Variations In Predicted Employment-related Tripmaking Caused By Alternate Systems Of Job Classification

Edward Limoges, Southeast Michigan Council of Governments

Abstract

The purposes of this paper are to examine alternate classification systems of jobs, and to investigate how predicted volumes of employment-related trips vary according to the system used to classify jobs by type.

SEMCOG has obtained a special crosstabulation of 1990 census data on workers by traffic analysis zone of work. We have developed a method that uses industrial class and occupational class in conjunction to assign land use classes to the workers. This allows the linking of the workplace's land use class to the commuting trip characteristics (time of departure, trip duration, means of transportation) that are contained in the census crosstabulation.

In addition, in 1994 SEMCOG conducted a household travel survey, that covered 7,400 households in Southeast Michigan. This survey included questions on the industrial class, and the land use class, of each employed person's primary job. These items are linkable to the characteristics of the home-to-work trip, including time of departure and arrival, means of transportation, and trip end locations, collected by the survey.

The paper will contrast two systems of classifying kind of work or kind of job activity. One of these systems is industrial class, which relates to the overall purpose of the business, agency, or governmental department. Examples of general industrial classes are manufacturing, retail trade, services, and public administration. The other system is land use class, by which is meant the nature and characteristics of the activities, and usually also the buildings and associated open lands that the activities occupy, occurring at specific individual locations. Examples of general nonresidential land use classes include office, commercial, institutional, and industrial. To illustrate, an industrial class system would put the label retail trade on all the establishments and workers of the Kmart Corporation, whereas with a land use class system the headquarters would be called office, the stores commercial, and the warehouses industrial.

SEMCOG's transportation modeling has used industrial class employment data because that was the best available. Now that we have a new wealth of tripmaking data by land use class employment, we want to apply this information to our transportation models. We believe that grouping jobs by land use class may significantly improve the models' performance for several reasons. Should the findings of these comparisons support our underlying assumption that employment by land use class, rather than by industrial class, is a better predictor of employment-related tripmaking, SEMCOG will investigate the feasibility of creating new trip generation equations in our transportation model.

The purposes of this paper are to describe how the locational patterns of jobs, and the arrival time of home-to-work trips, vary according to the system used to classify jobs. SEMCOG has obtained a special crosstabulation of 1990 census data on workers by traffic analysis zone of work. We have developed a method that uses industrial class and occupational class in conjunction to assign land use classes to the workers. This allows the linking of the workplace's land use class to the worker's commuting trip characteristics (time of departure, trip duration, means of transportation) that are contained in the census crosstabulation.[1] The analysis is based upon data for workers

whose jobs were in Oakland County, a portion of the Southeast Michigan region and located immediately north and west of Detroit City. In 1990 Oakland County contained nearly three-tenths of the seven-county region's 2.4 million total jobs.

The paper contrasts two systems of classifying kind of work or kind of job activity. One of these systems is industrial class, which relates to the overall purpose of the business, agency, or governmental department. Examples of general industrial classes are manufacturing, retail trade and services. The other system is land use class, by which is meant the nature and characteristics of the activities, and usually the buildings and associated open lands that the activities occupy. The paper uses five general nonresidential land use classes: office, commercial, institutional, industrial, and transportation, communications, and utilities, or TCU. To illustrate, an industrial class system would put the label retail trade on all the establishments and workers of the Kmart Corporation, whereas with a land use class system the headquarters would be called office, the stores commercial, and the warehouses industrial.

Degree Of Spatial Segregation

This section is concerned with the locational pattern of employment. Specifically, it examines the hypothesis that total jobs, when classified by land use class, will exhibit significantly higher degrees of spatial differentiation and separation then would the same total when divided by industrial class.

The first two figures address the locational pattern of employment. Each figure portrays the spatial distribution of a given land use class, and compares it to the distribution of each of the other four land use classes. Figure 1 is based upon office land use employment, and Figure 2 on industrial land use employment.

The x-axis of the two graphs gives a count of TAZs, arranged in an order that corresponds to the occurrence of workers in the base land use class, i.e., office, or industrial. The leftmost TAZ has the greatest number of workers in that land use, with the other TAZs arrayed in descending order.

