were going to be processed in time to start the 1900 census. Hollerith's company merged with two other businesses and eventually became International Business Machines. So it worked out well for him as well as for us.

Since 1940, we have only asked a sample of Americans all those program-related questions. Some very noted statisticians came to work with the Census Bureau during the 1930s and got us into sampling in a big way, and we have been using it more every since, and we plan to increase it still more in 2000.

Here is how it is going to work. It costs six times as much to visit respondents to have them fill in the census forms than to get them mailed back already filled in. If we have to go back over and over again to find the final missing individuals, it costs 18 times as much, and we still don't find everybody. Eventually we run out of time and use a lot of ad hoc procedures to finish up.

This time, after we make every effort to secure a voluntary response, we are going to visit a sample of the most unresponsive households in each community, and we will use that sample as the basis for completing the count. We will be using scientific sampling instead of ad hoc methods at the very end, and we will be using it in a way that will enable us to save a considerable amount of money. We did this in the 1995 test, and it allowed us to complete the census on schedule for the first time ever as well as to reduce our costs. In fact, we learned from the 1995 test that the sampling of unresponsive households may not be just an attractive cost-savings option, it may be the only option we now have for completing the census.

Historically we have recruited large numbers of census takers among people who were not in the labor force. We need temporary full-time workers, not part-timers, which generally means those who are not already in the labor force. The people that we hired tended to have previous work experience and skills, so we only had to train them for the technical tasks at hand. Today the pool of available census takers who are qualified and have had enough work experience has decreased dramatically just at a time when responsiveness of the public has decreased as well. The experience with the 1995 test suggested that we could not do the census in the old way even if we wanted to and if Congress were inclined to give us enough money to do it.

In addition to using sampling, we now use follow-up to check all of our work—the forms we get by mail, the forms we get by visits to people's homes, and the forms that we estimate for those last unresponsive housing units. We will check all of them with another separate intense sample survey as a quality control, and on the basis of the 1995 test, we will be able to complete this quality control procedure in time to provide one set of numbers to the President by the due date, December 31, 2000.

In short, these procedures will lead to a "one-number census," a census that should prevent rancor and litigation. Most important of all, it should give Americans a clear, correct, and comprehensive idea of who we are and who we are becoming. The value of the census to Americans is not just as a snapshot that we use to keep our democracy truly representative but also as an in-depth portrait of our communities that we depend on to govern effectively.

With the strategies of partnership, simplicity, technology, and statistical methods, we will deliver a Census 2000 that is both more accurate and less costly. With appropriate funding and with your help on the address list and in the other areas I have described, the Census Bureau intends to deliver a census in 2000 that we can all be proud of and that you can rely on to meet your challenges throughout the decade.

I conclude by asking you to share our excitement about the possibilities of this new age of information and by seeking your confidence, your support, and your commitment to be our partners in the 4 years ahead.

Census Journey-to-Work Long-Form Survey: Does It Support State and Metropolitan Transportation Planning?

William R. Loudon, *COMSIS Corporation*

The possibility that the journey-to-work questions, along with the other questions on the long form, might be eliminated from Census 2000 motivates the question, "Do the census journey-to-work data provide meaningful support to state and metropolitan transportation planning?" The collection, geocoding, and processing of the journey-to-work data are not inexpensive and so planners have to also ask themselves, "Is the information worth the money?" Numerous reports of its use will be heard during this conference, but the question is whether the availability of the journey-to-work data in combination with other census household data sufficiently improves the state and metropolitan transportation planning process to justify its cost. If the answer is yes and collection of this information is eliminated anyway, what are the alternatives? How would these data for state and metropolitan planning organizations (MPOs) be replaced throughout the country?

To help in structuring the collective thinking for the next three days of this conference, a perspective is provided here on how census data currently support the transportation planning process as well as a look at how data needs are changing and how the journey-to-work data might address these emerging data needs.

The Clean Air Act of 1990 and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), in combination, significantly changed the process by which transportation improvements are planned and programmed in the United States. In a combination of subtle and not-so-subtle requirements, the role of technical analysis in the evaluation of project or program alternatives has been significantly increased. The Clean Air Act not so subtly mandated that nonattainment areas classified as serious or worse must formally model the mobility and air-quality impacts of long-range transportation plans, transportation improvement programs (TIPs), and projects sufficiently to demonstrate that the resulting emissions will be in conformity with the state implementation plan for air quality, that is, that the actions are consistent with the state plan for meeting the national air-quality standards.

Among the more subtle requirements are the following:

- For the first time, states must prepare statewide long-range plans to guide transportation investment;

- All long-range plans and TIPs must be fiscally constrained;
- In metropolitan areas, the long-range plan and the TIP must be developed in a process of cooperative consultation among the state, the MPO, and other participating agencies;
- Every metropolitan area of 200,000 or more must have a congestion management system to guide the programming of improvements; and
- All major new transportation investments that use federal funds must undergo a serious review of alternatives before being included in the long-range plan and ultimately in the TIP.

None of these requirements explicitly involve use of models or analytical procedures, but each is greatly facilitated by tools and data that allow a quantitative assessment of alternative projects, plans, and programs. Because of the fiscal constraint requirement, the selection of projects for the long-range plan and the TIP is now significantly more competitive, and good, hard analysis is essential to support the advancement of any particular project or sets of projects. This requirement is particularly significant for many of the states, which now must prepare a statewide plan but must also use more quantitative analysis to support their projects.

The Clean Air Act and ISTEA significantly broaden the definition of when and where analytical tools are needed to support transportation planning and programming, particularly for small and medium-sized metropolitan areas and state departments of transportation in their role of developing statewide plans and acting as a partner in developing plans and TIPs for metropolitan areas.

This increased need for analytical tools is relevant to the discussion of the census journey-to-work data because these data represent the major source of information for the analytical tools used by many metropolitan areas and states and the major source of supplemental data for the larger metropolitan areas.

To help assess the value of the journey-to-work data in meeting the new planning and programming requirements, one must examine the ways in which the data are used. The data can be used alone to provide descriptive analysis of work-trip patterns and, when compared with previous census-year surveys, of how those work-trip patterns are changing over time. In combination with other data, the journey-to-work data can support a region's travel demand forecasting package, providing input on workplace attractions, work-trip origin-destination distribution patterns, work-trip departure times, work-trip length distribution, and travel-time distribution. To smaller metropolitan areas with limited resources, the survey becomes a foundation on which to build a model system, and in larger metropolitan areas the survey is a useful data base on observed travel behavior with which to calibrate or validate the model system. Where other surveys such as home interview or workplace surveys are collected to support the modeling effort, the journey-to-work data provide a sampling framework for a home interview survey or an expansion factor for the home interview and other surveys.

Because of the importance of the work trip for much of transportation planning—the peak commute period being when capacity requirements are determined and work trips being the focus of much of the air-quality planning—the journey-to-work data also provide a valuable data base for specialized study within a region or within a specific corridor. When the journey-to-work data are used in the form of the Public Use Microdata Sample (PUMS), travel patterns and trip characteristics can be related to a valuable set of household characteristics for the trip maker. This relationship is particularly useful in the assessment of demand management approaches such as pricing strategies that have differing responses from different income levels and in the assessment of how a project might affect different socioeconomic groups. The new federal emphasis on environmental justice has spawned a new set of requirements for analysis of federally funded projects; census journey-to-work data can significantly enhance the specificity and quality of data used in these analyses.

ISTEA also significantly elevated the importance of performance measurements and performance monitoring as factors in determining the direction for transportation programs and projects. This emphasis is reflected in the requirement for a congestion management system (CMS) to inform the planning and programming process in metropolitan areas of 200,000 or

more. Although certainly not supplying all of the data required for a CMS, the consistently collected journey-to-work data provide a useful monitoring tool with national coverage. Not only can historical trends be examined for any particular metropolitan area, but also certain work-trip performance characteristics (trip length, trip travel time, and mode of travel) and stratification or population characteristics can be compared across metropolitan areas or geographic areas or within a metropolitan area. It is not hard to see how this monitoring can be useful at national and statewide levels and within specific metropolitan areas.

It would seem from this assessment and from the evidence provided by the case studies prepared for this conference that the census journey-to-work data can have a number of useful applications in state and metropolitan transportation planning. Now one must ask, "Is the information collected by the survey accurate and unbiased? Are the data of sufficient quality to be used in making long-range investment decisions?"

Clearly the journey-to-work survey is not perfect. It has flaws that limit its overall usefulness and that certainly require that it be supplemented with other data to correct these flaws or biases. COMSIS Corporation has just completed a handbook for the Bureau of Transportation Statistics (BTS) and the Federal Highway Administration (FHWA) that describes the ways in which the data from the survey are flawed and provides factors that can be used to adjust the data for use in planning. As most planners are aware, the most significant flaw is that the survey asks for the respondents' "usual" work-trip activities. If the survey data are used directly, unfactored, the data will overreport the most frequently used options and underreport the less frequently used ones. The person who normally drives to work but takes transit several times a month will report only that he or she drives to work. Similarly, the person who telecommutes once a week will be reported as if he or she traveled to the work site every day of the week.

In the handbook, correction factors are provided for four different sources of bias: absenteeism, multiple work trips, trip chaining, and "usual" mode to work. These correction factors were developed by comparing the census journey-to-work data with home interview survey data for a set of selected metropolitan areas and with the Nationwide Personal Transportation Survey (NPTS) data base.

Certainly the journey-to-work data would be more useful if these biases or flaws could be eliminated through more specific questioning about travel activities and work activities on a specific day. But even in their present form, the corrected data are useful in the metropolitan and statewide transportation planning process.

A second factor limiting the usefulness of the journey-to-work data is incomplete geocoding of workplaces. At least one of the conference presentations this week illustrates how geographic biases where the geocoding is incomplete can result in significant biasing of the journey-to-work data, particularly when the aggregated tables are used. As is illustrated by the case study from the Baltimore region, supplemental geocoding can significantly improve the overall quality of the data base for a region.

Finally, the journey-to-work data are frequently criticized for the format in which they are distributed. The unformatted and condensed files, although efficient in the use of storage medium, have required sophisticated knowledge of data storage and retrieval protocols. Fortunately this issue has also been addressed through the efforts of FHWA and BTS. Under contract to FHWA, COMSIS has developed standardized SAS programs to read and manipulate the data, and under contract to BTS, Caliper Corporation has produced a stand-alone Windows program called TransVU that will also read and manipulate the data sets. Under contract to FHWA and BTS, JHK & Associates will provide training on the use of TransVU and the Census Transportation Planning Package (CTPP) Urban Element files.

How are data needs changing? What are the emerging needs for data? In addition to the broader use of analytical tools described earlier, three significant trends relate directly to a better understanding of the household characteristics of any particular traveler on the system. The increasing complexity of travel patterns, the more and more common chaining of trips with different purposes, and the increasing number of options available—such as whether to work at home or on site for any particular day—are moving planners toward

- More use of personal and household characteristics in the modeling process,
- More reflections of household life-style as a determinant of travel, and
- Activity-based modeling that reflects all the needs and constraints of a household rather than treats each individual household member in isolation.

Although it is not clear how much these trends will permeate the modeling process, any significant increase in accuracy in modeling urban travel behavior will have to come by incorporating these trends into the modeling systems. The trends provide still further substantiation of the argument for continuing to collect journey-to-work data because of the depth of household characteristics that these data contain. Any alternative source of journey-to-work data might not carry the same richness of household information or would include it only with substantial increase in the cost of collection.

As a final point in this overview assessment of the usefulness of the journey-to-work data, what are the options for replacing the data if the survey is eliminated in Census 2000? What are the alternative sources for the data provided by the journey-to-work survey? The journey-to-work survey adds three types of data to what is already collected by the basic census form:

- Location of employment in the metropolitan area,
- Characteristics of those who commute to specific locations or between specific origin-destination pairs, and
- Specific commute travel patterns within a region: the origin-destination combination, the choice of travel mode, the departure time, the trip length, and the trip travel times.

There are alternative sources for employment location, but unfortunately none of them (including the census journey-to-work data) are 100 percent comprehensive and accurate. It is actually the combination of the journey-to-work data files and the other sources, whether they be commercial inventories or public-sector-sponsored inventories, that provides the best opportunity to obtain a comprehensive employment location inventory.

For the two other categories of data, which relate to commute travel patterns and the characteristics of the trip maker, there appear to be only two logical sources for replacement data: home interview surveys and workplace surveys. The traditional home interview survey is already used by many of the larger metropolitan areas in combination with the journey-to-work data. But for a smaller metropolitan area, a home interview survey of sufficient sample size for statistical reliability may significantly tax the region's resources.

The other alternative is to conduct a survey at the work site, which can be significantly less expensive but generally requires that the survey be more limited to be acceptable for implementation at a work site and therefore limits the ability to determine socioeconomic characteristics of the worker's household. There is also significant concern about the willingness of businesses to cooperate in more surveying of employees. Clearly, replacement of the journey-to-work survey with a home interview survey or a workplace survey would cost substantially more to implement nationwide, and it would be virtually impossible to ensure consistency in a way that would accommodate the development of a national data base and facilitate comparison across state or metropolitan areas.

To summarize, it would appear that the census journey-to-work survey provides data that are valuable to the planning and programming process for transportation projects in states and metropolitan areas. The data are becoming more valuable to a broader range of agencies as a result of the subtle and not-so-subtle influences of the Clean Air Act and ISTEA. The journey-to-work survey is not perfect, but supplemental data factors can be applied to correct the flaws. Emerging data needs would appear to also further underscore the need for a transportation survey connected with the Census of Population. Finally, replacement of the data on a consistent national basis with equal coverage of household characteristics would be enormously more expensive if done independent of the census.

SUMMARY OF CASE STUDIES ON USES OF 1990 CENSUS DATA

Large Metropolitan Areas

Arthur B. Sosslau, *COMSIS Corporation*

The purpose here is to summarize uses of 1990 census data along with user experiences and recommendations for the year 2000 as reported in the case studies for large metropolitan areas presented at this conference. These case studies tend to be different in terms of emphasis, which makes them all the more interesting. (Case studies may be found in Volume 2 of these proceedings.)

Brooks and Bandy of the Baltimore Metropolitan Council (BMC) describe the serious inconsistencies between the originally released Census Transportation Planning Package (CTPP) and BMC's own place-of-work employee tabulations. On the positive side, BMC was able to work successfully with the Census Bureau to produce an acceptable revised version of the CTPP Urban Element. Zakaria of the Delaware Valley Regional Planning Commission (DVRPC) provides a review and evaluation of the CTPP and describes its accuracy and uses. Christopher of the Chicago Area Transportation Study (CATS), Sööt of the University of Illinois, and Stuart of the Chicago Transit Authority prepared a discussion that includes information about CATS, small metropolitan planning organizations (MPOs), the transit community, and the research and university community. This summary will concentrate on reporting the uses of census data at CATS. Limoges of the Southeast Michigan Council of Governments in Detroit reports on an innovative method to assign land use classes to census small-area employment data. Purvis of the Metropolitan Transportation Commission reports on the use of census data in the San Francisco Bay Area. His case study serves as an update on the resource paper he prepared for the 1994 conference.

Endorsements of Census Data

First, some of the endorsements of the census data presented in the case studies will be summarized here. From the Baltimore case study, many of the data tables contained in the CTPP are "one-of-a kind" tabulations that are nearly indispensable in updating trip tables and other components of travel demand modeling. Unless a massive household and travel diary survey were conducted that would be statistically valid at a very small unit of analysis (which

would be astronomically costly), the CTPP alone provides critical data that could not be easily obtained elsewhere.

Zakaria cites the census data for air-quality and transportation planning, travel forecasting, economic base and employment location studies, urban development analysis, and planning and evaluation of transit services. The CTPP minimizes the need for large-scale data collection and decreases the rising costs of surveys required. Under current budget conditions, it is almost impossible to conduct a home interview survey that would provide results similar to those included in the CTPP.

Christopher et al. find that CATS has a substantial history in the use of the planning packages: when CATS first received the CTPP, the data were examined and checked against other local data. CATS was satisfied with the results of the validity check.

Limoges sees the decennial census as by far the single most important source of information on employed persons and jobs and their interrelationships.

Finally, Purvis commends the decennial census data as an independent, observed estimate of various demographic characteristics and travel behavior for many applications. The census long form could be replaced by national or local surveys, but probably at a higher unit cost with lower sampling rates and higher statistical variance and standard errors.

Putting these accolades aside, it would be well to discuss some of the problems with the 1990 census data.

Problems with Census Data

Zakaria found problems in his review of Parts 1, 2, and 3 of the CTPP. All trips were not allocated to transportation analysis zones (TAZs) because the Topological Integrated Geographic Encoding and Referencing (TIGER) file does not contain address ranges for some suburban and rural areas. The DVRPC found the format of the tapes complex and confusing. There was no labeling, and table names were puzzling. There was no documentation of certain record types. As for the data, worker trips by mode included some walk and railroad trips that were unrealistic in terms of travel time or distance. The evaluation of employment by industry showed that some respondents misunderstood the question that used the Standard Industrial Classification (SIC) codes.

The Southeast Michigan Council of Governments (SEMCOG) also found geocoding errors and allocation inaccuracies, which they corrected before use of the data.

The lack of reliable commuting characteristics could have forced the BMC to conduct a costly travel survey. Instead, working with FHWA, BTS, and AASHTO, the Census Bureau produced a revised Urban Element. The BMC's Geographic Base File/Dual Independent Map Encoding (GBF/DIME) file was licensed by the Census Bureau in 1984 as the basis for the TIGER file. However, the Census Bureau never obtained updates after the initial purchase. New streets added after 1984 were never incorporated into the 1990 TIGER file. The Census Bureau's efforts were hampered despite the fact that the BMC created and transmitted to the Census Bureau an Employer Workplace Coding File in 1988 to assist in identifying the location of major employers. Before releasing the data, the Census Bureau informed the BMC that address range problems, primarily in Carroll and Harford counties, had affected small-area coding and that default TAZs had to be created to capture this missed information. The lack of coding for these counties created small-area undercounts that affected 44 and 30 percent of their employment bases. Further comparisons revealed 23 percent small-area undercounts in Baltimore County and pervasive small-area employment differences throughout the region. The BMC staff embarked on an investigation of small-area employment in activity centers in each suburban jurisdiction, which gave an indication as to whether misallocations might be attributed to boundary discrepancy problems or whether they were symptoms of a much larger problem.

Once the Census Bureau decided that it would revise the apparent misallocations, the BMC provided reference materials and tabulations to assist the process. The Census Bureau stated that it could not "re-geocode" census records based on a later and more accurate BMC

JURISDICTION	ORIGINAL CTPP URBAN ELEMENT RELEASE (1994)	REVISED CTPP URBAN ELEMENT RELEASE (1995)
ANNE ARUNDEL COUNTY	214,599	216,860
BALTIMORE CITY	396,360	395,483
BALTIMORE COUNTY	318,654	318,597
CARROLL COUNTY	26,451	40,024
HARFORD COUNTY	50,191	65,724
HOWARD COUNTY	88,995	88,512
BALTIMORE REGION	1,095,250	1,125,200

FIGURE 1 CTPP revision comparisons by jurisdiction, Baltimore region.

BaseMap. Census was informed that serious street coverage and address range problems continued to plague the 1990 and post-1990 TIGER files. The Census Bureau was urged to "re-geocode" 1990 records using a more accurate street and address reference file. The Census Bureau could not do so citing a lack of proper computer software and hardware. Because of confidentiality statutes, the Census Bureau could not allow the BMC staff to geocode these records. Thus, the Census Bureau made the adjustments using a combination of automated and manual allocation techniques. The reallocations of small-area employment resulted in dramatic changes in total employment as shown in Figure 1.

