

# Improvement of Decennial Census Small-Area Employment Data: Method To Assign Land Use Classes to Workers

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The 1990 census collected data on a wide variety of demographic characteristics, including employment. The census recognized three dimensions of kind of work or job activity: industrial class, the overall purpose of the employing organization; occupational class, the kind of work done in the individual job; and class of worker, the relationship between the organization's ownership and the employed person. However, there is a fourth dimension of job activity, land use, which is not recognized by the decennial census. Non-residential land use classes describe the nature of economic activities and facilities occurring as individual establishments. Major land use classes include office, commercial, institutional, industrial, as well as others. SEMCOG has obtained a special cross-tabulation of 1990 census data on workers by zone of work. A method has been developed at SEMCOG that uses industrial class and occupational class in conjunction to assign land use class to workers. This method allows the linking of census demographic characteristics to the land use class of the workplace, and thereby to noncensus data on land use characteristics; to the spatial distribution of nonresidential land uses that these data describe; and to the locational determinants that underlie these patterns. SEMCOG has used the method to assign land use classes to 1990 census employment data. Testing and improvement of the method are continuing. The indispensability of decennial census data on employment for analytical and planning purposes is emphasized, and a proposal is made to incorporate the land use assignment method into the procedures for Census 2000.

The purpose of this paper is to present a method for adding land use classes to decennial census employment data. There are four major objectives: to discuss the ways in which the job activity or kind of work aspect of employment is classified, especially in the decennial census; to describe the special tabulation of 1990 census worker data that the Southeast Michigan Council of Governments (SEMCOG) has obtained from the Census Bureau and to contrast it with the Census Transportation Planning Package (CTPP); to present a procedure that uses the special tabulation to add a land use "tag" to decennial census employment data; and to discuss the current status of this work.

In this paper, the term "land use" is used in a restricted sense. It does not include all the "land use" inputs—employment, households, population, developed and vacant land, etc.—that transportation models require nor is it the inclusive, umbrella concept implied in the phrase "land use and transportation." Rather, land use in this discussion means the nature and characteristics of the activities occurring at specific individual locations and usually also the buildings and associated open land that the activities occupy. Land use is site specific. Land use class describes the general activity performed by a particular establishment. Commonly recognized types or classes of land use include residential, office, commercial, institutional, and industrial, as well as others.

The following sections of the paper discuss the classification of job activity by the decennial census, the de-

velopment of a method for adding a land use class to existing census data on employment, the current status of this work, the indispensability of decennial census data on employment, and last, a proposal to incorporate the land use assignment method into the procedures for Census 2000.

## DECENNIAL CENSUS DATA AND CLASSIFICATION OF JOB ACTIVITY

### Decennial Census Data on Employment

The 1990 census collected data on a wide variety of employment characteristics, including

- Labor force status (employed, unemployed, or not in labor force; year last worked);
- Complete address of workplace;
- Travel to work (means of transportation, departure time, trip duration);
- Number of hours worked (last week and during 1989); and
- Job activity (industrial class, occupational class, class of worker).

For persons who held more than one job, data were collected only for the principal job, defined as the job at which the person worked the most hours. Workplace location and hours worked last week were determined only for employed persons who were actually at work some time during the week preceding April 1, Census Day (1).

### Dimensions of Job Activity in Decennial Census

The decennial census recognizes three dimensions of job activity. These are industrial class, occupational class, and class of worker.

Industrial class refers to the overall, predominant purpose of the business, agency, or governmental department for which the person works. This purpose corresponds to the major product or service of the organization. The 1990 census used 236 separate industrial categories grouped into 13 major groups to code industrial class. Examples of the categories (with the corresponding major group in parentheses) are petroleum refining (manufacturing), hardware stores (retail trade), hotels and motels (personal services), and hospitals (professional and related services).

Occupational class describes the kind of work done in the individual job. The 1990 census used 501 separate occupational categories grouped into 6 summary and 13 major groups to code occupational class. Examples of the categories (with the corresponding major groups in

parentheses) are architects (professional specialty), computer programmers (technical, sales, and administrative support), aircraft engine mechanics (precision production, craft, and repair), and hoist and winch operators (operators, fabricators, and laborers).