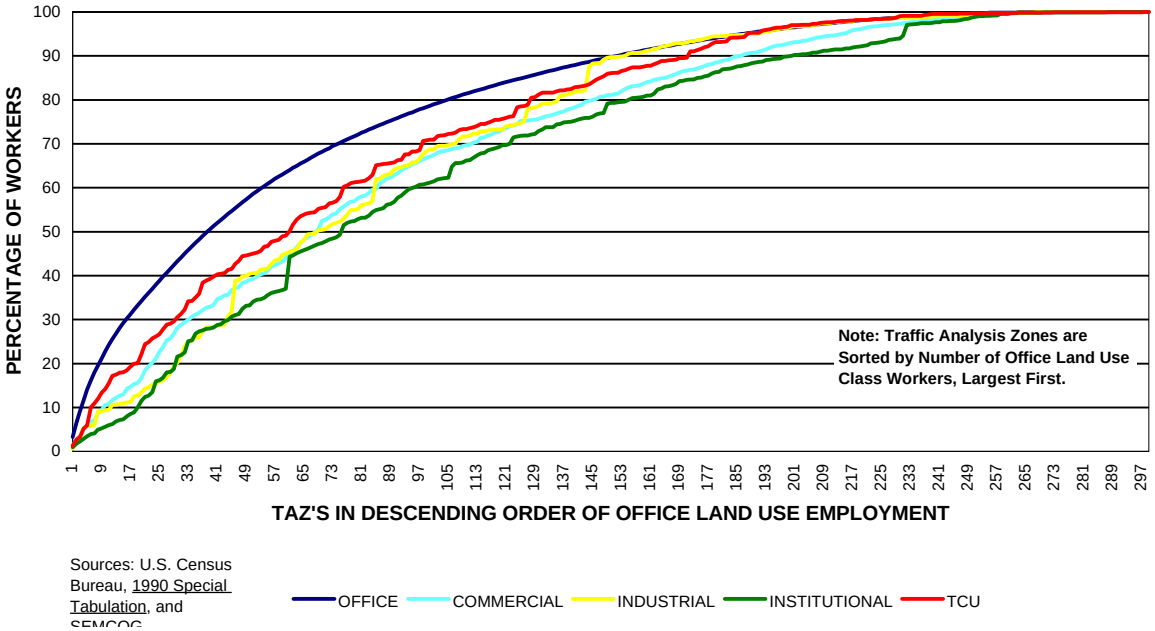
Each graph shows five curves, one for each of the five land use classes. The curves are cumulative, rising with the occurrence of workers of the given land use. In Figure 1 it is the office curve that ascends most rapidly and most smoothly, because the TAZs are arrayed by the percentage share of Oakland County office jobs that each successive zone contains. The same applies to the curve of industrial land use of Figure 2.

The slope of the base land use curve reflects the degree of concentration of that class of employment. For example, in Figure 1 the first 38 zones account for 50 percent of total county office employment, and the first 100 for nearly 80 percent. But industrial land use employment is even more concentrated. As shown in Figure 2, the 50 percent mark is reached by the 23rd zone and 80 percent is reached by the 70th zone.

The vertical distance between the base land use curve and any of the four other curves is an indication of the degree of spatial segregation between the base land use class and that other land use. For example, in Figure 1, for almost 90 percent of accumulated office employment, TCU is the curve closest to the office curve. (Keep in mind that post offices, an activity that is fairly compatible with office land use, make up roughly 20 percent of Oakland County's TCU employment). The distance between the two curves averages roughly 10 percentage points. The institutional