Uses of Census Data

Figure 2 summarizes the uses of census data reported in the five case studies. They are the ones that have been mentioned in the past. Most probably occur in all five metropolitan areas, but Figure 2 indicates which ones are specifically mentioned in each case study.

Some of the special studies shown in Figure 3 are interesting, as described next. The first application of interest is the use of 1990 census Public Use Microdata Sample (PUMS) data as part of the Bay Bridge Congestion Pricing Demonstration Project. MTC consultants were able to extract Bay Bridge commuters on the basis of PUMS area of residence and county of work, which allowed MTC to understand their income and modal use characteristics to determine, for example, who would be affected by a toll increase during peak travel times.

An example of a transit application is recent MTC work with the Central Contra Costa Transit Authority on a geographic information system (GIS)–based analysis of transit-

	MTC	DVRPC	BMC	CATS	SEMCOG
Descriptive Analysis - Trends, Database	X	X		X	
Model Estimation	X	X	X	X	
Model Market Segmentation	X				
Model Validation	X	X			
Highway/Transit Corridor Studies		X			
Outreach - Public/Private	X	X			
Input to Land Use Models					X
Socioeconomic Forecasts			X		
Transportation Research	X				X
Special Studies	X	X		X	

FIGURE 2 Uses of census data.

	MTC	DVRPC	CATS
Bay Bridge Congestion Pricing Demonstration	X		
Profile of Those Working at Home	X		
Analysis of Transit Dependency	X		
Evaluate Change in Location of Industry/Commercial		X	X
Evaluate Declining Urban Centers		X	
Potential Users of Downtown Circulator System			X
Establishing HH Travel Surveys			X
Intercity Jobs Accountability			X

FIGURE 3 Examples of special studies.

dependent population in the service area. One of the layers in MTC's GIS is local bus stops and rail stations. The analyst used the GIS to create a buffer zone around each bus stop to represent areas within a certain walking distance. The GIS program then separates demographic data within and outside the buffer zone.

The 1990 CTPP was used in two different studies related to the CATS 1990 Household Travel Survey, first, to help establish the weights for each survey instrument and, second, to establish a model to estimate the nonresponse rates in a mail-out–mail-back surveying procedure.

DVRPC used the 1990 CTPP information on employment to evaluate the significant changes in the type and location of industries and commercial establishments. This evaluation resulted in recommendations and strategies aimed at attracting new industries and high-technology firms to the Delaware Valley. The employment information was also useful in the redevelopment of declining areas of old urban centers and provision of the required physical improvements for their rehabilitation.

Limoges of SEMCOG presented a method for adding land use classes to decennial census employment data. The current version of the land use assignment procedure classifies workers by small-area place of work into six basic land use classes: office; commercial; institutional; industrial; transportation, communications, and utilities; and residential. Before applying the land use assignment method to the special tabulation data, SEMCOG staff conducted a separate project whose purpose was to make improvements to the census data. The improvements addressed geocoding errors and allocation inaccuracies.

Upon examination of the data, the overall quality of tract and block geocoding appeared to be quite good. There were relatively few recognizable major errors, and these were corrected. In the four most urban counties of Southeast Michigan, an average of over 30 percent of all workers needed to be allocated to tract and block. In Detroit City, nearly two-thirds of the tracts had more than 40 percent of their workers allocated by the Census Bureau. SEMCOG believed that the allocation procedure seriously reduced the overall accuracy of the small-area employment data and developed their own reallocation procedure. That procedure accepted the Census Bureau's geocoding to county and to place, and then used the special tabulation's detailed breakdown of industrial class and occupational class to match workers needing to be reallocated to zone with workers who had been geocoded to tract and block and thereby to zone by the Census Bureau. SEMCOG's reallocation greatly increased the accuracy of the zone-of-work geocoding.

SEMCOG next grouped the Census Bureau's 236 industrial classes into 74 and the 501 occupational classes into 39 to develop a matrix. The next task was to assign a land use class to each cell, wherever possible. First, they addressed each industrial class, for example, finance or hospital, where they believed it was justified in assigning all employment of that industrial class to a single land use class. Next, for each occupational class that was assigned entirely to one land use class, all cells in that occupational class column of the matrix would

be assigned to that land use class except where the cell had already been given a land use class because of its industrial class. For example, the occupation of computer programmer was assigned to office land use except for cells belonging to an industrial class, for instance, hospitals, that already had an overall land use class, in that case, institutional. The third step assigned a land use class to each matrix cell that was yet unassigned but that could be assigned a land use class on the basis of the characteristics of that particular combination of industry and occupation. Motor vehicle mechanics and repairers is an example of this cell-by-cell assignment. The remaining cells of the matrix had no assigned land use class.

The matrix was then used to assign employment to land use classes by TAZ. Within each industrial class, the employment in each cell for which a land use class had been assigned was summed by land use class, and the plurality land use class was identified. All employment in the given industrial class, including that in cells for which a land use class had not been assigned in the general matrix, was then reassigned to that plurality land use class. The special tabulation made it possible to assign the plurality land use class of the given industrial class of the given zone to workers in that industrial class in that zone. Land use class became an additional dimension of the cross-tabulation.

The one quantitative comparison made to date is with data collected in SEMCOG's 1994 household travel survey. The two data sets are compared in Figure 4. Considering the differences in data collection method, date, and coverage area, the two sets of numbers are quite close.

Zakaria describes some of the adjustments made in the census data before their use by DVRPC. First, he found that the data on population, households, car ownership, employment, and other socioeconomic characteristics from Part 1 are quite accurate and do not require any major adjustment. Adjustments were made in the CTPP work destinations to account for absentees (2.16 percent for the region) and multiple job holding (6.2 percent). Adjustments at the Minor Civil Division (MCD) level were made to account for coding discrepancies and respondent errors. Employment estimates at the TAZ level were adjusted because of the census allocation to default zones and water tracts. Total regional trips by mode compared favorably with traffic counts and transit surveys. Within smaller areas differences were much larger, with a difference in subway-elevated and bus trips in the central business district of 35 percent. It appears that many respondents confused the access mode to a station with the principal mode. The 1990 CTPP average regional travel time compared very well with DVRPC survey data (24.6 versus 23.8 min).

Recommendations for Census 2000

In each of the five case studies, recommendations were made for Census 2000. Purvis (MTC) states that the long form is critical to provide the accurate and precise data needed to support demographic analysis and transportation planning and research activities. The likely substitute would be a set of metropolitan travel surveys that would be more costly and less accu-

Employment (%) by Land Use Class

Land Use Class	1990 Census	1994 Travel Survey
Office	36.0	33.4
Commercial	23.8	19.8
Institutional	17.3	18.8
Industrial	15.6	18.8
TCU[a]	3.0	2.4
Residential	4.3	6.9
Totals	100.0	100.0

FIGURE 4 Comparison of employment by land use class, 1990 census and 1994 SEMCOG household travel survey.

rate. Purvis also suggests that workplace geocoding is still a major issue and that legal barriers that limit the involvement of local planning staffs should be liberalized. In order to increase the relevance of transportation planning research, it would be desirable to create a census microdata research program that would allow bona fide researchers the opportunity to "add value" to census microdata and prepare more in-depth research. To collect, analyze, and disseminate decennial census data, rapid changes in information systems and information technology should be dealt with along the lines that the Census Bureau has planned. New information technology should lessen the need for "paper-and-ink" publications in favor of electronic data on demand, and public access to the Internet should be a high priority to facilitate collection and dissemination of census data.

Zakaria (DVRPC) suggests that most of the 1990 problems and errors can be avoided in 2000 by quality control edits and a careful review of the census questionnaire as well as the computer formats and programs required for processing the information. Specifically, the journey-to-work questions should be simplified to prevent any confusion on the part of those responding to questions on mode of travel, destination, and industry classification. The questionnaire should be redesigned to capture multimodal trip information. The format of the 1990 CTPP tapes must be simplified. The funding and development of two packages in 1990 was an excellent idea and should be repeated in 2000. AASHTO should again provide the funding for the 2000 CTPP. Finally, DVRPC has not as yet received all parts; a more timely release of data is obviously important to all census data users.

On the basis of their experience, Brooks and Bandy (BMC) make the following recommendations: the Census Bureau needs to maintain the most up-to-date TIGER files and should continue using regional workplace coding; MPOs should prepare data bases to check and validate census data.

CATS recommendations for simplification and timely release parallel those of DVRPC. SEMCOG's recommendations are related to their case study on land use coding. Census place-of-work data would be improved through the correction of geocoding errors and the use of a new procedure to allocate ungeocodable workers. The Census Bureau would give each worker a workplace land use class and would incorporate this land use attribute into a variety of census files and products.

Transit

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Case studies on transit uses of census data involving several geographic study areas were presented. This summary will cover study objectives, how the data were used, and what data were used. The methodology, some of the tasks that were covered and some of the problems, and recommendations of the authors will be noted.

New Orleans

The study objectives were to evaluate transportation alternatives for a corridor between the New Orleans central business district (CBD) and the airport. Ways of using an existing railroad right-of-way to increase capacity in that corridor were being considered. The possibilities were to widen an existing highway, extend an expressway, or build a light-rail line. A no-build or transportation system management alternative was also considered. The census data used included Summary Tape Files (STFs) 1 and 3 and the Census Transportation Planning Package (CTPP).

The first task in this study was a comparison of the population estimates from their model transportation analysis zones (TAZs) with CTPP data. The results for the overall population in the corridor were similar, but significant differences were found for individual analysis zones, and the researchers had trouble reconciling these differences.

The second task was to use the journey-to-work data to show whether levels of transit use in the corridor might support building a light-rail line. The mode split for each census tract in the corridor was reviewed, and here the results were questionable. Very little could be deduced about corridor-oriented travel. Some results were obtained that could not quite be rationalized, including higher levels of ridership in areas that were poorly served by transit and in areas that were farther from transit routes.

One of the problems noted in this study was the difficulty in comparing the model data from previous studies because, in New Orleans at least, the TAZs did not match up very well with census tracts. It appeared that the CTPP data lacked information on travel direction, such as to or from the CBD. An early release of the census data was used, and

the work end data at that point were only coded to the county, which, of course, did not do any good in smaller-area analysis. It appeared that travel in directions not served by transit might have overwhelmed transit use, that is, made it look smaller for the tract overall.

The researchers believed that there was a problem because of restriction in the questionnaire to reporting the main travel mode. The overall conclusion was that they would not use census data further for this study because of their lack of trust in the results.

Los Angeles

The same researchers also studied transit riders in the Los Angeles area. The objective of this case study was to estimate the ethnic make-up of riders for the rail lines that were projected to operate in 2015. One of the constraints in this study was that the existing travel forecasting models did not contain ethnicity or race as a variable. So they turned to census data, STFs 1 and 2 and the Public Use Microdata Sample (PUMS).

The study used a simple method first to see if feasible results could be obtained. The first element was to estimate the walk access of rail riders by analysis zone. To do this, an assumption was made that the rail riders produced by a TAZ would have the same ethnic proportions as the TAZ population in general. (The TAZs in the Los Angeles area have a high equivalency to census tracts, unlike those in the New Orleans area.) STF 1-A was used to get TAZ ethnicity breakdowns, which were then applied to the walk access rail riders produced by a TAZ, available from prior modeling work.

To estimate automobile access to rail for each TAZ, cross-tabulations of ethnicity by car ownership data were developed from the PUMS data for Los Angeles County for areas within automobile access of the rail system. Proportions of households with vehicles available were assigned by ethnicity to each census tract in the Public Use Microdata Area (PUMA), and the proportion of automobile access rail riders by ethnicity was obtained for each TAZ.

The researchers believed that these results looked credible and proceeded to what was referred to as a more complex phase two analysis. In this procedure, they extended the analysis to include the effects of demographic variables that were included in some of their models, for example, vehicle ownership, household size, type of dwelling unit, and licensed drivers. The following steps were involved: (*a*) the PUMS data were used to produce vehicle ownership by household size and by ethnic group; (*b*) the trip rates for these factors from their models were applied to the PUMS data; (*c*) an average trip rate for work and nonwork trips within each PUMA was obtained; (*d*) those rates were then applied to ethnic proportions within a TAZ; which were known from the STF 1-A data; to obtain trip rates by ethnic group within a TAZ; (*e*) mode choice model data were combined with PUMS data to produce the relative propensity of a person to make transit trips versus automobile trips for each ethnic group in the PUMA; and (*f*) this percentage was applied to each TAZ in the PUMA. The research team believed that the results from this more complex approach were remarkably similar to those obtained with the first method. Generally, minority groups produced fewer total trips, although certain minority groups had a higher propensity to use transit.

Among the problems noted by the authors in this study was the need to apply the PUMS data averages to a large number of TAZs in the PUMA. They also noted that the study could not have been performed without the available census data.

Some overall recommendations from that study were (*a*) faster release by the Census Bureau of block-group-level data, which in the New Orleans case would have been a positive factor; (*b*) TAZ and PUMA boundaries contiguous with smaller census geography, which was not always the case; (*c*) PUMAs consisting of entire tracts; (*d*) better information from the journey-to-work survey on the direction of travel, such as the proportion CBD bound, bound in the opposite direction from the CBD, and bound in all other directions; and (*e*) information on driver's license status on the long form.

New Jersey

The case study from the New Jersey area reported on at least six applications of census data. The first application was to estimate ridership for rail extensions into new areas. The CTPP journey-to-work data were used to identify the total potential work trips within the state of New Jersey. It was believed that these were the only journey-to-work data that exist for New Jersey locations. An alternative would have been older and less reliable data, which, it was believed, would have cost more than several hundred thousand dollars to collect.

In the second application, census travel time data were used to estimate automobile travel times to a sports complex for use in a forecasting model. These data were believed to be reliable because they are based on actual observed reported times.

The third application used journey-to-work data to assess the statewide potential for transit service on existing and abandoned rights-of-way. In this case, these were believed to be the only consistent statewide work-trip data available because New Jersey encompasses three metropolitan planning organizations (MPOs), and the individual MPO models do not account for trips outside of their individual boundaries.

The fourth application in the New Jersey area was to document the impact of rail travel on local economies. Median home values from 20 municipalities were obtained and a regression model was developed to predict change in housing value on the basis of travel time savings. It was believed that the census provided a consistent source of housing value information over the entire region.

In the fifth application the impact of transit service on reducing automobile travel and automobile ownership was estimated. Census journey-to-work data combined with census household and worker data were used.

The sixth application evaluated the need for transit support facilities, such as park-and-ride lots. Again, the journey-to-work data were used to establish the rail or bus trip rates per household. These were modified on the basis of some regional demographic forecasts and then combined with the rail and bus survey to estimate future ridership and parking demand.

Some overall problems noted in the New Jersey case study were lack of non-work-trip data, user confusion over definition of rail modes, definition problems with multimodal trips, and lack of data availability until 3 to 4 years after the census was conducted.

Overall recommendations were the following: use the census data in combination with other regional surveys and, to the extent possible, customize journey-to-work questions for specific areas, such as definition of modes, stratified sampling within modes, and some non-work questions.

Cleveland

The case study from Cleveland involved the identification of additional work-related transit demand within the Cleveland service area. The CTPP data on workers and their key travel characteristics, such as mode, origin, and destination, were used.

To make the data more manageable, the first task was to aggregate TAZ data, which are continuous with tracts in the Cleveland area, to larger districts on the basis of their models. There were two approaches in the study. First, residential districts that exhibited high transit dependency on the basis of income, vehicle availability, population density and age, and mobility limitations were studied and 15 or so residential districts that had a high transit dependency were identified. Second, the primary work destinations for those areas were determined and then compared with the transit mode share and level of bus service provided in those areas to determine which of those corridors might benefit from improved transit service. The employment side of the data was also studied by looking at TAZs with high employment levels and comparing those with the transit mode share and level of service to further identify some areas of latent transit demand. Work-related transit latent demand from any corridor into the Cleveland CBD was determined to be limited; however, several reverse-commuting opportunities were identified.

Problems noted in this study included the lack of non-work-trip data. However, in some cases employment locations such as retail districts or medical centers were used as surrogates for non-work-trip destinations. In addition to aggregating the data up to make them more manageable, it was also found that to do route-level analysis the data had to be disaggregated back down to the TAZ level. Different numbering schemes for TAZs in different MPOs had to be dealt with, and it was suggested that there be a nationwide TAZ numbering scheme.

Southern California

The Southern California case study, which covered seven counties, looked at the effects of immigration on mode choice for transit riders' journey to work in the area. The census data used were PUMS File A. The study examined the year immigrants arrived in the United States, their ethnicity, whether they were employed, and how they got to work. The cohort analysis technique was used to compare data for 1980 and 1990 for the same group over time.

It was found that recent immigrants (those who have arrived in the last few years) make up 45 percent of the total transit commuters and are much more likely to ride public transit than native-born workers. However, over time, as they adapt to California society and improve their economic status, their use of public transit declines by about 50 percent and in fact approaches that of native-born commuters.

Because of this longitudinal type of analysis, an overall recommendation for Census 2000 was to collect data comparable with data collected in 1980 and 1990.

Chicago

The Chicago area case study covered at least 11 applications of census data—transit, regional, and so forth. Some examples were (*a*) establishing a regional-level data base for understanding changes in multimodal demand between 1980 and 1990; (*b*) performing feasibility studies for station relocation or route-level service expansion; (*c*) developing an atlas of route-specific market demographic data as profiles for areas served for each of 125 bus routes; (*d*) analyzing population, housing, and employment changes around defined market shares for rail stations; and (*e*) comparing the results of on-board surveys with census data along bus routes.

CTPP data were used to get origins and destinations of work trips and to examine their geographic distribution. STFs were used to get demographic data to analyze CBD and non-CBD work travel patterns. In 9 of the 11 applications it was believed that the census was the only source of data for the study area.

Overall in the Chicago area study it was concluded that the census represents a consistent method of data collection on a small-area basis and that it provides data for use in longitudinal studies. Without CTPP data, the work in these applications would have been much more difficult and would not have had the same level of detail. It was also believed that the data need to be available in a user-friendly form.

Summary

In summary, some likes and dislikes and some recommendations from all of these studies are as follows:

Likes

- Many studies could not have been performed without the available census data or it would have cost several hundred thousand dollars at least to get equivalent data.

- The CTPP journey-to-work data are the only consistent statewide work-trip data available that encompass three MPOs in one particular region. Again, this study could not have been done without census data since individual MPO models do not account for trips outside their boundaries.
- Some researchers liked census data for regional aspects and some for small-area aspects: the census provides a consistent source of housing value information over the entire region, and, conversely, it represents a consistent method of data collection on a small-area basis. It also allows for the use of census data in longitudinal studies.

Dislikes

- Comparison with some model data was difficult because, in some areas, TAZs did not match up with census tracts.
- The restriction to reporting the main travel mode was a limitation.
- The need to apply the PUMS data average to a large number of TAZs in the PUMA was a concern.
- Lack of non-work-trip data was a limitation.
- Users were confused over the definition of rail modes.
- There were definition problems with multimodal trips.
- Data were not available until several years after the census.

Overall Recommendations

- Faster release by the Census Bureau of block-group-level data might have made mapping to the TAZs easier in the New Orleans study.
- TAZ and PUMA boundaries should be contiguous with smaller census geography.
- The PUMA should consist of entire tracts.
- The Census 2000 should collect data comparable with that collected in 1990 and 1980 to allow measurement of trends over time.
- The data need to be available in a user-friendly form.