Class of worker describes the relationship between the ownership of the organization and the employed person. The 1990 census used eight such classes: wage and salary (subdivided into private for profit and private not-for-profit); government (local, state, federal); self-employed (not incorporated, incorporated,); and unpaid family worker (2).

### Land Use Class as Fourth, "Missing" Dimension

Industrial class and class of worker relate the employed person to the dominant nature—purpose and ownership, respectively—of the employing organization. Occupational class relates the employed person to the nature of the work performed in his or her own job. But there is a fourth dimension to job activity, a dimension that is not included in the decennial censuses: land use. Land use as a concept relates to what is happening site by site in establishments on the land. It relates the employed person to the nature of the individual establishment, the workplace, in which he or she works. These establishments—the stores, shops, restaurants, theaters, lodging places that form commercial areas, factories and warehouses that form industrial areas, schools, churches, and hospitals that form institutional areas, etc.—are the building blocks of nonresidential land use patterns.

In a paper presented at the 73rd Annual Meeting of the Transportation Research Board, Putman, the developer of the DRAM and EMPAL demographic forecasting models, discussed the use of employment types. He noted that many of the agencies forecasting with DRAM and EMPAL use up to eight employment types based on slight aggregations of the one-digit Standard Industrial Classification (SIC) industrial classes. However,

the problem with this is the S.I.C. categorization of employment, which often does not match what might be termed a land use based categorization. For example, the office staff of a manufacturing firm will often be located in a central city area, but it will be classified, by S.I.C., as heavy manufacturing. The actual manufacturing facility for that same firm might be located in a suburban area. When the calibration is done for manufacturing, the model will encounter two zones containing manufacturing employment, but with apparently very different location determinants. While this would argue for the use of employment categorizations based on land use classifications, there is a further complication. An im-

portant component of the linkage between EMPAL and DRAM is the employment-to-household (EMP/HH) conversion process. In this, the employees, by type and by place of work, are converted to implicit heads of households by type, still at place of work. Adjustments for unemployment and workers per household are subsumed into this conversion. The data for the conversion are based on U.S. Census data, now generally obtained from the PUMS (Public Use Microdata Sample) data involving a cross tabulation of S.I.C. of employment and household income. The preparation of the EMP/HH conversion matrix for land use based employment categories would be extremely difficult if not impossible. Finally, the data for employment by place of work are amongst the most difficult data for regional agencies to obtain, and they often have no choice as to the categorization in which they get it. (3, p. 5)

In short, there is a double problem. First, decennial census employment data do not include a land use classification. Second, even if employment by land use class were obtainable from a source other than the census, it would not be linkable with decennial census data on employee characteristics. Land use class is a "missing dimension" in decennial census data. Its absence severely limits the possibility of interrelating physical data on land use, such as building type, floor space, and acreage, of both existing and planned development with census data on the demographic characteristics of workers by place of work.

A solution is offered in this paper in two basic steps. Beginning with a cross-tabulation of decennial census data on the employment and household characteristics of workers by zone of work, in Step 1 each zone's number of workers cross-tabulated by industrial class and occupational class is input into a procedure that assigns a land use class to the workers in each industrial class. In Step 2 assigned land use class is cross-tabulated with the workers' household characteristics, for example, household income, that are part of the original cross-tabulation.

## CLASSIFICATION OF EMPLOYMENT BY LAND USE

### Overall Procedure

The overall procedure used to assign land use classes to small-area decennial census employment data is illustrated in Figure 1. There are three major phases. Phase I involves the design, creation, and subsequent improvement of the census special-tabulation data. Phase II consists of the creation of an industrial class by occupational class matrix, followed by the assignment of land use classes to the cells of the matrix. Phase III assigns land use classes to the workers of the special tabulation.

These phases are described in detail in following sections of the paper.

### Basic Land Use Classes

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 (TCU); and residential. These basic land use classes are defined in the following paragraphs.

#### Office

Workers in the office land use class fall into three general groups. One group consists of those industrial classes whose workers are in mostly white collar occupations and work in office floor space, including finance, insurance, and real estate; business services, such as advertising, collection and credit reporting, direct mailing, computer programming, and data processing; and professional services, such as offices and clinics of physicians and dentists, membership organizations (business, professional, labor, etc.), and legal, engineering, architectural, accounting, research, and management services.