Figure 1

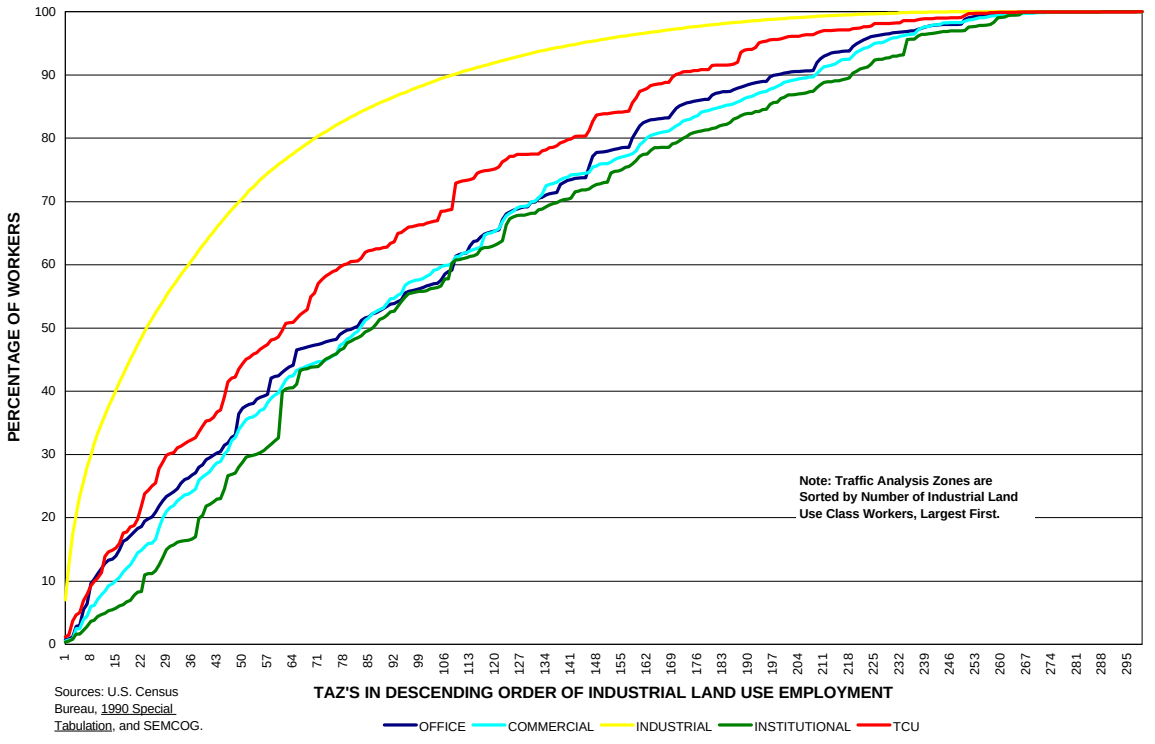
CUMULATIVE DISTRIBUTION OF WORKERS BY TRAFFIC ANALYSIS ZONE OF WORK, OFFICE LAND USE CLASS COMPARED TO FOUR OTHER LAND USE CLASSES, OAKLAND COUNTY, MICHIGAN:1990



Sources: U.S. Census Bureau, 1990 Special Tabulation, and SEMCOG

Figure 2

CUMULATIVE DISTRIBUTION OF WORKERS BY TRAFFIC ANALYSIS ZONE OF WORK, INDUSTRIAL LAND USE CLASS COMPARED TO FOUR OTHER LAND USE CLASSES, OAKLAND COUNTY, MICHIGAN:1990



Sources: U.S. Census Bureau, 1990 Special Tabulation, and SEMCOG.

land use curve is the farthest from the office curve, the degree of separation averaging about 20 percentage points.

Figure 2 compares industrial land use employment to that of the other land uses. Note that as with the office employment curve of Figure 1, the TCU curve is closest to the industrial curve. (This probably represents the presence of "industrial-like" components, e.g. truck and rail terminals, within the TCU land use class). At its greatest, the separation between the two curves is around 25 percentage points. The remaining three curves, office, commercial, and institutional, have roughly the same degree of separation from industrial land use, about 35 percentage points at the maximum.

Time Of Arrival At Work

This section is concerned with the home-to-work trip. Specifically, it uses time of arrival at the workplace. Time of arrival can be seen as a measure of two phenomena: travel behavior of the workers, i.e., the time they choose to or must arrive at work, and work behavior of the business establishments, i.e., the Circadian rhythm of their operations.

The next three figures examine time of arrival at the workplace. The graphs show hours of the day along the x-axis, in one-hour intervals 6:00 a.m. to 7:00 p.m., and by multiple-hour intervals for the remaining eleven hours. The y-axis of each graph represents the percentage of total arrivals of the given class of employment. The curves are cumulative, rising with the percentage of workers of the given land use class arriving within the given internal. The curves use 6:00 a.m. as the starting line or zero point. Therefore, for example, workers arriving at 5:40 a.m. will be recorded in the rightmost interval of the graph.

Figure 3 portrays the time of arrival of workers of each of the five land use classes, as well as of all workers (shown as a heavy line). There are considerable differences among the six lines.