The Private Sector

William R. Loudon, *COMSIS Corporation*

This review of the private-sector role in the use of census data answers these questions: Do those in the private sector support and facilitate the use of census data? Do they provide supplemental data? Do they supply data that might be a substitute if the journey-to-work data or other census data were not available? Do the private-sector companies rely on the journey-to-work data for their business practice?

There are a number of areas in which the private sector is providing either products or services. Of course, some of these are being provided through contracts with government agencies such as the Bureau of Transportation Statistics (BTS) and the Federal Highway Administration (FHWA). Some are also private commercial enterprises selling products and services.

The first area in which services and products are being provided by the contractors represented in this session is repackaging of census data, including different kinds of repackaging of the population data; repackaging of the employment data from the census in combination with data from other sources; and repackaging of both of those kinds of employment and population data for life-style identifiers. Provision of boundary and line file information from the Topologically Integrated Geographic Encoding and Referencing (TIGER) files is quite common.

The second area also involves software to facilitate the use of census data. There are two examples of reformatting the Census Transportation Planning Package (CTPP) files for easier use. Another significant contribution is geographic information system (GIS) software for better integration of the census data as well as other transportation planning data into the planning and programming process. It is a significant enhancement of professional practice for transportation planners to be able to display data and the results of analyses graphically in a way that facilitates the decision-making process more readily.

The services also include guidance in the use of the CTPP data, a CTPP training course and handbook, conversion factors for the use of the CTPP data, Census Mapbook, and supplemental data, particularly data on business inventories and locations.

Caliper Corporation

Caliper Corporation develops software products to support transportation planning and research. One is TransVU CTPP, developed for BTS specifically to aid in the reading and graphical display of the CTPP data. TransVU CTPP is a specialized application designed to read the files, provide mapping and tabular representation of the data, and transfer data to another format in which it can be manipulated and printed. The software is free to all users and is not designed to compete with other kinds of presentation software and thus does not print products but will allow viewing of the data in graphic and tabular forms. The data can then be transferred to another software in which it can be used for spreadsheets or graphic presentations. It is Windows-based with pull-down menus and a point-and-click orientation that makes it quite easy to use.

Other products that Caliper provides to the industry include TransCAD and Maptitude. TransCAD is one of the GIS software packages that is being used extensively within the transportation industry. It was designed specifically for transportation applications and has a broad range of capabilities. It is supported by a large data set including all of the census data to support transportation planning already available on CD-ROM for use with TransCAD.

Maptitude is an inexpensive but versatile software for mapping. There has been a significant increase in the use of mapping software from a variety of sources to support transportation decision making. The new software helps to put the information and analyses in a more interesting and usable format for presentation to broad audiences, particularly to decision makers.

Claritas, Inc.

Claritas is an information provider relying heavily on census data but also drawing on a significant number of other sources for information both of a residential nature and business or employment nature. Claritas supports primarily private-sector clients doing market analysis but also supports many public-sector clients in completing inventories or making supplemental use of data.

PRIZM and Workplace PRIZM are two products that Claritas provides primarily to its private-sector business clients for use in market research and market analysis. These products use clustering analysis techniques to create 62 different clusters of residential populations according to income, household size, and household characteristics, a variety of information that can be drawn from the census. These 62 clusters range from the Blood Estates and the Winners' Circle populations all the way to the Scrub Pine Flats and Hard Scramble populations, with such other characterizations as Big Fish, Small Ponds neighborhoods; Boomers and Babies; and Big City Blend neighborhoods. It is easy to see how this type of characterization of neighborhoods might be useful to companies to identify the greatest potential markets for their goods.

Workplace PRIZM uses the census journey-to-work data and flip-flops the residential information to provide characterizations of workplaces. Using the information on origins and destinations of the work trips, Claritas is able to identify for a particular tract where the population that works in that tract resides and, on the basis of that place of residence, to be able to identify the types of neighborhoods from which the workers come.

Because of confidentiality requirements, the actual characteristics of the individuals who are traveling to those workplaces cannot be revealed, but the characteristics of the neighborhood can provide identification. Each workplace cannot really be developed as one type of area, such as the Big City Blend, but is a combination of residential categories. This software has been quite useful to a number of firms that specifically want to market to the workplace location and understand the characteristics of its population. Although this application is primarily outside the public-sector transportation orientation, it may become more useful as lifestyle information is brought into transportation planning or as more marketing of a broader

range of products develops, not just for transit, but also intelligent transportation systems, information strategies, and products of different kinds.

Claritas also repackages the data from the census in several forms, for example, the journey-to-work information in the STF–3 Info Pack, but also provides a demographic data base that is very similar to the census but is updated regularly by Claritas with in-house staff and methodologies. Claritas provides a 5-year forecast for all of the demographic data, which can be quite a valuable source for ongoing updating and projecting of information.

Finally, Claritas provides business data, including type of establishment, number of establishments by tract and Standard Industrial Classification (SIC) code, and employment inventories. The primary source for the Claritas business data is the telephone Yellow Pages.

Dun and Bradstreet

One of the premier suppliers of business data, Dun and Bradstreet has for many years supplied such data as a byproduct of its main line of business, which is providing information on credit evaluation of companies. It has roughly a 99 percent complete business data base with information on over 10 million businesses in the country, including valuable information on SIC code and number of employees by location that can be provided on a point-specific basis and aggregated to any kind of zone system. They have also attached geographic referencing data so that the data can be tied into virtually any kind of GIS system for processing.

Another byproduct of the business data from Dun and Bradstreet is the TRINC transportation file, which contains quite complete information about businesses that own transportation fleets and the characteristics of those fleets. This, again, can be an important data base for any organization attempting to do a commercial vehicle survey and wanting to know who owns and operates commercial vehicles within any particular area.

Environmental System Research Institute

One of the foremost providers of GIS software is the Environmental System Research Institute (ESRI), whose principal package is called ArcInfo. ESRI also provides a mapping software called ArcView that is also getting significant use within the industry.

ESRI puts out a catalog that lists a large number of data suppliers, including suppliers of census information, geographic boundary information, and business data. The emergence of actual suppliers of geographic boundaries and of data to populate the GIS has made GIS much more usable in the transportation industry.

JHK & Associates

JHK & Associates has been actively involved with FHWA in developing a training course that was first delivered using the Statewide Element of the CTPP and in describing more generally the products available from the census. The course was taught in over 30 locations, and about 900 people were trained in the use of CTPP data. A handbook was developed for those who attended but is also available for those who could not attend one of the training sessions. A 20-min video and a brochure are available on the use of CTPP data.

The TransVU software and the Urban Element of the CTPP became available at the conclusion of the original training course provided by JHK, which has now contracted to provide another training course specifically on the Urban Element using TransVU. JHK also provides a variety of other technical assistance in the use of the CTPP.

COMSIS Corporation

COMSIS Corporation has developed a Conversion Factors Handbook for use with the census data. The handbook provides factors that are essential in converting the information to a

format that is usable in modeling or urban translation analysis. It was developed under contract with FHWA and should be available soon.

COMSIS, also under contract to FHWA, developed SAS software for use of the CTPP, recognizing that there may be different kinds of users: some who would use the predesigned TransVU software for viewing, but others who would want to use SAS for different kinds of applications. COMSIS developed a number of programs for easy use of the package with SAS; the software should be available soon from FHWA.

Summary

Products and services are available from the private sector that facilitate the use of the census data. Employment data are available from the private sector to check, supplement, and factor census workplace data. There really exists no commercial source that can substitute for the journey-to-work data, particularly the detailed tract-to-tract, origin-destination information that is so important in the transportation industry. Census data are essential to both public- and private-sector practice.

Small Metropolitan Areas

Kenneth J. Dueker and Philip Wuest, *Portland State University*

The context of transportation planning has changed dramatically since passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) and the Clean Air Act Amendments (CAAA). In addition to the need to satisfy specific requirements for comprehensive statewide and metropolitan planning, governments at the state and local levels are faced with a changed decision-making environment. Along with an increased emphasis on performance-based planning and restricted funds for both planning and projects, the most significant change for smaller areas has been the relationship between transportation investment decisions and growth management policies (*1*).

The 1994 conference on the use of decennial census data in transportation planning outlined changes to the planning process mandated by ISTEA and CAAA, but actual changes run much deeper than the response to the ISTEA policy initiative. The need for new policies is itself a reaction to significant changes in residential and workplace location, the changing nature of urban areas, the level of technology, and growing awareness and concern for the efficient allocation of public funds and control of transportation externalities. These changes and concerns are reflected in a planning agenda that includes demand management, carpool facility planning, transit planning, air-quality management, and congestion and management systems (*2*).

The 1994 conference sought to explore the role census data could and would play in the new planning environment. Census products, especially the 1990 Census Transportation Planning Package (CTPP), were considered to be an extraordinary step forward in terms of the quality and availability of data for planners at all levels of government. Yet, at the time of the last conference, relatively few jurisdictions were actively using the 1990 data. Cervero listed specific applications for the data that ranged from multimodal analysis and transit service analysis and planning to transportation demand management (*3*). A survey by Meyer and Mazur indicates that trend analysis, model development, and validation and corridor development would likely be key areas where census data would be applied (*1*). Although most agreed that census data in general, and the CTPP in particular, would provide one of the only consistent and reliable sources of data for the transportation planning process for smaller areas, it remained unclear exactly how that data would be applied. Since that time, statewide

planning agencies and metropolitan planning organizations (MPOs) have demonstrated a wide variety of applications and uses for available census data.

Some concerns were also presented at the last conference. These spanned the range from the accuracy of census data to the future needs of transportation planners. Could the census continue to supply the current level of data, or would the level decrease because of shrinking resources and rising costs? Also, although vast improvement in transportation-planning-related census data was recognized and lauded, there was a call for still further improvement in the content, quality, and timing (*2*). A discussion of data quality included concerns about wording of the journey-to-work (JTW) questions and accuracy of geocoding workplace data. Asking about the "usual" mode of travel is thought to understate occasional use of transit to work. Geocoding inaccuracies are allegedly due to lack of reliance on local knowledge. The JTW trip is seen as crucial to fulfilling the mandates of ISTEA and CAAA, but effective planning over the long term requires understanding the character of a wide range of trip types. Participants at all levels in the planning process insist that there is a need for data for nonwork trips—trips for shopping, school, and recreation—and trip chaining. The demand for better data is driven by a need to understand the fundamental shifts in transportation behavior caused by the changing urban landscape. Effective planning for the future is impossible without understanding today's patterns of growth and behavior. What impact will temporal adjustments in commuting hours have on regional transportation systems? How will specific policies, such as an urban growth boundary, affect residential and workplace locational preferences and commuting patterns? Will the widening income gap change the nature and location of public infrastructure investment? Responding to these questions exposes the weakness of too much reliance on the JTW data from the census. Lawton contends that the JTW data are inadequate but could be vastly improved with more cooperation between the Census Bureau and local MPOs and councils of government (COGs) (*4*). Quackenbush, although noting the value of census transportation data in validating and calibrating travel models, echoes the concern that current census data are insufficient (*5*). Finally, Wickstrom cites a wide range of applications for decennial census data, especially as a base data set, and reviews the importance of local travel surveys to provide adequate information for the travel modeler (*6*).

Attention to the level of available technology is another essential element in planning for future data needs. During the last conference it was predicted that most statewide planning would shortly be based on a strong modeling framework (*1*). This is happening. New technology that allows for the linking of geographic information systems (GIS) and more traditional transportation modeling renews the call to look hard at the future of data needs and data delivery media and formats. At the same time, a note of caution should be sounded so that planning does not become too method driven. Further, because so many jurisdictions are applying census data in the planning process, there is a need for a published forum in which statewide planning agencies and local MPOs could share their findings and explore other creative methods of transportation analysis and planning.

Purpose

It is in this context that the role of census data in transportation planning today and in the future is considered again. Since the time of the last conference many agencies have new experience in applying census data using new technology and methods. The focus here is on how these experiences fit into the framework for improvement put forward at the last conference. Issues will be highlighted that seem most relevant to the data needs and uses of small MPOs. Experiences of various MPOs will be highlighted, and some of their concerns about data quality, the role of census data in planning for small MPOs, current data shortcomings, and future data needs will be raised.

This summary will

- Review the case studies submitted to this conference on the use of census data in transportation planning for small MPOs, especially the CTPP Statewide Element;

- Identify some of the common issues in terms of usefulness of the CTPP;
- Outline some of the major obstacles in the use of the CTPP;
- Provide examples of the type of analysis that can be done with the currently available data;
- Cover the strengths and weaknesses of the current format and availability of census data; and
- Review suggestions for improving both the quality and use of the data.

Case Studies

In preparation for the conference, several papers by local MPOs on their experience with census data in general and the CTPP in particular were reviewed. The organizations range in size from an MPO for the four-county area around Albany, New York, to small non-MPO cities in Northwest Oregon; their experiences vary widely. The applicable findings from each study follow. (Some of the case studies may be found in Volume 2.)

Association of Monterey Bay Area Governments

The Association of Monterey Bay Area Governments (AMBAG), a tri-county regional MPO, uses census data, both Summary Tape Files (STFs) and the CTPP, to recalibrate their regional travel demand model, which is based on CTPP traffic analysis zones (TAZs). Because they are an MPO and had previously defined the TAZs used in the CTPP, most of the data were pulled directly from the CTPP tables. The TAZs were originally designed to be used as building blocks for a regional model. AMBAG also aggregated block-level STF data to TAZ using a GIS for population and household information. (As suggested at the last conference, this level of sophistication is almost commonplace as GIS capability reaches more users.) AMBAG cites the inadequacy of local travel survey data because of lack of resources and funding and an inordinately small California Department of Transportation (Caltrans) survey sample size as reasons for primary dependence on census data in model development.

AMBAG used the CTPP Urban Element, which was received in late 1994. The richness of the CTPP cross-tabulations by TAZ allowed them to apply trip generation rates for a wide variety of trip types to households. In addition, CTPP data were essential to the modal-split portion of the modeling process because there was no alternative data source. AMBAG found the CTPP Urban Element to be highly reliable and useful and recommend expanding it to include

- Description of weekend travel behavior,
- All other trip purposes, and
- Survey information from a typical Wednesday, rather than any typical day, to account for randomness of working characteristics for each person [this is a common theme throughout most papers reviewed and reflects a concern outlined in the proceedings from 1994 (7)].

San Luis Obispo Council of Governments

The San Luis Obispo Council of Governments (SLOCOG), a single-county entity planning for seven cities within their jurisdiction, used census data primarily for the development of a Jobs–Housing Balance Project that was applied for a variety of purposes—to determine the effects on transportation of commute patterns and times and means of work-related travel. This project was done for both small metropolitan areas and the region as a whole. In order to accomplish their goals, SLOCOG broke the county down into planning area boundaries and then subdivided those into cities and census-defined places (CDPs); this breakdown allowed them to apply census data without substantially resorting it geographically. Where city

and CDP data were not available, tract and group-level data from STFs were aggregated to planning areas.

SLOCOG encountered some important concerns in using census data. The data were not always reliable or accurate when compared with local data sources. In addition, because San Luis Obispo County was not designated a Metropolitan Statistical Area (MSA) until 1992, the data for this area were not aggregated by TAZ, which greatly inhibited the ability to apply the CTPP. A review of all data sources used in this study shows that STF data were far more essential to SLOCOG than the CTPP. This situation is common for areas in which aggregation by TAZ is not available. Finally, there is a concern at SLOCOG about the updatability of their work; because it is based on decennial census data, it can only be updated at a wide time interval (D. Polley, Volume 2 of these proceedings).

Santa Barbara County Association of Governments

The Santa Barbara County Association of Governments (SBCAG), MPO for the county and multijurisdictional body for all areas in the Santa Barbara–Santa Maria–Lompoc MSA, used census data and other local sources to develop a regional growth forecast for 1994, which provides data on population, employment, and household growth for the region. This forecast was used as an input to traffic forecasts, regional transportation plans, air-quality plans, and housing demand projections. SBCAG used only the STF data in developing the baselines for their projections of household characteristics, and cited the census data as essential to the level of detail achieved in the process (*8*).

Rutland Regional Planning Commission

The Rutland Regional Planning Commission (RRPC), Rutland County, Vermont, is a regional transportation planning agency providing services to more than 27 predominantly rural municipalities. RRPC used census data in the development of a regional transportation plan based on existing and future conditions, which are based on a regional traffic forecasting model. RRPC cites extensive use of both STF and CTPP data. STF-3C is used for block-group-level sociodemographic data. The CTPP is used to gather JTW trip patterns by mode, town-to-town trip patterns, and calibration of their regional demand model. The census data in the CTPP were essential to the analysis that they conducted; no reasonable substitutes were currently available.

Because of the relatively high level of aggregation used for JTW trip origins and destinations, RRPC defined their TAZs to be coterminous with census block groups, owing to the availability of data at this level, which is a breakdown not available in the CTPP.

There was also a case in which the data were not reliable and had to be adjusted according to local data sources. This is a danger for smaller, rural regions where samples are small and census tabulations may not be representative of newer exurban commuting patterns (D.L. Pierce, Volume 2 of these proceedings).

Metropolitan Transportation Planning Organization for Gainesville Urbanized Area

The Metropolitan Transportation Planning Organization (MTPO) for the Gainesville Urbanized Area, which is coterminous with Alachua County, is responsible for developing a regional transportation plan. MTPO, in conjunction with the Florida Department of Transportation (FDOT), hired JHK & Associates to develop a countywide travel demand forecasting model to be used for long-range transportation planning for the Gainesville Urbanized Area. The CTPP was used primarily for model development and validation. MTPO was delayed at the beginning of the effort as staff waited for the release of Urban Element

Parts 1 and 2. Much of the area being analyzed was rural, and MTPO found that place-of-residence information was always not coded properly to TAZs in smaller incorporated areas. Larger incorporated areas reported no coding problems. Part 2, for place of work, was somewhat more reliable, although some recoding was still necessary. For example, more than half of the University of Florida employees were coded to a single TAZ—across the street from the university campus—and all of the 1,000 service and commercial workers were coded to Sorority Row. MTPO concluded that the CTPP was only marginally helpful for this portion of the project. The lengthy process of verifying and recoding data precluded any appreciable savings in time or money.

MTPO notes that census data were used to develop socioeconomic inputs for the travel demand model, although there was significant delay as they waited for the CTPP Urban Element Parts 1 and 2. The CTPP was also used to determine average automobile occupancy rates and trip length reasonableness and to compare the number of home-based work trip productions predicted by the model with a realistic base. Several TAZs were also aggregated, and this level of analysis was used with JTW information to compare zone-to-zone travel with the flows that their model generated.

MTPO has done extensive planning for bicycle and other modes of transit, and the CTPP has proven to be the only reliable external source of data that describes this kind of travel behavior. When compared with a locally developed data source, the mode share of bicycles described in the CTPP proved to be accurate.

The study concludes by noting that the CTPP was absolutely essential in developing the 2020 Transportation Plan for the Gainesville Urbanized Area. In some cases there was no local alternative data source. In addition, the use of the CTPP lent additional credence to the planning effort. MTPO cites census data as very helpful in convincing various oversight committees of the ability of the traffic demand model to predict traffic levels (W. Blanton, Volume 2 in these proceedings).

Capital District Transportation Committee

The Capital District Transportation Committee (CDTC), the MPO for a four-county urbanized area including the cities of Albany, Troy, and Schenectady, is a planning organization for a larger metropolitan region. The STF tabulations and the CTPP Urban Element were used extensively by the professional staff of the CDTC for

- JTW tabulations by municipal groups by mode and by vehicle occupancy,
- Vehicle occupancy information that was used to fine-tune a freeway queueing simulation,
- Identification of areas of households with no vehicles available as prime markets in which to concentrate bicycle and pedestrian accommodations, and
- Demographic information aggregated by TAZ and JTW data for calibrating a new mode-choice model.