The second group of workers that is found in office land use occurs in industrial classes whose workers are predominantly not white collar. Using Putman's example, a large, multiestablishment manufacturing firm, in addition to industrial facilities such as factories and warehouses in which blue collar workers predominate, will typically also have one or more offices at separate locations that are primarily engaged in performing management and other general administrative functions. Such separate office establishments are called central administrative offices in the Office of Management and Budget *Standard Industrial Classification Manual* (4). Such central office establishments, along with research laboratories and warehouses, are called auxiliary establishments; they serve the other establishments of the same enterprise, called operating establishments, which produce the goods and services that are the business of the enterprise (4, pp. 13-15).

Third, there are industrial classes in which blue collar occupations might predominate but which include operating establishments staffed mainly by white collar workers. A firm in the construction industrial class can have a majority of workers in blue collar occupations and working at temporary construction sites and at the same time maintain a permanent office location at which the firm is headquartered. Within the wholesale trade industrial class, some firms maintain inventories of goods and therefore require establishments that are designed for goods storage and so fall into the industrial land use class. Other wholesale trade firms, however, do

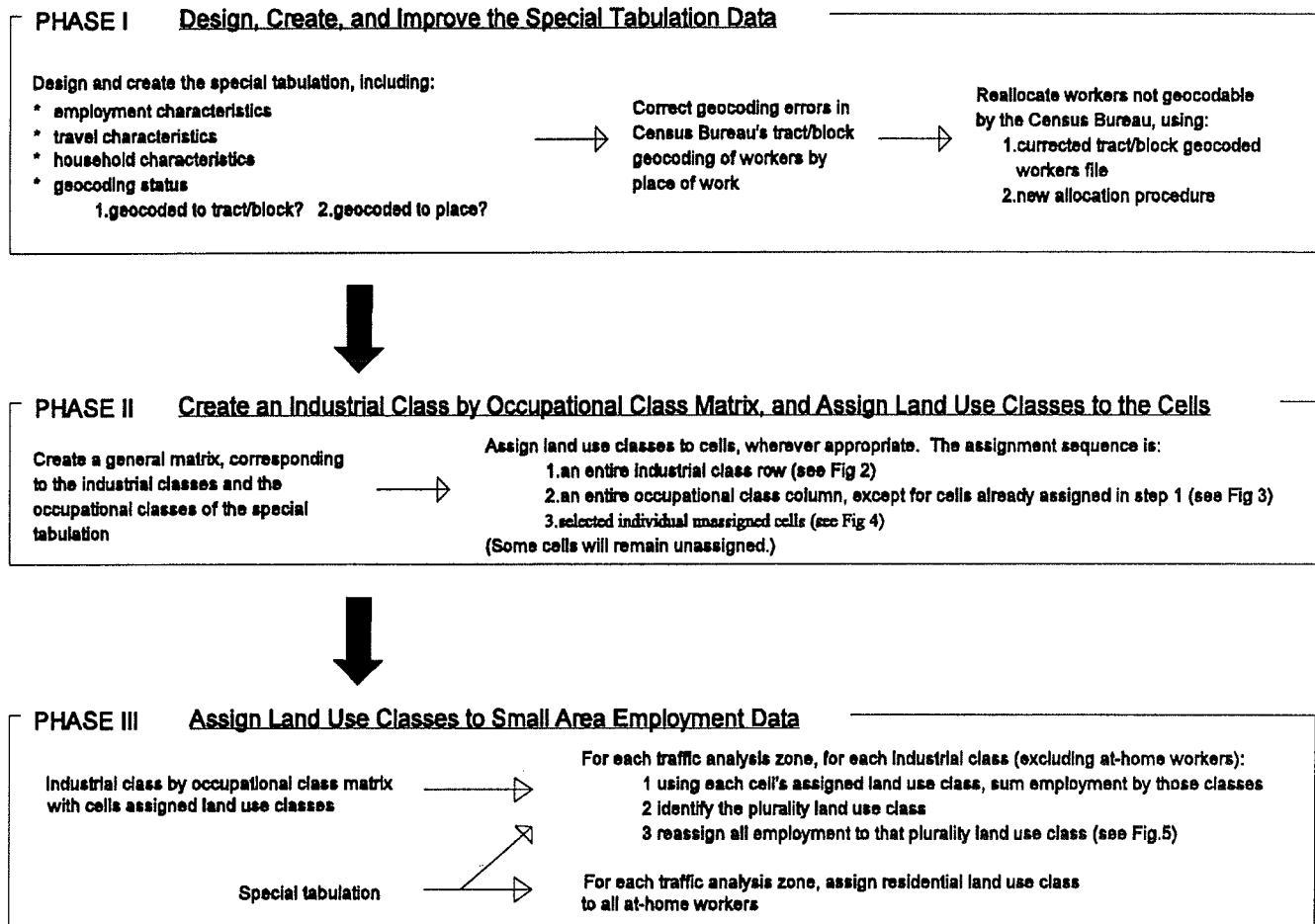


FIGURE 1 Overall procedure for assigning land use classes to decennial census small-area employment data.

not maintain their own inventories but instead act as middlemen who arrange and direct deliveries of goods from manufacturers directly to retailers. Workers of such wholesale trade firms occur solely in office land use.

### *Commercial*

Workers in the commercial land use class are found in such establishments as stores, restaurants, theaters, hotels and motels, gasoline stations, and repair shops. Typically, commercial land use establishments deal directly with the final consumers of products and services. In a very broad sense, commercial land use is "retail" in its orientation. It should be noted, however, that this group includes not only establishments in the retail trade industrial class, but also others in a wide variety of service industrial classes.

### *Institutional*

The institutional land use class includes establishments that provide services of a public, educational, or chari-

table nature. Employees of these establishments are, in terms of class of worker, mostly governmental or private not-for-profit. Industrial classes in the institutional land use class include hospitals, elementary and secondary schools, libraries, museums, and houses of worship. The SEMCOG assignment method also includes correctional facilities in the institutional class; government offices, conversely, are included in the office land use class. Hospitals and colleges and universities are treated as campuses that are entirely institutional land use. Therefore, an administrative office building belonging to a hospital or a university will be called institutional rather than office land use.