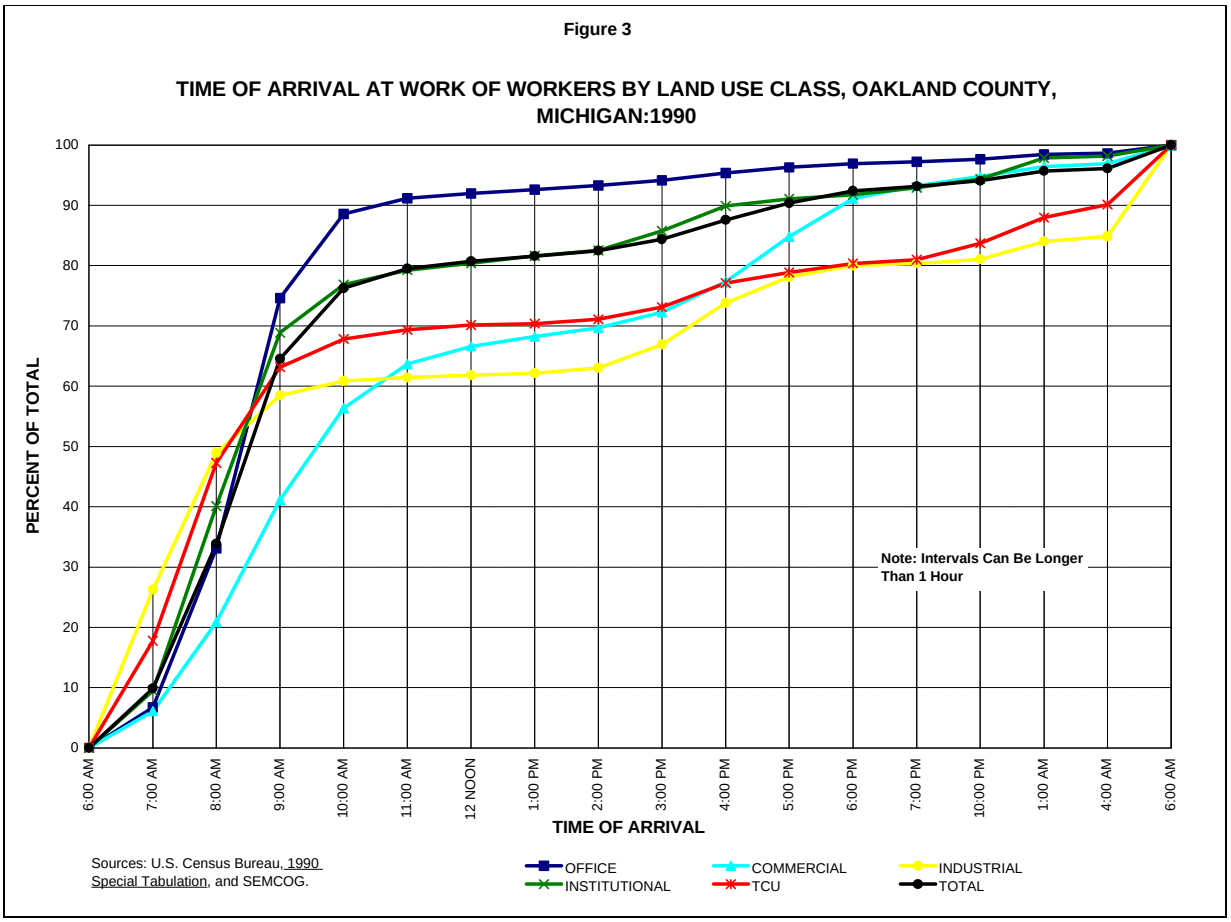
The total workers line shows that 50 percent of all workers arrive at work between 6:00 a.m. and just past 8:30 a.m., and 80 percent arrive by 11:00 a.m. Workers in institutional land use follow the same pattern almost exactly, except that there is a group that arrives somewhat earlier. No doubt this reflects the operational rhythm of hospitals, and elementary and secondary schools.

Industrial land use workers have the earliest pattern of starting work; more than one- fourth arrive between 6:00 a.m. and 7:00 a.m., and almost half by 8:00 a.m. A subsequent six hours of general plateauing is followed by a 15 percentage point rise between 2:00 p.m. and 5:00 p.m., as the second shift begins. Evidence of a third shift begins to appear after 7:00 p.m.

TCU land use employment shows a three-shift pattern similar to that of industrial land use, except that the TCU curve is five to ten percentage points higher from 9:00 a.m. to 3:00 p.m. This difference probably reflects the necessity for many TCU activities to be immediately responsive to demand, whether the demand be for the movement of persons, or information, or energy. The rhythm of industrial land use work is not as time sensitive, and so can be accommodated by a relatively larger second shift.