As discussed by Poorman (Volume 2 of these proceedings), CDTC makes an important point with regard to the use of census data for each of the above applications: "A key ingredient to successful use of Census data is the integration of readily-available Census data with other data—household survey data, National Personal Travel Survey data, transit on-board survey data and other information. Census data alone cannot be expected to be sufficiently comprehensive to serve sophisticated analytical methods adequately."

In conclusion, timeliness is cited as being central to the needs of a complex planning process. CDTC also reports that census data are crucial to lending credibility to the planning process. The professional technical staff of the CDTC has the ability to use census data beyond the ability of many smaller planning organizations. For CDTC the CTPP does not stand alone but is an essential data ingredient (J.P. Poorman, Volume 2 of these proceedings).

Chicago Area Transportation Study

After a survey of nine small MPOs from around the state of Illinois, a stark contrast was found between Chicago and the other areas in the state. The findings from the survey are briefly summarized in Table 1; the full case study may be found elsewhere in these proceedings (Christopher et al., Volume 2). They indicate that the CTPP, although used, is not widely depended upon by smaller organizations for a variety of reasons, which will be discussed in the next section.

Common Issues

There are several recurrent issues in the case studies reviewed above. The issues can be divided into broad categories including uses and users of the various census products, timeliness, geocoding accuracy, level of aggregation, access to data and structure of CTPP products, and level of technology.

Uses of Products

It is important to begin any discussion of census data by drawing a sharp, clear distinction between the STF tabulations and the CTPP Statewide and Urban elements. The characteristics, abilities, and resources of users of each product are different enough to merit discussion. In most cases it is the larger MPOs that are in the best position to make use of each type of data; they have the necessary professional staff and experience working with data. They are more likely to have locally developed data sets that can be used in conjunction with census products. They have the ability to manipulate information available in the CTPP Urban Element. Smaller MPOs vary in the resources and capability to use data in each of the above categories. They are much less likely to have locally developed data and the resources necessary to mine census data for local applications.

Because ISTEA mandates statewide planning and states generally have more professional capacity and resources to develop and manipulate data, strong linkages between state departments of transportation (DOTs) and smaller MPOs should be developed. Two examples are drawn from the case studies just discussed. Both AMBAG in California and MTPO in Florida cite their reliance on the census as a result of either inordinately small sample sizes for their areas in a statewide survey or lack of recently developed local data. Historically, state

TABLE 1 Results from Selected MPOs (Christopher et al., Volume 2 of these proceedings)

MPO	Used the CTPP?	Census data necessary?	Census data essential?	Would same work have been done w/out Census data?
Bloomington-Normal	VERY LITTLE	YES	YES	NO
Champaign-Urbana	EXPLORATORY	YES	YES	NO
Davenport/ Rock Island-Moline	NO	YES	YES	?
Decatur	YES	YES	NO	?
Dubuque	NO	YES	YES	NO
Kankakee	YES	YES	YES	NO
Peoria	NO	YES	YES	NO
Rockford	NO	YES	NO	NO
Springfield	Very Little	?	?	?

DOTs have provided technical support for urban transportation planning in smaller cities; these roles and expectations need to be clarified in the ISTEA environment. Particularly, states and MPOs need to assess data requirements in terms of reliance on census JTW data in conjunction with state or locally collected travel survey data.

Timeliness

There are three main concerns regarding the timeliness of census data. The first is that census data are only available once every 10 years. For planning purposes, this means that any models or projections based on census data can only be updated at wide time intervals. Continuous measurement will change the time-line issue from decennial snapshots to a 5-year rolling average that will require modification to methodologies.

The second two concerns regarding timeliness raised in the case studies of small MPOs are related to the release of the various census products—STFs and the CTPP Statewide and Urban elements. The delayed release of the CTPP Urban Element leads many larger MPOs to seek or develop other resources, including locally developed travel survey data, using the STF as a sampling frame. Smaller MPOs often do not have the resources available to develop alternative sources of data. Although the Statewide Element can provide important descriptive information on place-to-place flows that are useful for internal to external MSA analysis, it is an underutilized data resource. Because STF data are available first and are crucial to the planning process, the Statewide Element has received little attention as a tool for effective transportation planning. Small MPOs consider the Statewide Element a poor substitute for the Urban Element and continue to wait rather than exploit the place-to-place data.

Geocoding Accuracy

The small-MPO case studies raised several important points with regard to the accuracy of the geocoding of the place-of-work data. The MTPO case, in Florida, where much of the place-of-residence and place-of-work data needed to be checked for accuracy and, in many cases, recoded, raises a flag of caution for users who lack extensive local knowledge or alternative data sources against which to check the accuracy of census data. Another example was raised by RRPC, in Vermont, where coding problems were found between a county in northwest Vermont and a town of the same name in central Vermont. Although all MPOs surveyed appear to agree that the census JTW information is crucial to the transportation planning process, it has also been indicated that secondary data sources against which census information can be checked for accuracy are also important. The need to check the data for accuracy is true for both place-of-residence and place-of-work tabulations. Experience in building models of small cities in Oregon has indicated that caution is warranted when using JTW data where geocoding problems are compounded by small sample sizes.

Level of Aggregation

The level of aggregation is closely related to geocoding accuracy. For smaller MPOs and statewide agencies, coding to a remainder-of-county level could be equivalent to inadequate geographic accuracy because the remainder-of-county level is not specific enough for effective transportation planning. The level of aggregation differs between the Statewide and the Urban elements. The Urban Element is suited directly to the transportation planning process because the level of aggregation has previously been defined by the MPO that will be using the data. AMBAG, the MPO for the Monterey Bay area, provides a good example. They designed their TAZs to be building blocks for a regional model. Once they received the CTPP Urban Element, it was simply a matter of extracting and using the data.

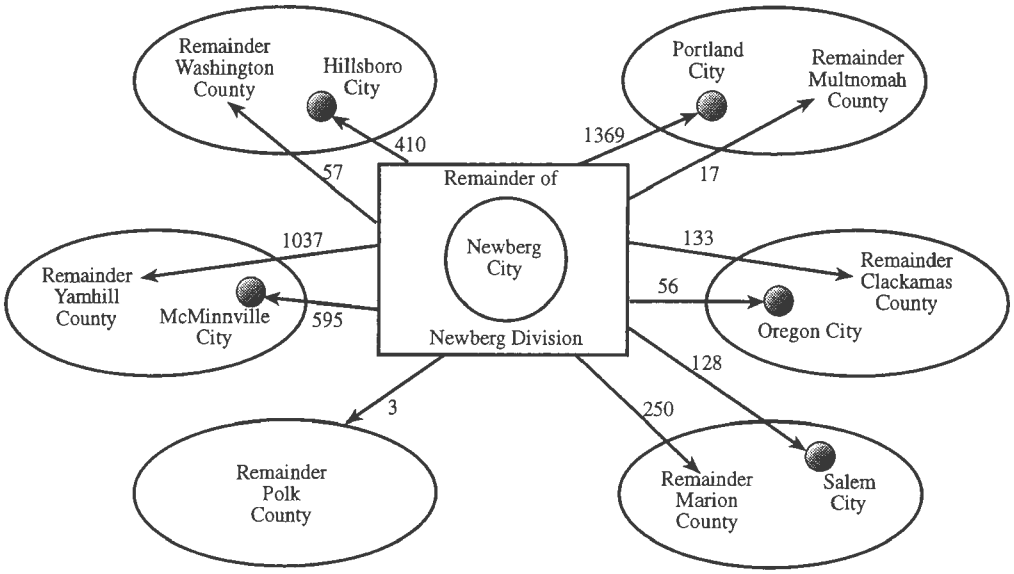

FIGURE 1 Journey to work by residence from Newberg, Oregon, to selected cities and counties (source: 1990 CTPP STCO/MCD/Place, JTW by Residence, Table CO1, All Trips).

The Statewide Element, on the other hand, is much more difficult to apply. Tabulations are available by place of work, place of residence, and JTW flows. Further, each is available at various levels of geography. For a small MPO the task of choosing an appropriate and useful level of data extraction could be daunting. In addition, JTW data flows are not equivalent in their level of geography by place of work and place of residence. Figures 1 and 2 illustrate this problem; both use the city of Newberg, Oregon, as an example. Figure 1, outgoing JTW trips by residence, shows the trips originating both in the city of Newberg and in the Newberg Minor Civil Division (MCD). The flows shown go to both specific places and remainders of counties. These flows constitute one aspect of JTW trips in Newberg. JTW trips bound

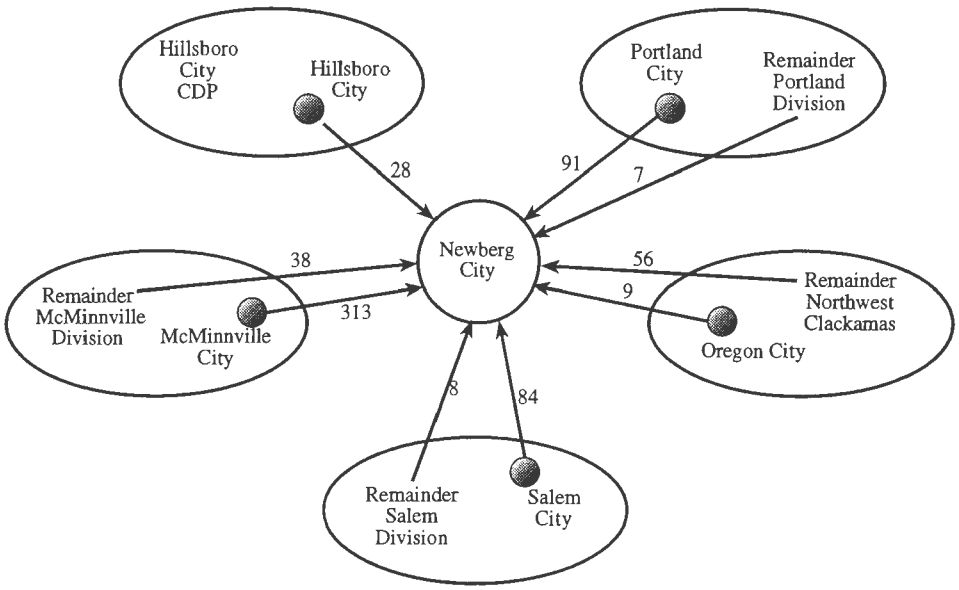

FIGURE 2 Journey to work by workplace to Newberg, Oregon, from selected MCDs and places (source: 1990 CTPP STCO/MCD/Place, JTW by Residence, Table CO1, All Trips).

for Newberg and the surrounding area provide the reverse commute. Figure 2, incoming JTW flows by workplace, however, shows how the coding of place-of-work data makes these flows asymmetrical. Because JTW trips by workplace are only aggregated to the place and remainder-of-county levels, only trips that are bound for Newberg (the place) can be considered in this portion of the analysis. Figure 2 shows JTW trips bound for Newberg (the place) only; any trips that are bound for the remainder of Newberg are allocated to the remainder-of-county level. The result is that users cannot extract symmetrical JTW data, which precludes accurate description of traffic flows for an area. The place of residence is not necessarily the same as the place of work.

The Statewide Element can still play an important role in the transportation planning process. MPOs and statewide planning agencies can extract descriptive information from the Statewide Element that will enhance the understanding of regional traffic behavior. Figure 3, a schematic representation of the I-5 Corridor in Oregon from the southern Willamette Valley to Portland, is a good example. Figure 3 does not cite any data directly, but it shows how data might be extracted from the CTPP and applied to develop a descriptive model of JTW traffic along a regional corridor and through several MSAs. The CTPP Statewide Element can be used to identify and priority rank cordon-line impacts and interregional trends for further exploration. A similar graphic could be developed for southbound interregional travel in the I-5 corridor.

Several other applications of the Statewide Element are worth mentioning. The Willamette Valley Council of Governments, in Salem, Oregon, reported using some of the Statewide Element tabulations to identify areas for transit, vanpooling, and carpooling programs. The Gainesville MPO used the Statewide Element data to identify areas of high pedestrian and bicycle usage and noted that no other data sources were available with this kind of informa-

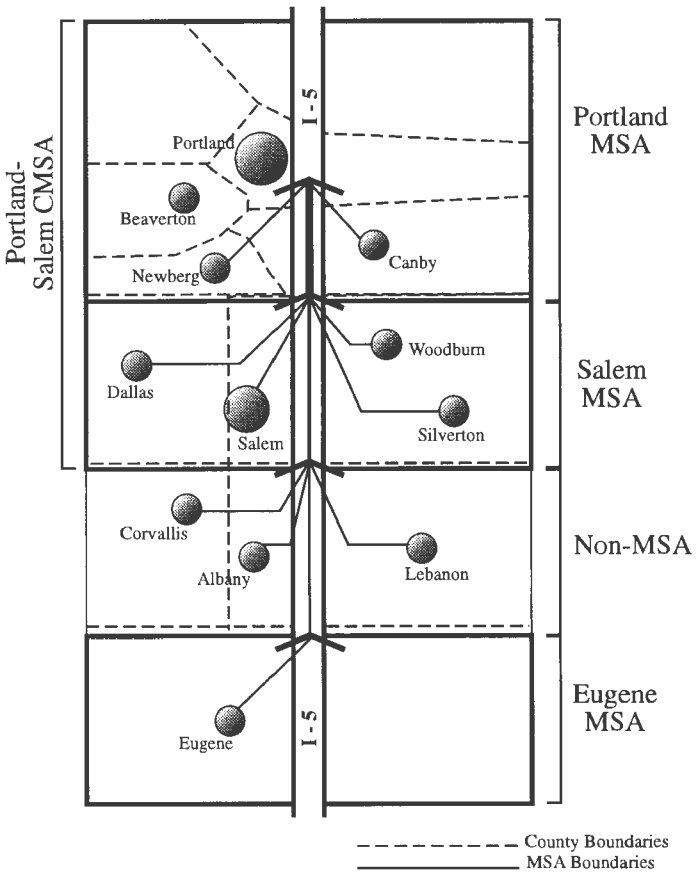

FIGURE 3 I-5 Corridor: counties, MSAs, and PMSA.

tion. The data allowed them to identify areas where infrastructure investment for pedestrian and bicycle facilities might be most efficient. Finally, JTW data from the Statewide Element provided the basis for directional allocation of trips generated using population, housing, and jobs data for small city development impact studies in Oregon. The ability to assess the flows to and from (internal-external trips) smaller cities proved to be essential to the modeling process. The CTPP was the only source of data for this information for smaller cities (from 2,500 to 10,000) in Oregon.

Experience with the CTPP in developing information for the analysis of smaller communities in Oregon and for entire corridors within the state also provides examples of difficulties with level of aggregation. Many of the smaller communities along rural corridors are too small (fewer than 2,500) to be tabulated. Although this does not prevent a serious problem when dealing with the JTW-by-residence information, which is aggregated to the next higher level, it is a major problem for the JTW-by-workplace data. The remainder-of-county aggregation for the JTW trips makes it extremely difficult to define corridors. The choice of including whole counties in the tabulation or excluding them is not a workable solution. Minor Civil Divisions (MCDs) are often workable for place of residence, but remainder-of-county for place of work is not. Another example is drawn from a smaller MPO surrounding Salem, Oregon. Within the MPO are many smaller communities that are too small to show up as a separate tabulation; this makes it difficult to use the CTPP Statewide Element for in-depth analysis.

Place-to-place flows can, however, be instructive. Figures 4 and 5, showing both directions of JTW flows—by residence and by workplace—are examples of how the CTPP Statewide Element might be applied by a smaller MPO. Figure 4, JTW by residence, shows three cities within the Salem, Oregon, MSA and three cities outside the MSA. For each city within the MSA, the total trips generated are shown in proportion to the external-MSA trips. The flows going to selected cities outside the MSA show both the absolute number of JTW trips from that city and the percentage of trips bound for external MSA locations that they represent. The data come from the STCO/MCD/Place level, Table CO1, all trips, and are pulled for JTW by both residence and workplace. Figure 5 shows the opposite flows—the percentage of trip ends within each city that arrive from outside the MSA and some absolute numbers from se-

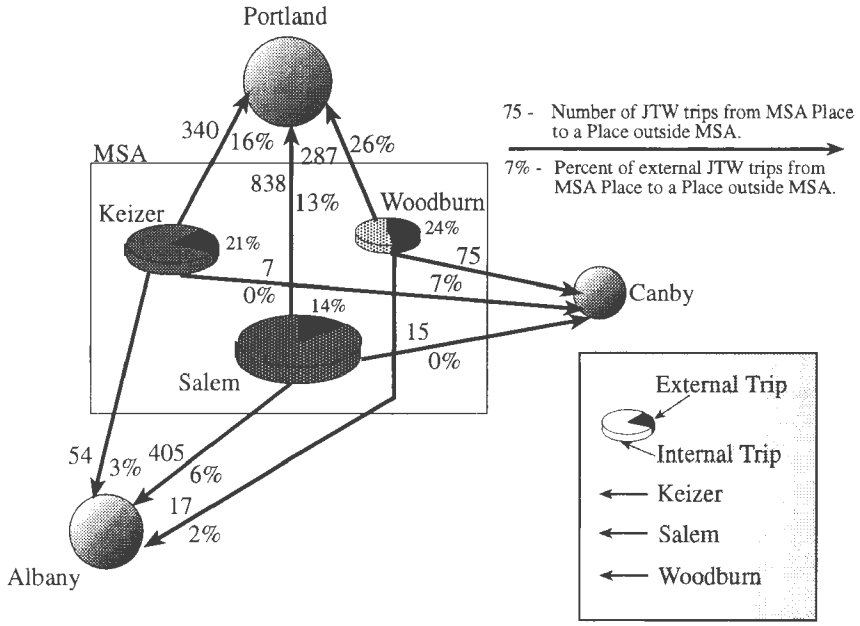

FIGURE 4 Journey to work by residence: all trips for selected cities in and around Marion and Polk counties (source: 1990 CTPP Statewide Element STCO/MCD/Place, JTW by Residence, Table CO1, All Trips).

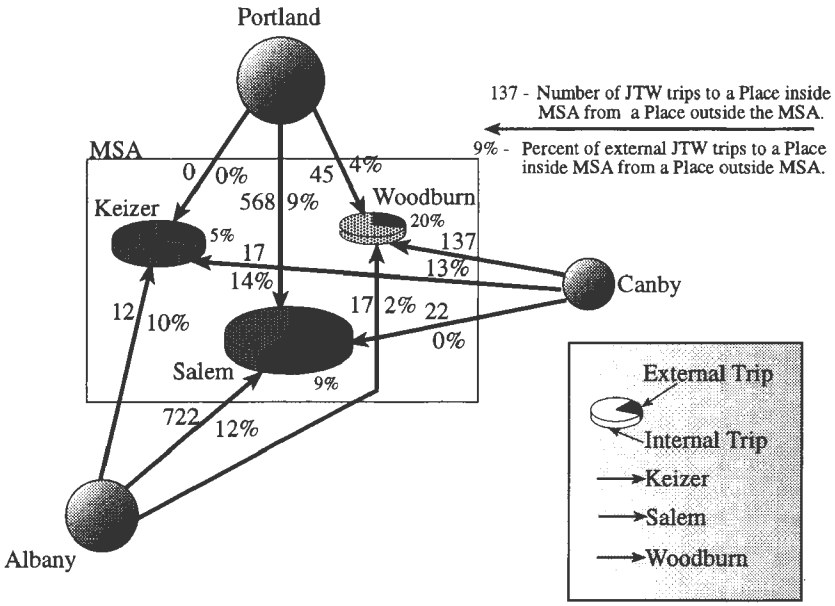

FIGURE 5 Journey to work by workplace: all trips for selected cities in and around Marion and Polk counties (source: 1990 CTPP Statewide Element STCO/MCD/Place, JTW by Residence, Table CO1, All Trips).

lected cities. Together they indicate the relative balance of trips to and from the places within the MSA. Further, if directional flows to and from each place or external region are aggregated, a picture of the overall impact of JTW trips at the cordon line can be estimated. Finally, it is important to note that although these examples present aggregate flows, corresponding demographic information is associated with each location. This depth and richness of data available in the CTPP can be tapped once aggregate flows are identified and understood.