### *Industrial*

The industrial land use class includes those establishments whose industrial class is manufacturing and that are engaged in converting raw materials into new products or in assembling component parts into finished products. Plants, factories, and mills are the usual names of such establishments. Industrial land use also includes warehouses in which goods and materials are stored. Ware-

houses are used not only by firms of the manufacturing industrial class, but also by firms of other industrial classes, especially wholesale trade and retail trade, when firms maintain storage facilities separate from their other establishments. Industrial land uses, for the most part, do not deal face to face with the final consumer for the goods that are produced and stored within this land use.

### *Transportation, Communications, and Utilities (TCU)*

The TCU land use class has as its unifying characteristic a concern for the maintenance of flows. The flows can consist of persons, goods, energy, or information. TCU land use includes a wide variety of specialized establishments, such as air, rail, bus, truck, and ship terminals; post offices; broadcasting stations; electric generating stations; water supply treatment plants; and sewage treatment plants.

### *Residential*

Residential land use includes all workers who work at home, regardless of their industrial class or occupational class. In addition, the residential land use class includes all other workers in four industrial classes that involve residential-type services: private households (that is, persons doing domestic work in others' residences), child daycare services, nursing and personal care facilities, and residential care facilities without nursing.

### **Census Special Tabulation**

The CTPP is a 1990 census product. It consists of a series of data tabulations oriented to transportation planning. The CTPP has two components. The Statewide Element includes data on all places having populations of 2,500 or more, plus all counties. The Urban Element covers only metropolitan-area counties. Within those counties, the Urban Element gives data by small area [traffic analysis zone (TAZ) and census tract].

Both components give data by three types of location: place of residence, place of work, and residence-to-work commuter flows. The 1970 and 1980 censuses had a similar product called the Urban Transportation Planning Package (UTPP).

SEMCOG's 1990 census worker special tabulation is like the CTPP in that it

- Was derived from the same "parent file" as the CTPP, the Sample Edited Detail File,
- Includes the key employment-related variables of the CTPP,
- Includes household characteristics, and
- Includes TAZ of work.

However, the special tabulation is different in that it

- Is more detailed (e.g., 75 industrial classes and 40 occupational classes compared with 18 and 14, respectively, in the CTPP) and
- Includes flags indicating whether or not the worker was geocoded to tract as well as to place.