Of all the curves, the commercial is the slowest to rise during the first two hours. It is the last to reach the 50 percent mark, not reaching it until just past 9:30 a.m. This reflects the fact that many retail trade establishments do not open for business until 9:00 a.m. or later. The curve rises slowly until around 3:00 p.m., when it goes into a rapid rise, that continues until 6:00 p.m. This three-

Figure 3



hour spurt probably represents a response to shoppers who are getting out of work or school, as well as the evening peak period for eating, drinking, and entertainment establishments.

The office curve begins with a slow start. At 7:00 a.m. it is at only seven percent. It then rises very rapidly, reaching 50 percent around 8:30 a.m., and 80 percent around 9:30 a.m. From about 8:30 a.m. on, it is the highest curve on the graph. It reaches 90 percent at 10:30 a.m., and rises slowly and steadily after that.

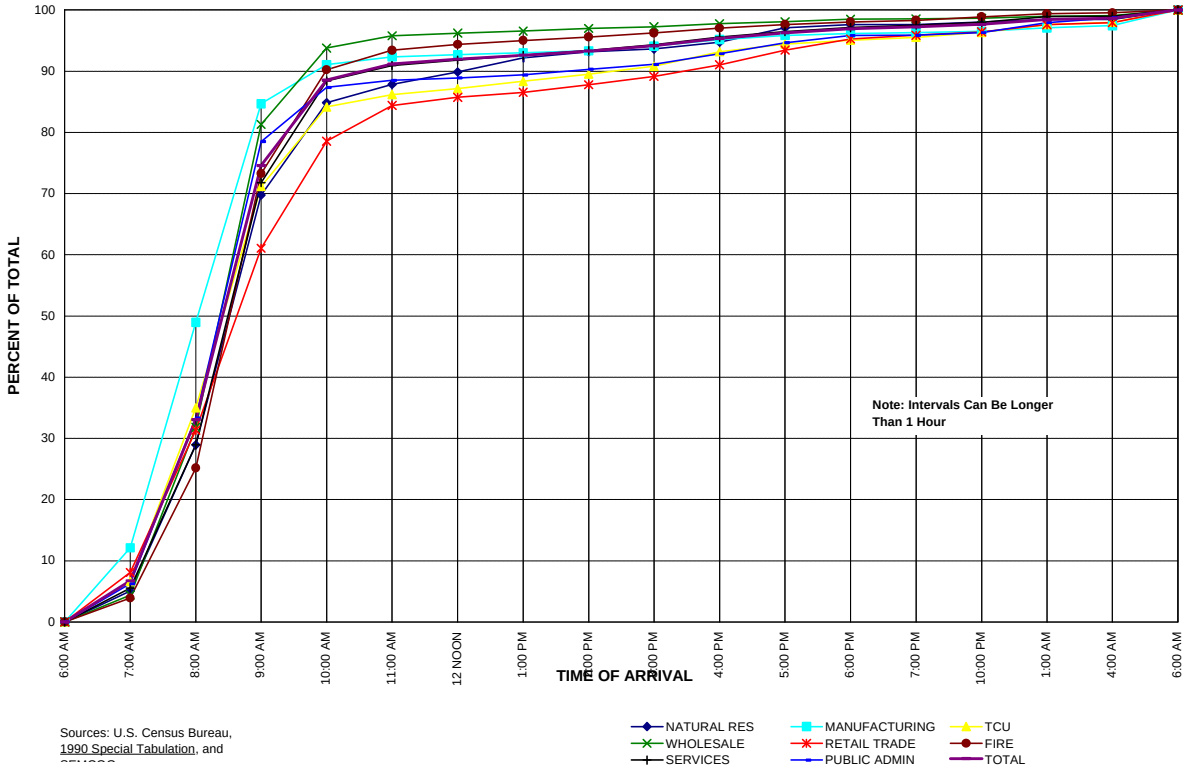
These curves of the five basic nonresidential land use classes, as well as the curve of total employment, illustrate the time patterns of establishments' operations. The changing shape of each curve is easily explainable, because the changes correspond to our direct experience of the rhythms of urban area economic activities.

The next graph, Figure 4, illustrates time of arrival for workers in office land use. The heavy line represents total office employment. Note that it corresponds to the office land use curve on Figure 3. The eight other lines represent office land use employment in each of eight industrial classes.