Access to Data and Structure of CTPP Products

Conventional census data are rich in the depth of information about residents of places and census-defined areas, whereas the CTPP adds demographic information by place of work and flows by mode between place of residence and place of work. Working effectively with census data, however, has several important prerequisites. First, MPO staff must be aware of the potential of census data for transportation applications and analyses. Next they must learn how to access the data. These steps can be difficult in smaller MPOs. Because creative use of the CTPP is not well developed, there is no common knowledge base about what kinds of analyses are possible, what is realistic, and what can be useful (although this conference seeks to address these issues). At the same time there is a need for more publication of exemplary analyses aimed at smaller MPOs. By providing examples of the analyses, part of the long learning curve associated with the use of census data can be overcome.

A related topic is the structure of the CTPP product. As noted in the last conference proceedings, as more and more jurisdictions turn to modeling, there is a greater need for flexibility of data. The standardized format and levels of aggregation of the CTPP facilitate documentation and development of access tools but impose on users the need for considerable judgment as to aggregation, selectivity, and presentation.

Level of Technology

At the last conference the consensus of the group was that by 2004 the stage would be set for a less standardized product than the CTPP. "Many users foresee that a direct user-specified

'retail' tabulation approach will become typical, in which each state or MPO can specify its own tabular requirements via direct access communication with the Bureau of the Census" (2). This view appears to be correct. The stage is set for less emphasis on a standardized product and more tools for flexible access by users. Providing a more flexible product would make the census data more valuable. Although computing power has caught up with the large volume of CTPP data, users have not yet learned how to analyze the richness of the CTPP. The data contain too many anomalies that require judgment, such as missing data, to trust automated analysis.

FINDINGS

Small MPOs have not been effective users of the CTPP, though they use the conventional STF tabulations extensively. The STF data are used as the baseline for population forecasting, small-area allocations, and a frame for sample surveys. Use of the STF as the universe from which to sample for travel surveys is particularly important. Surprisingly, small MPOs have not made much use of the commuting flow and urban tabulations for census tracts and TAZs. Many of the small MPOs are not ready to work with the data; they have not taken the time and effort to overcome the learning curve by working with the place-to-place JTW tabulations of census-defined places over 2,500 in population. This is surprising because the place-to-place tabulation of work trips would seemingly be of use to small MPOs, experiencing as they do a larger proportion of work-trip commuters from outlying places than do larger MPOs. Experience in working with the statewide CTPP on CD-ROM would prepare smaller MPOs for working with the more detailed internal zone and tract flow and zone and tract place-of-work and place-of-residence tabulations in the Urban Element for which, in many cases, they are still waiting.

One reason small MPOs have not been effective users of the CTPP is because the data are not considered essential for the conventional urban transportation planning process. The CTPP does not supply trip generation rates by purpose, and household types can be obtained from the STFs. Although zone-to-zone commuting flows from the CTPP would seemingly be of use in trip distribution modeling, synthetic data can be generated by trip distribution models with trip-type, trip-length frequency distributions and screen-line traffic counts. Similarly, mode choice in small MPOs can be estimated using trip-end rather than trip-interchange models.

Although not essential for the conventional transportation modeling process, the CTPP enriches the understanding of commuting flows to the urban area from outlying communities. This is needed to understand better the composition of flows to and from the region at the cordon line. County-to-county commuting flows have typically filled this need, though the flow data at that level of aggregation are too coarse for serious laboratory analysis. The place-to-place flow data available in the statewide tabulation provide an adequate level of detail for analysis of commuting flows to and from an urban area. For clarity some of the minor flows have to be discarded so that the major-flow patterns are discernible. However, this type of analysis is suited more for qualitative use and not for data input to a more formal quantitative travel demand modeling process.

Because of the delay in releasing the urban CTPP tabulation on CD-ROM, small MPOs have postponed use of JTW data from the census and place a greater reliance on local data. At this point many small MPOs may find it not worth the bother of processing and analyzing the data if they consider them more of an enrichment than a necessity for the conventional urban transportation planning process. These data should be considered essential; a good understanding of commuting patterns should not be replaced by a pure modeling approach.

REFERENCES

1. Meyer, M. D., and G. Mazur. Census Data Use for Statewide Transportation Planning and Transportation Planning in Smaller Metropolitan Areas. In *Conference Proceedings 4: Decennial Census Data for Transportation Planning*, TRB, National Research Council, Washington, D.C., 1995.

2. Summary and Conclusions. In *Conference Proceedings 4: Decennial Census Data for Transportation Planning,* TRB, National Research Council, Washington, D.C., 1995, p. 5.
3. Cervero, R. Use of Census Data for Transit, Multimodal, and Small-Area Analyses. In *Conference Proceedings 4: Decennial Census Data for Transportation Planning,* TRB, National Research Council, Washington, D.C., 1995.
4. Lawton, K. T. Continuous Measurement Position Paper. In *Implications of Continuous Measurement for the Uses of Census Data in Transportation Planning,* Bureau of Transportation Statistics, U.S. Department of Transportation, April 1996.
5. Quackenbush, K. H. Continuous Measurement: Implications for Transportation Planning. In *Implications of Continuous Measurement for the Uses of Census Data in Transportation Planning,* Bureau of Transportation Statistics, U.S. Department of Transportation, April 1996.
6. Wickstrom, G. E. Data Needs to Meet New Transportation Planning Requirements. Presented at the Conference on Decennial Census Data for Transportation Planning, Jan. 31, 1994.
7. Ceerla, R. Case Study on Monterey, California. Presented at Conference on Decennial Census Data for Transportation Planning: Case Studies and Strategies for 2000, Irvine, Calif., 1996.
8. Bresolin, B. Case Study on Santa Barbara, California. Presented at Conference on Decennial Census Data for Transportation Planning: Case Studies and Strategies for 2000, Irvine Calif., 1996.

State Departments of Transportation

James L. Covil, *Wilbur Smith Associates*

Case studies from four states were reviewed with regard to the uses of census data by state transportation agencies: Kentucky, Wisconsin, Kansas, and New York.

Kentucky Statewide Traffic Model

The use of census data for traffic modeling is probably the single most common use of these data in transportation. Without demand models, transportation planners would be ill-equipped to determine what kind of transportation system will be needed under different population and economic growth scenarios.

The case study covered the second of two projects performed for the Kentucky Transportation Cabinet by Wilbur Smith Associates. In the current project, the area covered by the model was expanded to include surrounding states. The purpose was to make the model sensitive to facilities and traffic conditions beyond Kentucky's boundaries. Also, the traffic analysis zone (TAZ) system was redefined to make it compatible with census geography and to facilitate the modeling process and tie it more closely to the census data that traditionally have been available. Finally, the project is refining and recalibrating the trip generation and distribution components of the model utilizing census data.

Applications

The old Kentucky Statewide Transportation Model covered only the commonwealth of Kentucky and almost ignored conditions in other states that could affect Kentucky. To make the enhanced model more sensitive, the modeling area was expanded to include portions of Tennessee, West Virginia, Virginia, Ohio, Indiana, Illinois, Missouri, and Arkansas. The value of census data in accomplishing this expansion is obvious.

Census geography has become a common denominator in the collection and forecasting of demographic and other spatial data. Consequently, the TAZ system used in the old model was

replaced with a new TAZ system that is consistent with 1990 census geography. Census tracts were used as the building blocks for the new TAZ system. As a result of these enhancements, the model now includes almost 1,500 TAZs. TAZ connectors were created using an automated proximity-based procedure that employed the use of the census Topologically Integrated Geographic Encoding and Referencing (TIGER) files. The results of these efforts are shown in Figure 1.

The third enhancement undertaken in the current study involved refinement of the trip generation and distribution model components. The Kentucky model forecasts vehicle trips for automobiles and trucks. For automobile trips, the model develops separate forecasts by trip purpose. The 1990 census journey-to-work data were used to derive home-based-work trip production rates, attraction rates, and trip length frequency distributions. The 1990 Nationwide Personal Transportation Survey was used to derive trip rates and trip length frequency distributions for home-based and other non-home-based trips.

The census data also played an important role in developing procedures for estimating truck trips:

- The Transearch Commodity data base was used to estimate truck trips at the Bureau of Economic Analysis (BEA) level, and
- Census population employment data were used to disaggregate the BEA-level truck trips to the TAZ level.

Value of Census Data

Without census data it is unlikely that these three enhancements to Kentucky's statewide model would have been undertaken. It simply would have been too expensive and too lengthy a process to conduct the very large and extensive surveys that would have been required.

Wisconsin Statewide Transportation Plan

The Wisconsin application of census data in the statewide transportation plan, Translinks 21, involved the development and use of statewide traffic models in which all modes were analyzed simultaneously and interactions among the modes were specifically addressed.

Applications

For the passenger travel forecasting process, the demand model TRANPLAN was utilized. The model predicts intercity passenger trips, which were defined as only those trips that cross county lines. It is an integrated two-stage model system that forecasts both travel demand and mode share.

One component is a model forecast of natural growth stratified by two trip purposes. Natural growth is that growth resulting from changes in one or all of the following: population, employment, and income. The model also forecasts induced demand resulting from changes in the combined level of service provided by all modes. Because of its composition and focus, the zonal structure is considerably coarser than that used in Kentucky, consisting of only 157 zones. The structure of the model is shown in Figure 2.

The Census Bureau socioeconomic data were essential to the development of independent variables used in the travel demand component of the model. Census population and housing data were used to develop population forecasts. Census employment data were used to produce employment forecasts. Because of the county-level zone structure, journey-to-work data were not used directly.

Development of freight forecasts involved a somewhat different approach. The analysis used commodity flow data acquired from a commercial source. Trend forecasts were based on forecasts of economic activity. As with the passenger forecasts, the trend forecasts basically considered continuation of previous trends.

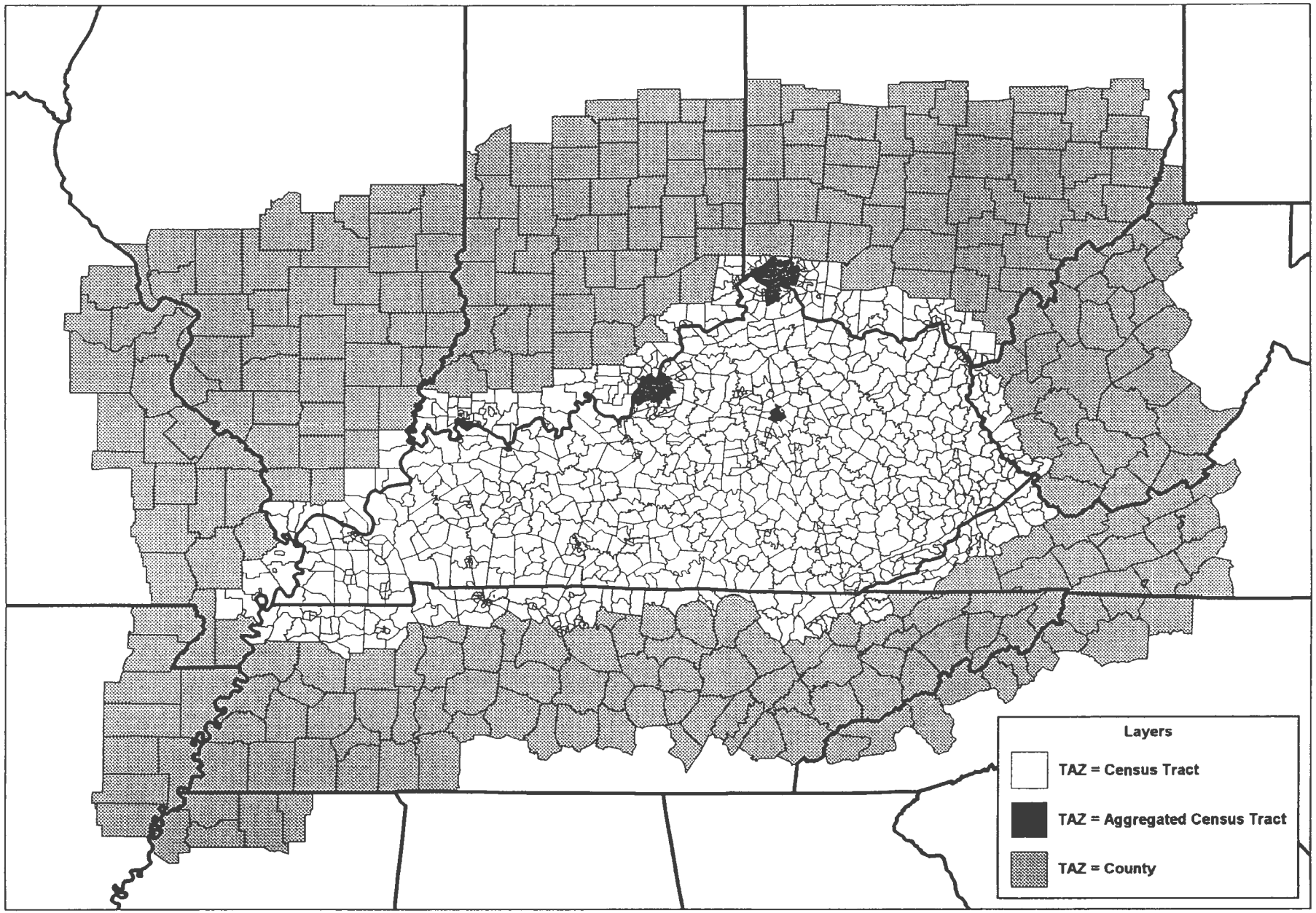

FIGURE 1 Kentucky statewide model traffic zone system.

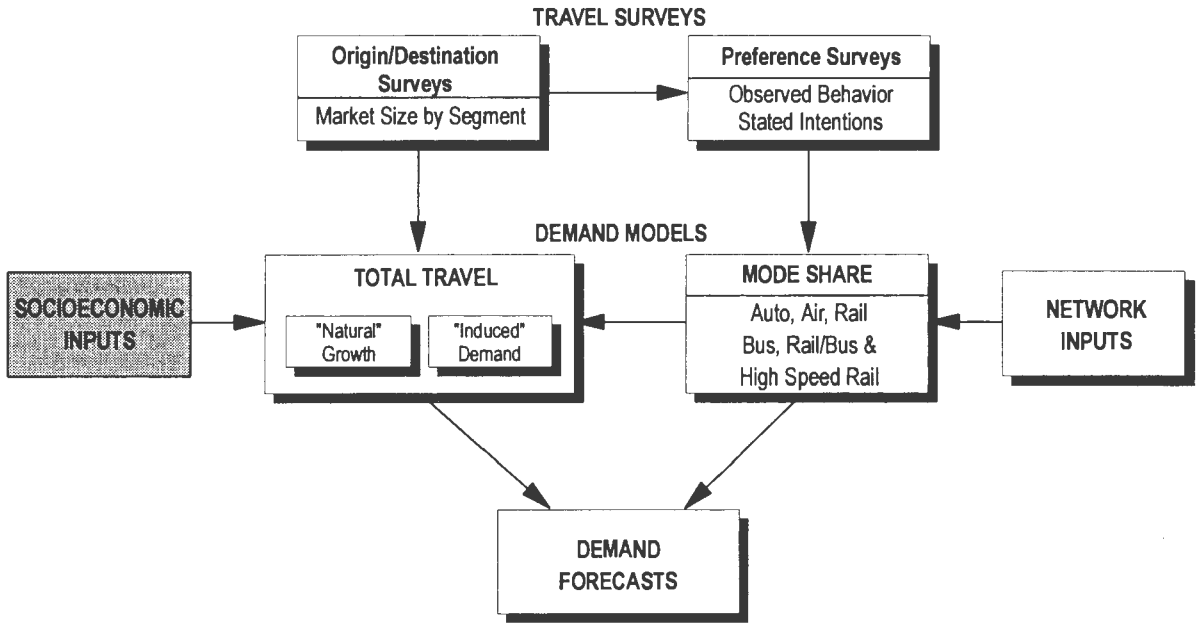

FIGURE 2 Translinks 21 intercity passenger analysis.

The plan forecast was largely based on a truck and rail intermodal scenario. An expert panel defined the extent to which different commodity types could be diverted from one mode to another on the basis of emerging truck-rail intermodal partnerships. This diversion would involve utilization of intermodal container, trailer-on-flat-car, and new RoadRailer technologies. The extent to which different commodity types could be diverted took into account haul distance as well as service frequencies necessary to achieve different levels of diversion. The diversion rates were applied to the freight forecasts and assigned to the network using a TRANPLAN methodology.

Value of Census Data

To accomplish the foregoing tasks, a wide variety of census data was required to produce a state-level multimodal plan that captures the interactions between and among the modes, including the census of population and housing; county business patterns; the census of transportation, communications, and utilities (in particular the Commodity Flow Survey); selected current industrial reports; the annual survey of manufacturers; and other important data.

The Wisconsin example clearly demonstrates that census data are extremely critical to statewide transportation planning activities.

Kansas Department of Transportation

The Kansas Department of Transportation case study involved three different types of applications.

Applications

The first type of application involves 12 months of experience by the Kansas Bureau of Transportation Planning in which census data were fundamental, and even essential, to their operations, such as the following:

- Voting district redefinition,
- Services for the mobility disadvantaged,
- Indian reservation transportation planning,
- Statewide trip exchange matrix,
- Regional trip exchange matrix,
- Airports relative to population centers,
- County population trends, and
- Wichita travel time analysis.

The foregoing list includes only those examples in which the census data were the primary source of information. It also reflects the Bureau's reputation in Kansas as experts regarding census data. Bureau staff are often called upon to support other organizations because of this expertise.

The Wichita travel time analysis highlights the critical nature of census data relative to the activities to the Kansas Bureau of Transportation Planning. As a part of the Wichita analysis, a map was produced that shows the travel times from various TAZs to the Wichita downtown area. The Bureau incurred certain trials and tribulations in generating these kinds of data. One of these involves the difficulties of combining the census data base with mapping procedures. Certainly, these capabilities should be enhanced in the future to facilitate meaningful displays of census data in relation to surrounding geographical attributes.

Value of Census Data

These examples demonstrate that the census data are the easiest data sources to access. They also highlight the importance of journey-to-work information from the census. If census data were not available, the timeliness, speed, and accuracy of transportation-related analyses would be greatly reduced. In fact, many of these activities simply would not be undertaken because of the unavailability of a good source of data.

The Kansas case study effectively communicates the essential nature of census data to transportation planning. It also made some recommendations for improvements. For example, the desirability of census output in a machine-readable compressed format was cited. In particular, a relational data-base format distributed on CD-ROM was suggested. Indicative of the importance of trend analysis in transportation planning, it was also suggested that the data from previously censuses be redistributed on CD-ROM and that there be consistency between successive census activities. The Kansas Bureau of Transportation Planning believes that the Census Transportation Planning Package (CTPP) urban and statewide data are the most critical of the data bases. These data concerning trip ends are not available from any other current source.