### **Improving Special-Tabulation Data**

Before applying the land use assignment method to the special-tabulation data, SEMCOG staff conducted a separate project the purpose of which was to make improvements to the census data. The improvements addressed two problems in the data, geocoding errors and allocation inaccuracies.

In 1990 the Census Bureau geocoded workers to tract and to block provided that the workplace addresses reported were sufficiently complete and either the Topologically Integrated Geographic Encoding and Referencing (TIGER) File could identify the address or the Workplace File included the specific worksite. (In 1980 the situation was similar, although some of the details were different.) However, some tract and block geocoding errors still occur. Such errors in the UTPP and CTPP are difficult to recognize and correct because geocoded workers and allocated workers are mixed.

Because the special tabulation included a flag that indicated whether or not the workers had been geocoded to tract (in most cases such workers had also been geocoded to block), SEMCOG was able to produce computer-generated maps of tract-geocoded employment by any of the 75 industrial classes of the special tabulation. Upon examination, the overall quality of tract and block geocoding appeared to be quite good. There were relatively few recognizable major errors and these were corrected, resulting in an improved base for the workers who needed to be allocated.

In the Census Bureau procedure for creating small-area employment data, workers who could not be geocoded to tract and block were instead assigned to tract and block by an allocation procedure. A considerable percentage of workers needed to be allocated. 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. Some sort of allocation procedure is absolutely necessary so that workers with ungeocodable addresses can be assigned to an appropriate small area. However, the currently used allocation procedure was believed to seriously reduce the overall accuracy of census small-area place-of-work employment data. Therefore, SEMCOG developed its own reallocation procedure.

That procedure accepted the Census Bureau's geocoding to county and to place, and then used the special tab-

ulation'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 and thereby elevated the quality of the subsequent assignment of land use classes to employment.

### Assigning Land Use Classes to Industrial Class by Occupational Class Matrix

In drawing up the specifications for the special tabulation, it was decided to group the 236 industrial classes and 501 occupational classes by which the parent census data file is coded. For industrial classes, separate identification of those industries that in actuality occurred mostly, if not completely, in a single land use class was requested. For example, the finance industrial class was identified as an industry that occurred overwhelmingly within office land use, the hospital industrial class as occurring overwhelmingly within institutional land use, and so on. In addition, it was requested that each industrial class that equaled at least 1 percent of the region's total employment be separately recognized. Finally, industrial classes that had unique physical land use characteristics—for example, wholesale trade in scrap and waste materials—were given separate recognition even though they had relatively few employees.

For occupational classes, separate identification of occupations that in actuality occurred mostly if not completely in one particular type of floor space was requested, with floor-space types corresponding to land use classes. In effect, this question was to be answered: "If an entire building was totally occupied by workers of this one occupational class, what kind of building would it be?" So, for example, the occupational class of financial records processing was assigned to office floor-space land use, whereas the occupational class of teachers, counselors, and librarians was assigned to institutional floor-space land use. Some occupational classes could not be assigned, in their entirety, to a single land use class. In some instances, individual occupational classes were assigned to one of several land uses on the basis of the particular industrial class. For example, the occupational class of motor vehicle mechanics and repairers was assigned to commercial land use when the industrial class was automobile repair, services, and parking and to TCU land use when the industrial class was road transportation. In addition, when grouping occupational classes (as for industrial classes), the amount of employment in the class was considered as well as unique relationships between occupational class and land use class that would require special treatment. The result of this work was a general matrix of industrial classes by occupational

classes. The cells themselves had no identification beyond an industrial class and an occupational class.

The next task to be performed was to assign a land use class to each cell wherever that was judged to be possible. First addressed were the industrial classes in which all employment could justifiably be assigned to a single land use class, for example, finance or hospital. For each such industrial class, each of the cells forming that industrial class's matrix row would be assigned to office land use or institutional land use, as was appropriate (Figure 2). 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 computer programmers occupation 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. Figure 3 illustrates that step. 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 industry-occupation combination. Motor vehicle mechanics and repairers is an example of this cell-by-cell assignment. Figure 4 shows this step. The remaining cells of the matrix had no assigned land use class.