The single most striking feature of the set of curves is how close they are to each other. The differences among them are not great, and are explainable. The manufacturing curve rises rapidly early in the morning because the manufacturing factories and warehouses — the industrial facilities being managed by the manufacturing offices — begin work early. The wholesale trade curve is

Figure 4

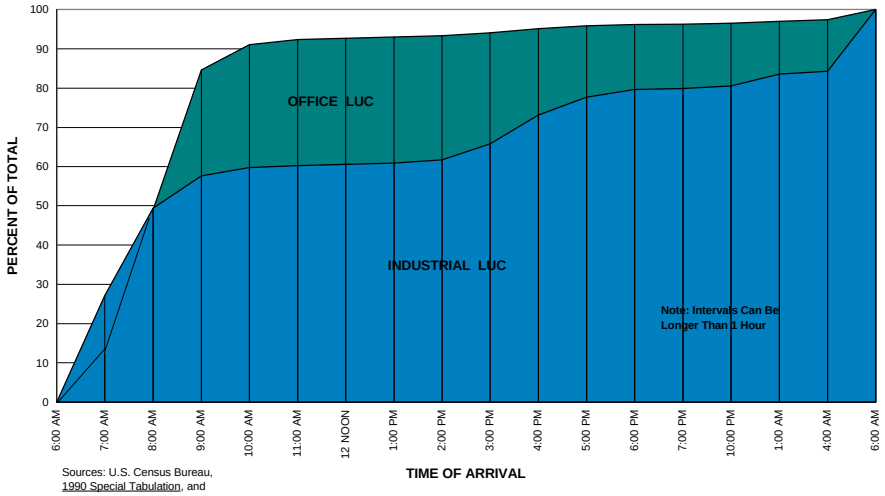
TIME OF ARRIVAL AT WORK OF WORKERS IN OFFICE LAND USE CLASS, TOTAL COMPARED TO EIGHT INDUSTRIAL CLASSES, OAKLAND COUNTY, MICHIGAN:1990



Sources: U.S. Census Bureau, 1990 Special Tabulation, and

Figure 5

TIME OF ARRIVAL AT WORK OF WORKERS IN MANUFACTURING INDUSTRIAL CLASS, OFFICE LAND USE CLASS COMPARED TO INDUSTRIAL LAND USE CLASS, OAKLAND COUNTY, MICHIGAN:1990



Sources: U.S. Census Bureau, 1990 Special Tabulation, and

high because office establishments in this industrial class are managing the deliveries that in many cases need to be arranged and completed during the daytime delivery hours that office and commercial establishments require. One the other hand, the retail trade curve is the lowest one across much of the graph because most stores and restaurants do much of their business during the afternoon and evening hours, so that's when management needs to be available.

Figure 4 indicates that overall, workers in office land use behave very similarly in terms of time of arrival at work. Office land use is the primary fact; industrial class is a secondary detail. Figure 4 provides evidence, in a time dimension, of the distinctiveness of each land use class. This evidence complements the spatial distinctiveness discussed earlier.

The final graph, Figure 5, contrasts employment in two land use classes, office and industrial, within a single industrial class, manufacturing. Both land use classes reach the 50 percent mark at 8:00 a.m., but after that there is a very striking divergence. The office curve continues its rapid rise, reaching 90 percent just before 10:00 a.m. After this the curve rises very slowly, probably reflecting building cleaning and maintenance workers, security guards, and evening data processing personnel. The industrial land use class is very different. After a six-hour long plateau, the curve rises again, reflecting the second shift, with some evidence of a beginning third shift at 10:00 p.m.

Conclusions

This paper has presented evidence that employment, when subdivided by land use class, shows greater degrees of differentiation than when it is subdivided by industrial class. The greater differentiation occurs both in the spatial dimension of job location, and in the time dimensions of worker tripmaking and business establishment operations. These findings will be further explored and developed, as they appear to have strong relevance for the modeling of both employment location and travel demand.

Reference

1. Limoges, E. Improvement of Decennial Census Small-Area Employment Data: Method to Assign Land Use Classes to Workers. In Conference Proceedings 13, Decennial Census Data for Transportation Planning: Case Studies and Strategies for 2000 Volume 2: Case Studies, Transportation Research Board, National Research Council, Washington, D.C., 1997, pp. 47-57.

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