New York State Department of Transportation

Like Kansas, the New York State Department of Transportation (NYSDOT) makes a strong point that many of its planning activities simply would not be done in the absence of census data. The expense would be prohibitive to conduct special surveys that would be needed to undertake the analyses that are currently performed on a regular basis.

Applications

The Planning Data Analysis Group (PDAG) of the NYSDOT has undertaken a multifaceted proactive role with regard to census data. To fulfill the need for those who are experts in census data to assist others who have little working experience with census data files and to increase awareness of the values associated with the census data, PDAG has undertaken an

outreach effort. As a part of this effort they have conducted training courses and twice have sponsored the National Highway Institute (NHI) course regarding the CTPP.

One of the means by which PDAG has attempted to increase knowledge and awareness of census data and its usefulness involves the production of a newsletter-type publication called FACTS, which is distributed to regional offices and to MPOs to tell them about certain aspects of census data. This newsletter is a good means of maximizing the value of the census to the greatest number of potential users. It also is an excellent means of improving the performance of NYSDOT and the MPOs by helping them to take advantage of information that is available but which they may not be aware of.

One example of NYSDOT's use of census data involves the results of a study regarding access from suburban counties to the core of Manhattan in New York City. In this analysis, data showing the county of residence, employment, and trip characteristics were examined in a variety of ways. Pie charts were developed showing how the choice of transportation mode is influenced by location. The journey-to-work data also were used to show the influence of the unique mass transit system that exists in the New York area. This study demonstrates that census data that are consistent for various geographical areas have high value in revealing those factors that influence transportation activities and choices.

The second example application by PDAG is the development of regional data profiles for use in NYSDOT's regional comprehensive planning. To assist in this planning process, county data profiles have been developed to provide the demographic, economic, and transportation information that affects travel characteristics. Regional profiles contain a variety of information, for instance, the characteristics of transportation choices by workers in relationship to their household income.

When the effort was initiated, PDAG experienced difficulties in getting input from the regions about what data they needed. After drafts of the regional profiles were circulated, requests for more details resulted, which indicates how the value of census data can be increased by increasing awareness of its availability and utility.

A final example application from New York is the development of processes that link census data with the Department's geographic information system (GIS). The illustrative application involves a transit market research project. Using GIS, the Department's Public Transportation Division identified market opportunities as an input to bus route and service planning activities. Visual comparisons of the type that were prepared greatly facilitate the assessments that must be undertaken to better plan for bus routes and services.

Value of Census Data

Given the extensive use of census data by NYSDOT, it is informative to look at their concerns regarding the application of census data in transportation planning. Briefly, there is the issue of trip-chaining, a phenomenon that clearly is affecting transportation choices in a significant way. NYSDOT also has suggested that the mode of transportation might be refined somewhat because it is possible in large areas like New York and Chicago to confuse commuter, subway, and heavy-rail modes. Like a number of other states, New York State must deal with international crossings. Therefore, the Department has suggested that it would be useful to know the origin and destination details of cross-border travel.

Conclusions

Valuable lessons may be learned from these four case studies. First, it is clear that there are far more applications involving census data than it was possible to review. In fact, this review covered only selected examples of items in the four case studies. If other states were contacted, it is very likely that still more applications would be revealed.

Second, because census data are available, transportation planners know a lot more about those factors that influence trip-making characteristics and choices than they would know

otherwise. Transportation planners are able to relate socioeconomic and geographical features with trip-making characteristics. That knowledge is crucial if appropriate plans are to be prepared for transportation systems.

Third, because census data are available, a better job of transportation planning is accomplished. There can be no question that transportation systems are better planned in the United States simply because census data are available.

Fourth, consistent, universal coverage is one of the most valuable characteristics of the census data. The same information is available for all areas. The same definitions are applicable. The temporal relationships are the same within the data base.

Fifth, if the census data were not available, it would require extraordinary efforts to obtain information on a case-by-case basis. This situation has extensive implications regarding cost, time, geographical coverage, inconsistencies between the way different surveys would be undertaken, and the ability to undertake trend analysis.

Sixth, although it is clear that some changes are appropriate to improve transportation planning capabilities even more, if census data were not available or there were a decline in the quality and comprehensiveness of census transportation data, transportation planners most likely would not do much of the transportation planning that is undertaken today. There would be a tremendous waste of efficiency in developing transportation plans and providing transportation systems that properly respond to the nation's needs, and future generations would suffer.

PLENARY SESSIONS

Alternative Data Collection Options

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The current recommendation from the Census Bureau to Congress is for Census 2000 to include in the traditional long-form survey those data items used in transportation planning, such as income, vehicle availability, and journey to work information, and to begin full implementation of the continuous measurement process in 1999. In the review of alternatives to the census during this conference, two primary directions were discussed:

1. Replacing the long-form survey with the continuous measurement process: In the event that Congress determines that the Census 2000 form will be restricted to only those items needed for apportionment and the Voting Rights Act (age and race), the Census Bureau has developed an ongoing survey program that has the potential to replace the long-form data with 3- or 5-year accumulations of data for small geographic units and with annual data for large geographic units.
2. Losing the long-form data altogether: Congress is in a budget-cutting mood, and it is still unclear whether the long-form data will be included in Census 2000 or whether continuous measurement will be implemented beginning in 1999.

Implications

Quality of Data for Small Geographic Units

The quality of data for small geographic units achieved through the decennial census cannot be achieved as cost-effectively through any other alternative. The credibility of the Bureau of the Census permits the highest achievable response rate for any large governmental survey process. By including the sample questions, that is, the long form, in the process of the 100 percent count for apportionment, a high response rate is also achieved for the sample survey. This high response rate, and the sample size of one-sixth of the households nationwide, permits local and state governments to use high-quality data for small geographic units, such as census tracts and block groups, for program planning and implementation, site selection, cor-

ridor analysis, and so forth. The long-form sampling ratio, which varies between urban and rural areas, permits analysis in rural areas that would be compromised with the standard sampling ratio currently proposed for continuous measurement.

Consistency and Comparability

One of the greatest benefits of the decennial census is that the data are consistent and comparable with those from previous censuses. A recent FHWA document included tables from 1960, 1970, 1980, and 1990 censuses on journey-to-work characteristics in metropolitan areas and for the nation as a whole (*1*). Such trend data from a reliable and credible base with national consistency cannot be easily replaced without serious thought and testing.

The transportation planning profession would face a serious loss of investment in existing data and models, and would need to invest in new data sources and new or revised processes using these new data sources. Under the U.S. Department of Transportation (DOT) Travel Model Improvement Program (TMIP), still newer procedures are being developed that are heavily reliant on census baseline data.

Shifting the Cost Burden

The marginal cost of the long form is low. The current Census Bureau cost estimate for Census 2000 is $3.9 billion. A 1995 National Research Council report (*2*, p. 127) states that the estimated marginal cost of the long form with sampling for nonresponse would be $200 million to $400 million. The transportation community could conceive of compromising by giving up sample size and reducing the sample from one-sixth of all households as done in 1990 to one-eighth of all households nationwide, but this is not likely to result in much cost savings.

Without the census long form (and also no guarantee that continuous measurement will be implemented), the data collection burden shifts to metropolitan planning organizations (MPOs) and states. In preparing for this conference, TRB conducted a survey of MPOs on use of 1990 census data. Although one-third of the agencies responded that they would probably replace the long-form survey with smaller regionally conducted surveys, two-thirds responded that they most likely would not replace the data. As alternatives to the census, larger agencies said that they were more likely to conduct regional surveys and traditionally have had multiple sources of transportation data. Smaller agencies, many of whom report that census data are not used in their transportation plans and programs, may be the most at risk for losing local small-area data. Consultants working on behalf of MPOs for small and medium-sized areas reiterated their reliance on the census long-form data for building new travel demand models. These smaller areas have much more flexibility and responsibility under the Intermodal Surface Transportation Efficiency Act (ISTEA).

Essential Data

Two critical uses of census long-form data in transportation are for population and employment forecasting and travel demand forecasting, used in the regional transportation planning and air-quality analysis required under ISTEA and the Clean Air Act Amendments. With forecasting horizons of 20 to 30 years, census data provide MPOs and state departments of transportation with a stable source of household characteristics and journey-to-work flow information.

Items seen as critical to obtain in a consistent, nationwide survey, with data reported for small geographic units, were household size, household composition, vehicles available to the household, and household income. (It is assumed that household size and composition will be available as part of the census 100 percent population and housing unit count.) There are now more cars than households and more cars than licensed drivers. It is important to know

the relationship of vehicle availability to household characteristics. Regional surveys cannot obtain accurate income data and typically ask for broad income category ranges such as less than $20,000, $20,000 to $35,000, and so on. The specificity of income data and income sources in the decennial census is irreplaceable at the local level.

The next most critical data are work location and travel mode to work (including vehicle occupancy). These are used in travel demand model calibration and validation, and specifically in checking trip distribution and developing mode-split models. These uses were documented in the case studies presented at this conference, which may be found in Volume 2 of these proceedings.

Finally, those items that are currently included but could be replaced at the local level with small samples are departure time to work and total travel time.

Alternatives to Long Form

The alternatives to the long-form survey that were discussed are as follows:

- Replace the long-form survey with continuous measurement as used in the American Community Survey (ACS),
- Expand the Nationwide Personal Transportation Survey (NPTS),
- Conduct regional household surveys,
- Conduct workplace surveys,
- Conduct on-board transit surveys, and
- Use secondary data sources, such as motor vehicle registrations and employment security files.

Replacement of Long Form with Continuous Measurement

The continuous measurement process as used in the ACS is currently being tested by the Bureau of the Census. This survey has been suggested as a replacement for the census long-form survey, so the decennial census would be limited to a headcount for congressional apportionment and for meeting the requirements of the Voting Rights Act. Other items currently collected on the long form would be moved to the ACS, a survey of 400,000 households each month (for 3 years, 1999 through 2001) to replace the long-form survey and subsequently to survey 250,000 households each month on an ongoing basis to provide annual estimates of population characteristics by state and congressional district. Small-area data (such as those for census tracts and traffic analysis zones) would be provided using accumulations of 3 years or 5 years of data collected during all 12 months of the year rather than on April 1 every 10 years. The Bureau of the Census sees one of their problems as having a budget that spikes once every 10 years and would prefer to present Congress with a budget that is more stable from year to year.

The current Census Bureau recommendation is to include the long-form survey in Census 2000 but to move toward use of administrative records in 2010. Although the transportation planning profession agrees that continuous measurement offers a wonderful opportunity for having annual data for large geographic units, the annual data on journey-to-work modes, vehicle ownership, and travel times are very valuable, especially at the national and large metropolitan area levels. However, conference participants were concerned that data for small geographic areas, especially the journey-to-work flows, might not be available because it would be dependent on continuous funding from Congress.

The transportation community would like a chance to evaluate the data from the continuous measurement test with a "hands-on" approach. The current continuous measurement test does not compare the long-form survey and continuous measurement directly, but is more an operational test of continuous measurement. (That is, results from a "point-in-time" larger sample are not being compared with accumulations of smaller samples over many

years.) It should be determined whether there are response rate differentials by urban and rural characteristics and other sociodemographic characteristics such as race and income and what impact these differentials may have on the final results.

In particular, the long-form survey is necessary for the year 2000 so that valid comparisons can be made with data collected by continuous measurement. It would be better to have the long-form survey and a 3-year test of continuous measurement in selected geographic areas rather than full implementation of continuous measurement simultaneously with the long-form survey. Average data for travel mode and journey-to-work flows should be examined to evaluate how annual data for large geographic areas and accumulated data (for 3 or 5 years) for small geographic areas can be used and to see where problems may occur.

Conference participants wondered why full implementation for continuous measurement is scheduled for 1999–2001 when it has not been determined whether it will work. The NRC panel, using estimates provided by the Census Bureau in 1993, reported that continuous measurement at 250,000 housing units per month would cost $615 million over 10 years, but that this estimate was not high enough (2, p. 129). An estimate of the cost for conducting continuous measurement beginning with 400,000 housing units per month for 3 years and subsequently declining to 250,000 housing units per month has not been developed by the Census Bureau. Under the assumption that the unit costs are proportionately the same ($5.14 million per month for 250,000 housing units per month and $8.22 million per month for 400,000 housing units per month), the cost for the current proposal can be estimated over 10 years as $728 million.

There were strong expressions that it seemed unrealistic to expect Congress to fund both the long-form survey in 2000 and full continuous measurement starting in 1999. The question was raised whether the Census Bureau was asking for much more than Congress would realistically fund in the hope that at least one of the alternatives would be selected.

Transportation planners are concerned about data access and cost. If the small-area data are available in new accumulations each year (one more year added), will MPOs and state departments of transportation want a new file each year? Probably not, but since some may want a new file in 2004 and some in 2006, it seems that it would be most efficient if DOT worked to get all MPO needs processed on a regular schedule in a nationwide coverage. Thus, instead of each MPO's requesting its own special tabulations, it might be better if a standard tabulation package (similar to the Census Transportation Planning Package) was worked out for each year.

Under the continuous measurement scenario, MPOs and other local government agencies would need to have an ongoing relationship with the Census Bureau to maintain the Master Address File and the Topologically Integrated Geographic Encoding and Referencing (TIGER) files and to geocode workplace locations.

Nationwide Personal Transportation Survey

Currently, NPTS is a sample of approximately 21,000 households (21,000 in the 1995–1996 survey and 22,000 in the 1990 survey). This sample size is sufficient for national travel trend analysis but insufficient for small-area geographic flow patterns. NPTS, conducted over a 12-month period, includes all trips made in daily travel, detailed information about vehicle use and acquisition, and, unlike the census, is not restricted to the journey to work. Also, because the current survey method is by telephone retrieval, the costs are close to $150 per household, similar to regional household travel survey costs using trip and activity diaries with a telephone recruitment and retrieval method (P. Stopher, unpublished data, NCHRP Project 20-5, Topic 26-03, Methods for Household Travel Survey: mean costs by two survey methods, $104–$128 per completed household).

Potentially, the NPTS could be expanded to a large sample, sufficient to provide data for updating and validating trip generation rates, and conceptually could be expanded to a very large sample to provide small-area flow data. However, DOT has not planned or budgeted for such a large survey. One benefit of expanding the NPTS compared with some other alternatives would be that nationwide consistency in survey method and implementation would be retained.

Regionally Conducted Household Travel Surveys

An alternative to expanding the NPTS would be for each state and MPO to work out its own data needs. Currently, many MPOs supplement census data with small sample surveys, predominantly ranging in size from 1,000 to 3,000. The sample rate is approximately 1 in 300 households compared with 1 in 6 households for the long-form survey. If the census data become unavailable, surveys of 5 percent of the region's households might be conducted as they were in the 1950s and early 1960s. Each metropolitan area did its own survey. The goal was to measure the origin-destination flow using a matrix of approximately 100 to 200 zones. This was done in only the very largest metropolitan areas: Boston, Chicago, New York, Philadelphia, and San Francisco. The inclusion of the journey-to-work question in the 1960 census and the development of the first Urban Transportation Planning Package (UTPP) flow data for a metropolitan area were in part to reduce overall data collection costs, so that although the census may cost more because of the inclusion of long-form questions, local agencies are saving significant amounts of money by the ability to conduct very small sample surveys (less than 1 percent of households) rather than the 5 percent sample collected in the past. Including the journey-to-work questions in the census allows regional agencies to limit the sample sizes where all trips, not just the journey to work, are surveyed.

Workplace Surveys

Another alternative would be to survey people at their place of work rather than at their residence by conducting workplace surveys. This approach could also differentiate between workers and visitors at workplace locations. Commercial business files or Bureau of Labor Statistics files could be used to identify workplaces and sample employers to conduct journey-to-work surveys of employees. Some MPOs currently conduct these surveys at a regional level. The greatest difficulty has been getting cooperation from small employers; therefore, response bias is a problem. Because there are significant differences between large and small employers in such benefits as parking provision, transit, emergency-ride-home provision, and other related benefits such as on-site daycare programs, this response bias would need to be addressed.

Conducting these kinds of surveys at a national level rather than having each state or metropolitan area design and conduct its own would ensure consistency and comparability.

Transit On-Board Surveys

Transit on-board surveys have traditionally been conducted by most major transit systems. This information can give details about current transit users, but it is difficult to evaluate transit markets or potential riders. The combination of small geographic area data with household and person characteristics and mode choice in the census provides a wealth of data that is used in the short term for transit route planning and longer-range transit system development. On-board surveys do, however, permit better data on such items as access mode to transit and transfers. Surveys can be customized for specific transit systems, which may be known locally by acronyms and nicknames that currently cannot be easily included in a nationwide study. On-board transit surveys, similar to other surveys, also have been suffering from declining response rates and rising costs.

Secondary Data

Similar to the stated goal that the Census 2010 would use administrative records, some possible secondary data sources were explored. First, state motor vehicle registration files could be used. Some of the problems with these files are vehicles operated out of state, leased cars

whose owner is not the operator and who may be many states away, and identification of company fleets. Other possible secondary data sources are commercial employment data bases or state employment security department files. These data bases may contain total employment and may give employment by physical workplace locations. Experience by MPOs has varied; some states are more diligent about disaggregating large employers to work locations rather than one personnel office address, and some states do not permit other governmental agencies access to the files.

The biggest problem with using these secondary sources is the lack of combining characteristics; for example, motor vehicle files do not include household characteristics such as size, life-cycle stage, or income. Similarly, employment files include the industry code of the employer but do not include occupations of the workers or any information on their vehicle ownership or travel characteristics.

Will Alternatives Meet the Needs?

The consensus was that the transportation community was not yet ready to abandon the long-form survey. Eliminating the long-form survey was seen as shifting the burden of cost of data collection from the federal level to states and local government, not as an end savings to the general public. The alternatives identified left a loss of consistency and comparability.

The use and value of census products should be documented for the transportation community, and the case studies prepared for this conference are a good start. How the data are used in major investment studies, in developing long-range transportation plans, and in selecting projects for metropolitan and statewide TIPs should be shown. The support of the American Association of State Highway and Transportation Officials, the National Association of Regional Councils, the American Public Transit Association, and other organizations should be enlisted to support the data needs.

Access to Data

Availability of data and flexibility in tabulation are the two key goals for access to all alternatives to decennial census data used in transportation planning. For either the decennial census or the ACS, the Bureau of the Census has recently been discussing the Data Access and Dissemination System (DADS), to replace most of the traditional standard census reports and products except those few profile reports necessary to show appreciation to the public for cooperation. DADS is envisioned to provide direct access to a limited number of data summaries, Public Use Microdata Samples, and a process for specifying special tabulations from confidential files. The goal is to provide tabulations rapidly and on demand.

DADS could potentially reduce the cost of producing standard and custom tabulations and provide tabulations more quickly to data users. Because users could define their own tabulations, there would not have to be predetermined and standardized tables. The transportation community needs assurances that DADS will accommodate requests not only for residence geography, but also for workplace geography and for flow (place of residence and place of work) tabulations. The ability to customize the tabulations would be beneficial. For example, income tabulations such as CTPP Part 1, Table 14 [Number of Workers (6) by Household Income (26)] or Part 1, Table 33 [Earnings of Workers (12) by Means of Transportation (11)] could use income groups appropriate to the area based on local median income values rather than using income ranges that cover a nationwide spectrum.