### Assigning Land Use Classes to Small-Area Decennial Census Employment Data

The resulting general matrix was still a cross-tabulation of industrial classes by occupational classes. However, the majority of cells in the matrix had now been assigned land use classes. The matrix was then used to assign employment to land use classes by individual TAZ. The assignment was made separately for each industrial class. (However, workers of any industrial class who worked at home were assigned to residential land use. Such workers played no further role in the land use assignment procedure.) 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 result is shown in Figure 5. 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. All data items that were part of the cross-tabulation then could be cross-tabulated by land use class. For example, it is now possible to create an employment-to-household conversion matrix using land-use-based employment

	OC1	OC2	...	...	...	...	...	...	OC39									
IC1																		
IC2																		
...																		
...																		
Finance										<i>Office Office Office Office Office Office Office Office Office</i>								
...																		
...																		
...																		
...																		
...																		
...																		
Hospital										<i>Institutional Institutional Institutional Institutional Institutional Institutional Institutional Institutional Institutional</i>								
...																		
...																		
IC74																		

FIGURE 2 Assignment of land use class by industrial class.

classes, which Putman characterized as “extremely difficult if not impossible.” Use of the census special tabulation in conjunction with SEMCOG’s land use class assignment procedure adds the missing land use dimension to census data. In a sense, it is as if the decennial census had included a question on the land use class of the employed person’s workplace.

### CURRENT STATUS OF WORK

#### Application of Method

Some general results of applying the land use classification method to decennial census employment data are

shown in Table 1. The industrial classes are the eight that SEMCOG has used in its current Regional Development Forecast (RDF). Construction employment is excluded. The land use classes are the six described in this paper.

Among the noteworthy points are the following:

- All eight industrial classes include employment in office land use;
- Office land use is the single most important class, comprising about two-fifths of all employment;
- Commercial, industrial, and institutional land use each equal roughly one-fifth of total employment;
- Aside from the finance, insurance, and real estate (FIRE) industrial class (which except for at-home workers is assigned to office land use), all seven other indus-

	OC1	OC2	...	Financial records processing	...	Teachers, counselors & librarians	...	...	OC39								
IC1																	
IC2																	
...																	
...																	
...										<i>Office</i>		<i>Office</i>		<i>Institutional</i>		<i>Institutional</i>	
...										<i>Office</i>		<i>Office</i>		<i>Institutional</i>		<i>Institutional</i>	
...										<i>Office</i>		<i>Office</i>		<i>Institutional</i>		<i>Institutional</i>	
...										<i>Office</i>		<i>Office</i>		<i>Institutional</i>		<i>Institutional</i>	
...										<i>Office</i>		<i>Office</i>		<i>Institutional</i>		<i>Institutional</i>	
...										<i>Office</i>		<i>Office</i>		<i>Institutional</i>		<i>Institutional</i>	
...										<i>Office</i>		<i>Office</i>		<i>Institutional</i>		<i>Institutional</i>	
...										<i>Office</i>		<i>Office</i>		<i>Institutional</i>		<i>Institutional</i>	
...										<i>Office</i>		<i>Office</i>		<i>Institutional</i>		<i>Institutional</i>	
IC74																	

FIGURE 3 Assignment of land use class by occupational class.