However, to be most expedient for the transportation community, it might be fastest for DOT to request standard tabulations for all states and all MPOs that might be a combination of a limited number of STF3 and CTPP tables so each state or MPO would not have to establish a DADS account or need to make a special request. Also, some priority might be given to a request by DOT compared with local governmental units should there be any problems in the ability of DADS to respond to tabulation requests in a timely manner. These stan-

dard tabulations might be used to further determine custom tabulations that the local agency would need at some later point. Similarly, consultants working on behalf of local governments would be assured of some baseline data in which comparability with other areas is guaranteed.

Workshop participants also expressed the view that DADS could have negative impacts such as loss of control, reduction in data quality, and a higher impact on small MPOs because of greater limitations on their ability to access the data and user fees.

All alternatives to the census long-form survey or the ACS should have the same goals of data availability and flexibility in tabulation. BTS should examine other data dissemination programs to recommend a data access program for DOT.

REFERENCES

1. Rossetti, M., and B. Eversole. *Journey to Work Trends in the United States and Its Major Metropolitan Areas, 1960–1990.* Report FHWA-PL-94-012. FHWA, U.S. Department of Transportation, 1993.
2. Edmonston, B., and C. Schultze (eds.). *Modernizing the U.S. Census.* Panel on Census Requirements in the Year 2000 and Beyond, National Research Council, National Academy Press, Washington, D.C., 1995.

U.S. Census 2000 Test

Phillip A. Salopek, *Bureau of the Census*

The U.S. Census 2000 Test, also known as the 1996 National Content Survey (NCS), is part of the Content Determination Process for the Census 2000. Census Day for the test was Saturday, March 2, 1996. Thirteen different questionnaires, seven short forms (100 percent items), and six long (sample) forms were tested. The long forms were targeted to collect responses from a national sample of about 4,200 housing units each. Four of the six sample questionnaires contained journey-to-work data. Facsimiles of the journey-to-work items from each of the four forms are shown in the Appendix.

The first form (DS-2A) is the 1990 control. It contains versions of the journey-to-work questions that are identical to those used in the 1990 census. Items included are place-of-work address (21a); city, town, or post office name (21b); inside/outside city limits indicator (21c); county (21d); state (21e); and ZIP code (21f). The questions ask persons where they worked last week. If they worked at more than one location during the week, they are asked to report where they worked the most (the greatest number of hours).

In addition to place-of-work information, Form DS-2A collects data on principal means of transportation to work (22a), vehicle occupancy (22b), departure time (23a), and travel time to work (23b). Each question asks respondents about their usual activity last week. If more than one means of transportation to work was normally used during the trip, they are asked to report the principal one, that is, the one used for most of the distance.

The second form (DS-2D) shown in the Appendix addresses several journey-to-work issues. Instead of inquiring about usual behavior during the preceding week, the questions on this form ask the respondents to report their behavior on a typical day that week. The expectation is that there will be no difference between the results obtained using the typical-day concept and those from the 1990 control form. This test is being conducted because many persons who use the journey-to-work data prefer a single-day (but not a typical-day) concept. Although there are a number of reasons why the single-day concept is not used in the decennial census, a different method of data collection (e.g., continuous measurement) might very well lend itself to the single-day concept. In that event, it will be important in evaluating data collected using the single-day concept to be able to show that the "typical day" and "usually last week" concepts yield comparable results.

Besides the typical-day concept, the work location items on Form DS-2D are essentially the same as on the 1990 control form. There is only a minor clarification on the county (21d) and state or foreign country of work (21e) items. The phrase "Name of" has been added to each.

There are several changes in the question on principal means of transportation to work (21a) on Form DS-2D beyond using the typical-day concept. The number of categories is reduced to eight by using a single category labeled "public transportation" instead of individual check boxes for bus, streetcar, subway, railroad, and ferryboat. A separate category is maintained for taxicab, however, since some respondents, analysts, and other data users may not consider it a public mode.

The number of public transportation categories was decreased on this form because of comments from transportation planners in metropolitan areas where multiple types of public transit are available. Planners tell the Census Bureau that respondents do not accurately distinguish among the public modes of travel. As a result, planners have to add the individual categories together to arrive at usable data for public transportation.

In addition to using only one public transportation check box on Form DS-2D, more space on the questionnaire was made available by reducing the number of vehicle occupancy categories. Instead of eight categories as in 1990, six check boxes are available in this version of the questionnaire. The "7 to 9 people" and "10 or more people" categories have been combined into a single "7 or more people" choice (21c). This limitation is in response to the steep decline in carpooling (especially large carpools) shown between 1980 and 1990.

The space conserved by the foregoing changes is being used to address a long-standing issue in data on means of transportation from the census. This issue is the occasional use of public transit to get to work. Many analysts have claimed that the "usually last week" concept results in an underestimate of public transportation use, since some people use transit occasionally, but not usually. To address the issue, Form DS-2D includes a question (21b) that asks respondents if they used public transit to get to work at any time during the preceding week.

The questions on departure time (22a) and travel time to work (22b) on DS-2D are unchanged from the 1990 control form, with the exception that they employ the typical-day concept instead of the "usually last week" reference.

The third set of journey-to-work questions shown in the Appendix is Form DS-2E. Like the 1990 control form, the wording in these items contains the "usually last week" concept.

The work location questions on Form DS-2E (11a–f) are essentially the same as on the control form. The only difference is in the instruction following the address block. Because geocoding reference materials do not include intersection coding guides, Form DS-2E asks for a shopping center or other physical location description of the place of work instead of the nearest street or intersection if the address is not known.

As in the previous form, DS-2E uses eight categories of principal means of transportation to work, with one check box for public transportation (12a). However, the individual modes (bus, streetcar, train, etc.) are listed in parentheses following the public transportation label to give the respondent examples of the types of transit to be included.

The vehicle occupancy item (12b) on Form DS-2E is like that found on the previous form; that is, it includes six categories with an upper limit of seven or more people.

The primary addition of new material to the third form concerns what transportation planners call "access mode," which refers to how respondents reached or were conveyed to their principal means of transportation to work. Two questions are included, one that asks if carpool occupants drove to meet the carpool (12c) and another that asks public transit users how they traveled from home to the public transportation stop or station (12d). One important application of this information would be in air-quality analysis, where the number of vehicle cold starts is an important input to air pollution models.

Although planners would prefer to have the census obtain information on all the means of transportation used to get to work, this procedure has proven difficult to put into operation and justify in a general-purpose data collection effort like the decennial census. Collecting information on access mode is seen as a reasonable compromise to obtaining complete multimodal data on the work trip.

The final two questions on Form DS-2E concern time leaving home to go to work (13a) and a new item, time of arrival at work (13b). The first question is unchanged from the other NCS forms. Time of arrival at work is being tested to see if travel times calculated from the departure and arrival time responses are less concentrated on numbers ending in 5 and 0 than the results obtained when respondents were directly asked their travel time.

The final form shown in the Appendix is Form DS-2F. It represents an attempt to create a simplified, user-friendly form. One aspect of user friendliness is the length or number of questions on the form. To address this issue, only one journey-to-work question is included on Form DS-2F, the question on place-of-work location. Although only a subset of the journey-to-work questions might be allowed if a simplified form is used in 2000, the inclusion of place of work here does not preclude different content later. The journey-to-work item or items to include on a simplified form in 2000, if used, have not been determined.

The place-of-work items used on Form DS-2F are little changed from those on the other NCS forms. The item on whether the work location was inside or outside the incorporated limits of the city or town reported has been moved. On this form it is the last item in the battery of questions, following the blocks for state and ZIP code, in response to opinions that its traditional location unnecessarily broke up the sequence of address responses that people are accustomed to providing.

Results of the Bureau of Transportation Statistics Study of Continuous Measurement

Philip N. Fulton, *Bureau of Transportation Statistics*

The Bureau of Transportation Statistics (BTS) study of continuous measurement was begun in mid-1994 and concluded in early 1995. The Census Bureau released the findings from that study in April 1996 in its report *Implications of Continuous Measurement for the Uses of Census Data in Transportation Planning*. The findings were provided to census officials soon after the study's completion to inform the Bureau's decision making for Census 2000.

Purpose of the Study

The Bureau of the Census received a great deal of criticism from Congress over the cost and accuracy of the 1990 census. In response to that criticism, the Bureau conducted an extensive evaluation of alternative methods for conducting the decennial census in 2000. On the basis of that evaluation, the Census Bureau selected a new data collection system called "continuous measurement" for extensive testing and possible implementation as an alternative way of collecting the detailed information obtained from a sample of U.S. households with the long-form questionnaire in previous censuses.

State and metropolitan transportation planning organizations have relied on journey-to-work data from the long form for a broad array of applications since 1960, when transportation questions were first added to the census. A change from the long-form census questionnaire to continuous measurement could have a significant impact on the utility of the data for transportation purposes. To assess this impact, BTS conducted a study of the implications of continuous measurement data for the uses of census data in transportation planning.

Continuous Measurement System

Under a continuous measurement system, the decennial census conducted in 2000 would still collect on a 100 percent basis population and housing unit counts and basic demo-

graphic information such as age, race and Hispanic origin, sex, and household relationship. The transportation characteristics traditionally obtained from a sample of households using the long-form questionnaire, as well as the whole range of social, economic, and housing data collected on the long form, would not be collected as part of the census. Instead, the long form would be replaced by an ongoing, continuous monthly survey of about 250,000 households.

Data from these continuous monthly surveys would be cumulated to produce averages over various periods of time. National estimates could be produced monthly. Annual estimates for large cities, metropolitan areas, and states could be derived by cumulating 12 months of interviews. Five years of interviews would be required to produce estimates for small areas such as census tracts and traffic analysis zones based on a sample of comparable size to the decennial census long form. But a new, moving 5-year average for these small areas would be available each year instead of every 10 years as with the decennial census.

Design and Method of Study

BTS contracted with the COMSIS Corporation to conduct the continuous measurement study. COMSIS assembled a panel of seven experts on the uses of data in the field of transportation planning to assess the implications of continuous measurement. Before the first meeting of the group, extensive background materials were sent to all participants describing uses of census data in transportation planning and the methodology of and proposals for continuous measurement. Panel members were asked to identify issues for discussion at the first meeting.

At the first session, held in September 1994, representatives of the Census Bureau provided the panel with an overview of continuous measurement and presented the Bureau's current thinking on its testing and implementation. The panel also heard a debate on the merits of continuous measurement between Leslie Kish, University of Michigan, and Stephen Fienberg, Carnegie-Mellon University. The panel then identified key continuous measurement issues to be developed into position papers for presentation and discussion at the panel's second meeting.

During the 9 weeks between the first and second sessions, each member of the panel prepared a paper analyzing a specific topical area or issue pertaining to the implications of continuous measurement for the use of census data in transportation planning. The panel reconvened in November 1994 and presented their papers, discussed and debated issues regarding continuous measurement and data needs for transportation planning, determined the findings of the study, and made recommendations.

General Findings

The transportation planning expert panel assembled for this study found that continuous measurement holds promise for providing useful data for transportation planning, but that continuous measurement is an untested process, the results of which need to be compared and evaluated against those obtained from a conventional census. The panel questioned the advisability of a decision by the Census Bureau in 1996 to eliminate the long-form questionnaire for the 2000 census without sufficient testing and the Bureau's ability to implement new systems to put continuous measurement into operation by 1999. The panel recommended that the Census Bureau undertake a test for the 2000 census in which long-form data are collected nationwide and compared with a parallel collection of continuous measurement data for a representative sample of geographic areas. Members of the panel expressed concern about the potential loss of benchmark data at the beginning of a new millennium. They also expressed skepticism about congressional funding of continuous measurement past the first 3 years at the sampling rates currently proposed.

EPILOGUE

On February 28, 1996, the Census Bureau formally announced that it planned to once again use a long-form questionnaire in the 2000 census, but as a bridge to a new continuous measurement system in the next decade. The Bureau is conducting an operational test of continuous measurement in selected metropolitan and rural areas in 1996 in anticipation of initiating the continuous measurement survey, now called the American Community Survey, in 1999. The BTS study of continuous measurement is therefore an important first step in informing the transportation community of the new census data system to which it must adapt after the 2000 census.

The American Community Survey will be a large monthly household survey independent of the census. For the years 1999 to 2001, the survey will consist of the same questions that are asked on the Census 2000 long form and will go to 400,000 households per month. After 2001, the content can vary and the sample size will likely drop to 250,000 households per month.

The overlap between the decennial long-form data and data from the American Community Survey will allow transportation planners to compare the two data sets to determine the implications of continuous measurement for the uses of decennial census data in transportation planning.

WORKSHOP REPORTS

Uses of 1990 Census Data

Arthur B. Sosslau, *Workshop Chair*

This report of the findings of the first workshop, Use of 1990 Census Data, relies on notes by the recorders for the four working groups: Bob Griffiths, Metropolitan Washington Council of Governments; Ed Christopher, Chicago Area Transportation Study; Gene Bandy, Baltimore, Maryland; and Ron Tweedie, New York State Department of Transportation.

There was much commonality among the findings of the four groups. However, there were some differences and conflicting opinions; for example, some said that the Census Transportation Planning Package (CTPP) was critical to smaller MPOs, and others said that smaller MPOs are not using it for a variety of reasons, such as staff and resource availability.

The four issues discussed were as follows:

- What has been the experience in using the 1990 census data for transportation planning?
- What problems have limited your agency's use of census data?
- Which agencies have relied on the data, and to what extent?
- Which products are most useful and which were not useful?

Experience with Census Data

The variety of uses for census data was surprising and impressive. They are summarized here since many uses were discussed earlier in the conference.

Descriptive analysis, such as with travel times, and trend development are major uses, as well as model estimation and calibration, such as development of trip generation, trip distribution, and mode choice; K-factor development for work trips; and production and attraction checks.

In many areas, highway and transit corridor studies are made using CTPP trip tables directly. This use differs from modeling in that the data from the trip tables are used directly rather than in a modeling sense, to see what the activity is relative to the various modes and their origins and destinations.

The census data are used to weight and adjust household travel surveys and to develop sample designs; to estimate or in some cases to check local-area estimates of small-area employment; to analyze transit markets; and to develop land use forecasts.

Other uses mentioned included geocoding household travel surveys, truck surveys, and so on, with the enhanced Topologically Integrated Geographic Encoding and Referencing (TIGER) file that is available from the census activities.

It appears that the Transportation Model Improvement Project (TMIP) relies quite heavily on data from the census. The approach being taken for this activity may be greatly hampered if some of the information on the long form is not available.

Still other uses mentioned include ethnic analysis, ridership estimates for rail extensions, environmental justice studies, adverse impact analysis, and various kinds of litigation. The census provides a baseline for congestion management and commute trip reduction plans.

Several agencies use census data in expanding their cordons. The census provides the information in the added areas, including the number of workers arriving from outlying areas. In a similar vein, the census often provides the only information for new MPOs' planning activities, especially number of households, population, and automobile ownership.

Descriptive statistics and presentation of data to the media are important uses. The census is often the best source of information for responding to local requests for data. Often it is the only source of data available. The census provides data to the private sector, developers, and real estate agents for activities like marketing studies. It is also used by banks, corporations, and retail stores for marketing studies. Especially useful is daytime population, where employees are accumulated at their workplace.

It appears that many state departments of transportation do not use the census data directly but act as clearinghouses for dissemination of data to local agencies.

Data on commuting are used by the Office of Mangement and Budget to designate metropolitan statistical areas and in job-housing balance analysis to see the results of moving jobs closer to housing.

Problems Limiting Use of Census Data

In small MPOs the major problem appears to be limited availability of staff resources, which is also sometimes true, but to a lesser extent, in the larger MPOs.

The issue of timely release was mentioned by several participants. First, it seems that there would have been a preference to have the Urban Element released before the Statewide Element if doing so resulted in an earlier release of the urban data. Second, the availability of adequate computer programming support at the Census Bureau should have been given a higher priority. There were comments that the CTPP data should have been designed in a PC format from the beginning and maybe Internet accessibility provided, all indicating that the data are needed earlier.

Another major problem in many areas related to geographic coding. This problem was pointed out graphically by the Baltimore experience, which was discussed earlier in the conference. It was commented that the Census Bureau is not using the latest information available, MPO address files provided to the Census Bureau were not always used, and small-level geography knowledge is best at the local area level, and local agencies need to be involved more. This involvement would both reduce the amount of allocation done and produce a better, more accurate allocation. In any case, place-of-work coding was not very accurate below the county level. One of the potential solutions mentioned to address geocoding problems is use of 911 address coding.

Relative to the file formats, the structure of the data files and the documentation provided were problems. Documentation was difficult to use. Some believe the file sizes are too large, and compression of files is required, resulting in high front end costs to reformat the data and process it before use. The geographic subtotals are confusing and not very useful, causing errors in accessing the data in which the wrong level of geography is sometimes picked up. This

problem of file format is also related to importing the data into Geographic Information System (GIS) packages.

Another problem is that the census data are not collected frequently enough. Perhaps continuous sampling will be the solution.

A problem related to software availability and problems in the software were brought up. TransVU was not available when the CTPP came out, which hampered the use of the data in the beginning.

Some users expressed the need to have block-level data available to them. This possibility should be thoroughly investigated for the future.

Combination of modes was presented as a problem. Sometimes the wrong mode is picked as the major one by the respondent. There also appear to be differences in the local vernacular for different travel modes, often causing confusion in responses to the mode question.

Since most users do not match zone boundaries to tract boundaries, the use of census products on a zonal basis is a problem before CTPP availability. It is difficult to match TAZs with the other census geography.

Reliance on Data

Small areas are using the census data for basic information on population, car ownership, and employment and for some model development such as trip generation. It appears that the STF-3 is used mostly and not the CTPP, perhaps because it is difficult to use or because it was late and they do not have the staff. There appear to be a number of reasons, which should be addressed, since one would think that small areas would be prime users of such data.

The census provides data at low cost for large MPOs for purposes such as survey enhancements, providing universe totals, and trip tables for special studies such as corridor analysis.

Transportation consultants appear to like the consistency of census data from the CTPP and STF-3 from area to area because if they do a study in one location, they have a ready source of information elsewhere with which they are experienced. Sometimes these are the only data available to do some of their work. One consultant mentioned the difficulty in doing transportation planning in international markets, where such data as the census provides are not available.

The private sector uses population, socioeconomic, and demographic data from the census in media campaigns, market research, and so on. The data on commuting are used for the publication *Commuting in America*, published by the Eno Foundation.

The research and academic community finds the census data useful, especially the Public Use Microdata Sample (PUMS).

It appears that federal agencies use the data for policy studies and for National Highway System work. The data should be useful for national policy studies because they constitute one of the few data sources that is consistent across the country.

The public and its officials make numerous requests of MPOs for information from the census. The Puget Sound MPO mentioned about 150 accesses a day to information provided via the Internet.

The transit industry appears to be a user of various census products but is hampered by the lateness of the products, especially the CTPP, which is used for studies such as transit alternatives for corridors, ridership estimates for rail extensions, ethnic make-up estimates for various routes, and so on.

The major activity for state departments of transportation relative to the CTPP appears to be as a clearinghouse for the data and for some special studies. Looking at the four individual working group reports, there does not appear to be extensive use of the CTPP in statewide planning. Some major uses were cited in the four case studies summarized by James Covil, but use does not appear extensive across the rest of the states.

Usefulness of Census Products

The working groups concluded that the population, sociodemographic, income, and housing data from the census are essential to just about everyone involved in transportation planning.

The PUMS is a rich source of data that is especially useful for research purposes, but many still do not know about it or use it.

The STF-3 is the most used census product, perhaps because it comes out early.

It does not appear that the CTPP, including the trip flows, has been used extensively by small MPOs, probably because of resource availability. Some small MPOs have used it; more probably have not.

There were some comments about not needing all the detailed cross-tabulations in the CTPP; the comments were based on the finding that people are using STF-3 to a great extent. Perhaps these detailed cross-tabulations delay early release of the basic STF data items by TAZ in the CTPP.

There was some question about the importance of the statewide package. Again, there have been examples of major use, such as those reported by Covil. It appears most useful in states with a small number of large metropolitan areas. However, the statewide package has not received the use anticipated. Naturally, the importance and use of the statewide package vary by state.

The Urban Element of the CTPP, Parts 1, 2, and 3, was found to be useful to states, MPOs, and transit agencies.

Last, Part 3 of the CTPP Urban Element was most important to large MPOs, being the only census product where work flows are available and by zone.

Quality of Data, Needs, and Improvement of 2000 Census Products

Phillip A. Salopek, *Workshop Chair*

Each of four working groups of conference participants discussed the issues relating to the quality of decennial census data, what data are needed by the transportation planning community, and what improvements should be made to products from the 2000 census. The four recorders were Mary Lynn Tischer, Dave McElhaney, Russ Robertson, and Randy Wade. The workshop chair wishes to recognize and thank the recorders for their diligent and valuable efforts. Any omissions, errors, or misinterpretations of the material submitted by them are unintentional.

The list of issues distributed to each conference participant for discussion under this heading included the following:

1. What data are needed to address current and emerging transportation issues?
2. To what extent can the year 2000 decennial census support those needs?
3. What improvements or changes to census data are needed (geocoding, etc.)?
4. If data items and tabulations are reduced, can more timely delivery of (or access to) the information be achieved?
5. How should users be provided data?
6. What is necessary to ensure maximum use of data?

The recorders agreed to treat issues 1 and 2 as one, rather than deal with them separately. It was also noted that issue 4 was not discussed as an issue, but was really a question to be addressed to the Census Bureau.

Issues 1 and 2

The discussions in the four working groups on issues 1 and 2 are summarized in Table 1. The data items that are needed by transportation planners are given in the first column. The items are shown in groups based on item similarity. For example, the first two data items are from the census short (100 percent) form; they are followed by two other critical items, income and

TABLE 1 Summary of Discussion on Issues 1 and 2
(1. What data are needed to address current and emerging transportation issues
2. To what extent can the year 2000 decennial census support those needs?)

Data Needed[a]	Priority[b]	How Supported
Population	Critical	Current short-form item
Housing units	Critical	Current short-form item
Income	Critical	Current long-form item
Number of vehicles	Critical	Current long-form item
Other model inputs	High	Current long-form items
Means of transportation	High	Current long-form item
Vehicle occupancy	High	Current long-form item
Multiple modes (chks.)	High	Modify long-form item
Stops (chaining)	Medium	New item
Frequency (no. of days)	Medium	New item
Starting point	Low	New item
Place of work	High	Current long-form item
No fixed place	Medium	New item
Work at home freq.	Low	New item
Small office home office	Low	New item
No. of jobs	Medium	New item Labor force
Departure time	Medium	Current long-form item
Travel time	Medium	Current long-form item
Arrival time	Medium	Alternate long-form item
Distance to work	Low	New item
Mobility limitation	Medium	Modify long-form item
Driver's license	Low	New item
Nonwork trips	Medium	New item

[a] Includes only transportation-related data items.
[b] No consensus was reached in the group regarding the priority classification.

the number of vehicles available. Other groups of items consist of means of transportation and related items, place of work and related items, and departure time or travel time and related items.

The middle column of Table 1 contains priority evaluations. The priority categorization generated considerable discussion during the presentation of this report to the assembled groups, and should only be considered a minority view, since no consensus was reached regarding priorities.

The third column, "How Supported," attempts to indicate the nature of the change that would be required in order to get the particular item onto the census questionnaire. Items currently contained on the census short or long form are indicated as such. Topics requiring only minor changes to existing questions are listed as necessitating the Census Bureau to modify a current item.

Data items labeled "new item" in the third column would require more drastic changes. These topics would need to be thoroughly tested before being included in the census and would also require the deletion of currently included items. The number of questions on the census form is likely to be reduced, not increased. Thus, each new question added will require the deletion of an existing question.

Since the Census Bureau's National Content Survey is already in the field, there is little chance to test any of these items before the Census 2000. The trade-off with other topics, that is, which current questions to drop from the census, would also be quite problematical because it would destroy comparability with past data.

It should be noted that Table 1 addresses only the transportation-related items on the census (with the addition of income). Comments from the working groups during the presentation of this report highlighted the importance to transportation planners of other census items such as basic demographic indicators like age, sex , and race, as well as the count of workers

and the prime importance of the labor force variables like industry, occupation, and class of worker.

The meaning of most of the items listed in the "Data Needed" column is self-evident. A few, however, require some clarification. The item "Other model inputs" is meant to refer to variables that are used in standard models of trip production or trip attraction or other applications currently in place. The "Multiple modes" item would be one in which the respondent checked all modes usually used to get to work, not just the principal one. "Stops" refers to stops made on the way to work, a facet of trip chaining. "Frequency" means the number of days worked during the week, and "Starting point" would attempt to identify work trips that did not begin at the normal place of residence.

The "No fixed place" item would be a check box for those who worked at various locations each day, such as truck drivers, route salesmen, and contractors. The "Small office home office" item would try to get a more complete picture of this phenomenon, not only the instances in which it is the principal or main job.

In addition to the current data needs, the following emerging issues were identified in the working groups. It was believed that these items may represent data needs in the future:

- **Telecommuting** (who, how often). This item is related to data needs listed earlier on the frequency of working at home and the small office home office phenomenon.
- **Aging of America** (where do older people live, do they have to go outside their communities to shop, etc.). Little is currently known about the activities of older people and what their transportation needs are.
- **Data to meet Transportation Model Improvement Program (TMIP) requirements; data to address air-quality issues.**
- **Characteristics of the fleet mix** (age, type and amount of fuel used, accidents, seat belts, air bags).
- **Life-style, activity changes.** These need to be monitored more frequently than once a decade.
- **Social issues, environmental justice, and social equity issues.** These will need to be addressed in future and cannot be answered without census data.
- **Other aspects of the increasing variability of work schedules and work experiences.** These may need to be tapped by future census questions.
- **Freight and nonmotorized transportation issues.**

ISSUE 3

The following points were made; they are given in no particular order:

- The questionnaire and the wording of the items should be simplified.
- Space on the questionnaire could be conserved if the departure and arrival time questions were combined into one item.
- The public transportation categories that should be used on the questionnaire are bus, rail, and other public. The group as a whole did not support the idea formulated at the 1994 conference that only one category, public transportation, should be used on the Census 2000 questionnaire.
- Research should be conducted on the 1990 responses to determine if the indicator for inside or outside city limits is really needed and still useful.
- The U.S. Department of Transportation (DOT) should work more closely with the U.S. Department of Health and Human Services and other agencies on the long-form questions about disability.
- If critical changes to the Census 2000 questionnaire are identified, attempts should be made to find funding to test the items after the National Content Survey.
- Proper identification of public transportation modes could be improved if the Census Bureau produced an insert with each questionnaire that listed the names of the local transit

systems and showed the correct category that should be checked for each. An alternative for identifying detailed transit rail types correctly would be to use pictures or icons.

- Census data would be improved if more internal consistency checks were made, for example, to ensure that the mode shown is available in the city of residence and that the travel time is reasonable for the trip origin and destination.
- The completeness and accuracy of place-of-work geocoding need to be substantially improved.
- The Census Bureau should work more on improving block coding than on improving place-of-work allocation.
- Cooperation between the Census Bureau and MPOs needs to be increased with regard to geocoding and improving the Topologically Integrated Geographic Encoding and Referencing (TIGER) file. Consideration should be given to funding for a person to go to the Bureau and work with MPOs on the TIGER Improvement Program and other geocoding issues.
- It seems that in the past, communication and cooperation between the Census Bureau and the MPOs has been piecemeal, on-and-off, and not well integrated into an overall plan. A schedule and timeline of activities needing to be completed during the precensus period should be constructed by the Census Bureau and given to the MPOs so they can put activities in their work plans, allocate staff resources, or take other actions to perform the activities they choose to participate in.
- An integrated, cooperative program between the Census Bureau and DOT designed to cover the whole gamut of operations from TIGER file update through place-of-work coding, geocoding problem resolution, and data product production and delivery is needed. A major benefit of such a program would be that each of the parties would know what was expected of them, and when, and also what they would be getting out of the program. In particular, the MPOs are currently being asked to do a lot of work without an up-front guarantee of what they are going to get out of their investment.
- The Census Bureau needs to be able to accept updated TIGER files from local geographic information systems (GISs) more readily. The current paper-and-pencil update process is clumsy, labor-intensive, and redundant for areas that have a GIS. The Census Bureau needs to review technology and be able to accept updates in electronic formats. Why not use the Spatial Data Transfer Standard? These issues will be even more critical with continuous measurement.
- MPOs should consider contracting with private-sector data providers to do the TIGER updating work, instead of tying up limited staff resources.
- Since it is difficult to work with such a large number of MPOs, the Census Bureau should look at working with private companies to help code the place-of-work responses. One contractor could try using several private files and work with the MPOs as well.
- The Census Bureau should ensure that it can provide MPOs with copies of the census employer list and the uncoded place-of-work responses.
- MPOs need to see preliminary results of coding before allocation so they can review before the data are finalized. They also need to review data after allocation, before they are finalized.
- Allocation of place of work needs review and improvement. Perhaps there should be an expert panel to work on ways to allocate to newly developed areas. Default traffic analysis zones (TAZs) are a problem for MPO users.
- A better indication in data products of the percent coded versus the percent allocated by TAZ is needed.
- Seven digits are needed for the TAZ code, not six.
- Better access to the base census data is needed.
- The Census Bureau needs to provide data in a more timely manner. The Data Access and Dissemination System (DADS) is not seen as guaranteeing earlier release of data. It could conceivably mean fewer data items available and fewer tabulations.
- If DADS results in a queue of users waiting to receive their data, how do those who use transportation data get priority? MPOs, states, and DOT should continue to look for other

ways to get the data they need in a timely manner, for example, hiring programmers to be lent to the Census Bureau to perform queries.

- There is a need to redefine the tables for the next Census Transportation Planning Package (CTPP). The experience of MPOs like SE Michigan should be used to enrich the next CTPP tables. Some tables should be eliminated; it may be better to have fewer tables and then charge for additional special tabulations. Fewer tables might mean quicker delivery of basic data; then DADS or some other tabulation system could be used for additional data.
- There is a need to field-test any software that is provided (like TransVU/CTPP) more carefully before it is distributed for use.

Issue 5

Some of the discussion points made are as follows:

- Some MPOs would prefer data in a more raw form. Some would like it in the same form as in 1990. A delimited format would help, or perhaps a data-base format. Access via Internet may also be a possibility. An ability to cross-tabulate any variables would be very valuable.
- For trend analysis, it will be important to issue 1990 census data on the same type of media as the 2000 data. It is a problem when historical census data are contained on media that are no longer accessible or readable. There are problems with old formats and with retaining the documentation and expertise necessary to use the old files.
- Most MPOs need access to data for MPOs in other states for comparison purposes.
- It would be useful to have a report that highlights the MPOs and small geographic areas in which big changes have occurred since the last census.
- A contextual Public Use Microdata Sample (PUMS) program would be an important addition to the products available from the census, for example, a PUMS file to which the transportation network level of service or other locally derived system attributes had been added.
- If data are provided through on-line access, care must be taken to avoid misuse or misinterpretation by nonprofessionals or others who do not understand the data.
- On-line access may be pay as you use; the Census Bureau is currently moving to a user-fee approach. Will states and MPOs be able to afford the fees? Should AASHTO or DOT develop an arrangement with the Census Bureau to make sure states and MPOs continue to get data free?

Issue 6

Discussion covered the following main points:

- Data products should be user friendly.
- Continuing, improved training is needed.
- First-time MPO users of census data for transportation planning need the most elementary, basic course or orientation program. Also helpful would be courses for major classes of users such as MPO staff, state policy staff, and system planning staff in which real-life examples are provided, perhaps including a slick, published report of 25 pages or so for ready reference.
- Another training option would be an interactive CD-ROM with a self-directed training program, possibly a tutorial allowing the student to assemble a data set for his or her own region or state.
- State department of transportation leadership in all aspects of data dissemination and training is essential.
- Documentation for users should be better, more complete, and more understandable.
- There should be better access for small MPOs, perhaps a technical person in each MPO.

- State Data Centers should provide assistance.
- The Internet should be a standard means of data dissemination.
- The Census Bureau should work with the National Association of Regional Councils (NARC) and the American Association of Metropolitan Planning Organizations (AAMPO).
- There should be maximum exposure of 1990 data. For example, the case studies written for this conference contain descriptions of many uses of census data and the CTPP. Their distribution should be maximized by putting them on Internet, perhaps at the Bureau of Transportation Statistics (BTS) site.
- DOT should establish a clearinghouse of information about data and reference other sites (the TRB Committee A1D08 home page is an excellent example).
- Newsletters should present examples of use, one example at a time. Bulletin boards could be used to bring many examples together in one place.
- Links from Census Bureau home page to the BTS site should be created where papers describing uses of census data are located.
- Formal relationships should be created with universities to provide census data and information as part of their curricula.

Appendix: Facsimiles of the Journey-to-Work Questions

U.S. BUREAU OF THE CENSUS

1996 NATIONAL CONTENT SURVEY

JOURNEY-TO-WORK QUESTIONS

Form DS-2A (1990 Control)

21. **At what location did this person work LAST WEEK?** If this person worked at more than one location, print where he or she worked most last week.

a. Address (Number and street)

(If the exact address is not known, give a description of the location such as the building name or the nearest street or intersection.)

b. Name of city, town, or post office

c. Is the work location inside the limits of that city or town?

☐ **Yes**
☐ **No, outside the city/town limits**

d. County

e. State **f. ZIP code**

22a. How did this person usually get to work LAST WEEK? If this person usually, used more than one method of transportation during the trip, mark ☒ the box of the one used for most of the distance.

- ☐ Car, truck, or van
- ☐ Bus or trolley bus
- ☐ Streetcar or trolley car
- ☐ Subway or elevated
- ☐ Railroad
- ☐ Ferryboat
- ☐ Taxicab
- ☐ Motorcycle
- ☐ Bicycle
- ☐ Walked
- ☐ Work at home -- Skip to 27–29
- ☐ Other method

If "Car, truck, or van" is marked in 22a, go to 22b.
Otherwise, skip to 23a.

b. How many people, including this person, usually rode to work in the car, truck, or van LAST WEEK?

- ☐ Drove alone
- ☐ 2 people
- ☐ 3 people
- ☐ 4 people
- ☐ 5 people
- ☐ 6 people
- ☐ 7 to 9 people
- ☐ 10 or more people

23a. What time did this person usually leave home to go to work LAST WEEK?

☐☐ : ☐☐ ☐ a.m.
☐ p.m.

b. How many minutes did it take this person to get from home to work LAST WEEK?

☐☐☐ Minutes -- Skip to 27–29

U.S. BUREAU OF THE CENSUS

1996 NATIONAL CONTENT SURVEY

JOURNEY-TO-WORK QUESTIONS

Form DS-2D

20. On a typical day LAST WEEK, at what location did this person work? If this person worked at more than one location, print where he or she worked most that day.

a. Address (Number and street)

(If the exact address is not known, give a description of the location such as the building name or the nearest street or intersection.)

b. Name of city, town, or post office

c. Is the work location inside the limits of that city or town?

☐ Yes
☐ No, outside the city/town limits

d. Name of county

e. Name of U.S. State or foreign country **f. ZIP code**

21a. On a typical day LAST WEEK, how did this person get to work?
If this person used more than one method of transportation during the trip, mark ☒ the box of the one used for most of the distance.

- ☐ Car, truck, or van
- ☐ Public transportation → **Skip to 22a**
- ☐ Taxicab
- ☐ Motorcycle
- ☐ Bicycle
- ☐ Walked
- ☐ Worked at home
- ☐ Other method

b. At any time LAST WEEK, did this person use public transportation to get to work?

- ☐ Yes
- ☐ No

If "car, truck, or van" is marked in 21a, go to 21c.
If "worked at home" is marked in 21a, skip to 25–27.
Otherwise, skip to 22a.

c. On a typical day LAST WEEK, how many people, including this person, rode to work in the car, truck, or van?

- ☐ Drove alone
- ☐ 2 people
- ☐ 3 people
- ☐ 4 people
- ☐ 5 or 6 people
- ☐ 7 or more people

22a. On a typical day LAST WEEK, at what time did this person leave home to go to work?

☐☐ : ☐☐ ☐ a.m. ☐ p.m.

b. On a typical day LAST WEEK, how many minutes did it take this person to get from home to work?

☐☐☐ Minutes → **Skip to 25–27**

U.S. BUREAU OF THE CENSUS

1996 NATIONAL CONTENT SURVEY

JOURNEY-TO-WORK QUESTIONS

Form DS-2E

11. **At what location did this person work LAST WEEK?** If this person worked at more than one location, print where he or she worked most last week.

a. Address (Number and street)

(If the exact address is not known, give a description of the location such as the building name, shopping center, or other physical location description.)

b. Name of city, town, or post office

c. Is the work location inside the limits of that city or town?

☐ Yes
☐ No, outside the city/town limits

d. County

e. State **f. ZIP code**

12a. How did this person usually get to work LAST WEEK?
If this person usually used more than one method of transportation during the trip, mark ☒ the box of the one used for most of the distance.

- ☐ Car, truck, or van
- ☐ Public transportation (bus, trolley, streetcar, subway, train, or ferryboat) → **Skip to 12d**
- ☐ Taxicab
- ☐ Motorcycle
- ☐ Bicycle
- ☐ Walked
- ☐ Other method

→ **Skip to 13a**

- ☐ Worked at home → **Skip to 16–18**

b. How many people, including this person, usually rode to work in the car, truck, or van LAST WEEK?

- ☐ Drove alone → **Skip to 13a**
- ☐ 2 people
- ☐ 3 people
- ☐ 4 people
- ☐ 5 or 6 people
- ☐ 7 or more people

c. LAST WEEK, did this person usually drive to meet his/her carpool?

- ☐ Yes
- ☐ No

→ **Skip to 13a**

d. LAST WEEK, how did this person usually get from home to the public transportation stop or station?

- ☐ Car, truck, or van - Parked at public transportation stop or station
- ☐ Car, truck, or van - Dropped off at public transportation stop or station
- ☐ Walked or bicycled
- ☐ Other public transportation
- ☐ Other method

1996 NCS Form DS-2E

13a. What time did this person usually LEAVE home to go to work LAST WEEK?

☐☐ : ☐☐ ☐ a.m. ☐ p.m.

b. What time did this person usually ARRIVE at work from home LAST WEEK?

☐☐ : ☐☐ ☐ a.m. ☐ p.m. → **Skip to 16–18**

1996 NCS Form DS-2E

U.S. BUREAU OF THE CENSUS

1996 NATIONAL CONTENT SURVEY

JOURNEY-TO-WORK QUESTIONS

Form DS-2F

17. At what location did this person work LAST WEEK?
If this person worked at more than one location, print where he or she worked most last week.

a. Address (Number and street)

(If the exact address is not known, give a description of the location such as the building name or the nearest street or intersection.)

b. Name of city, town, or post office

c. Name of county

d. State **e. ZIP code**

f. Is the work location reported in 17b inside the limits of that city or town?

☐ **Yes**
☐ **No, outside the city/town limits**

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