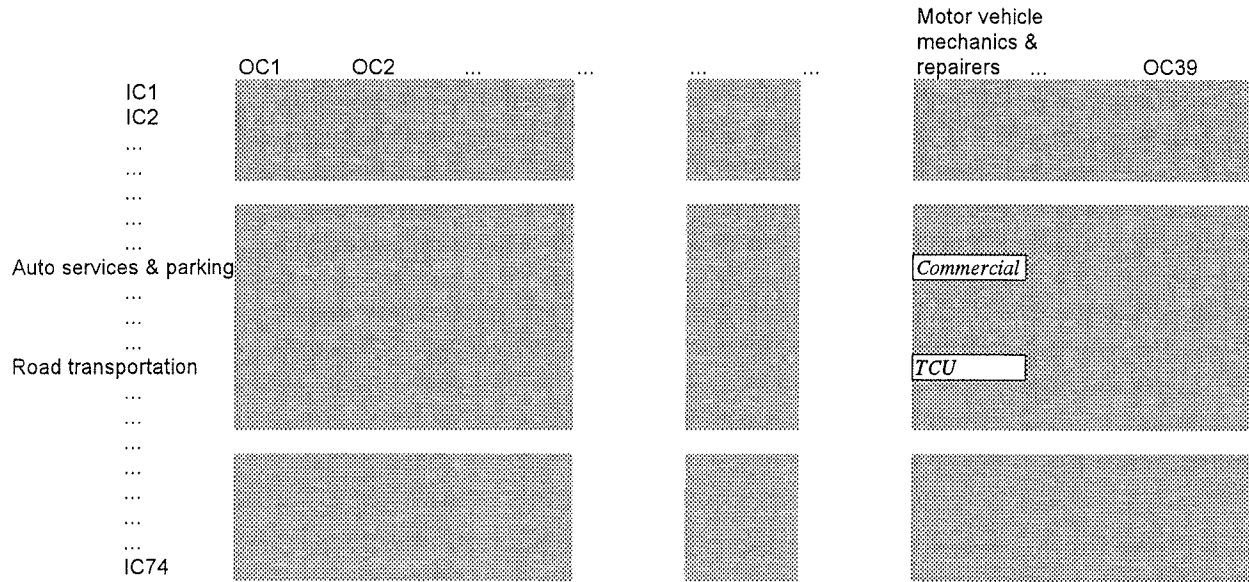


FIGURE 4 Assignment of land use class by individual cell.

trial classes contain significant portions of employment in more than one land use class.

The last point is especially significant in that it illustrates the serious distortions that can be involved in assigning all the employment in a given industrial class to a single land use class; for example, manufacturing to industrial, retail to commercial, services to office. In addition, because establishments of a given land use class tend to gather together and at the same time avoid establishments of unlike land uses, the percentage distributions of Table 1 cannot, of course, be applied to small-area data on employment by industrial class. In actuality, most employment in a given nonresidential land use class will be concentrated within a minority of

zones. Such spatial concentrations reflect the locational needs, compatibilities, and incompatibilities of the basic nonresidential land use classes and have very little to do with industrial class per se.

Multitenant office buildings provide a striking example of the primacy of land use class in the locational patterns of jobs. Such buildings can contain workers of any and all industrial classes, and the mix of industrial classes changes as some tenants move out and others move in. However, as long as overall occupancy rates stay about the same, the functioning of the buildings, including their traffic-generating characteristics, remains basically the same.

For the just-completed forecast, SEMCOG used the EMPAL model to project changes in employment by in-

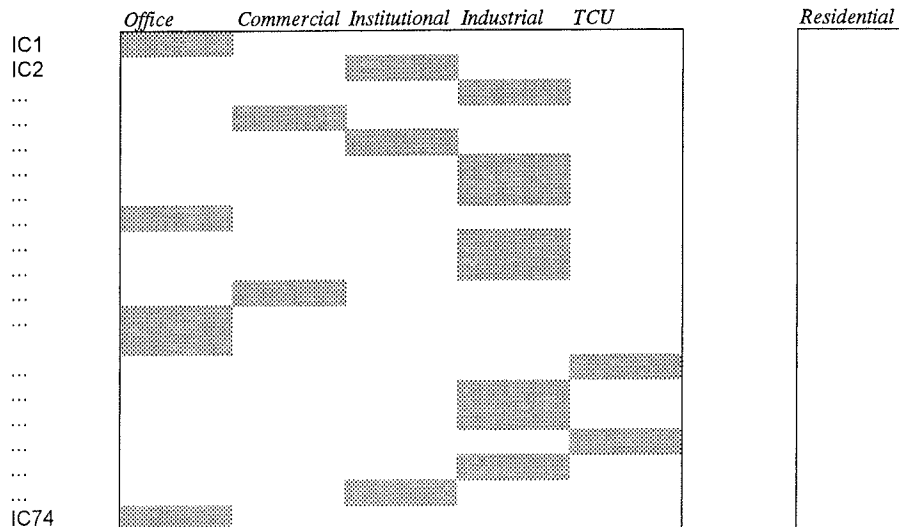


FIGURE 5 Reassignment of plurality land use class to small-area employment.



TABLE 1 1990 Census Place-of-Work Employment Data by Industrial Class Assigned to Land Use Class

Industrial Class	Employment (%) by Land Use Class						Totals
	Office	Commercial	Institutional	Industrial	TCU <sup>a</sup>	Residential	
Natural Resources	21.0	53.9	0.0	3.1	0.0	21.9	100.0
Manufacturing	31.6	--- <sup>c</sup>	0.0	67.6	0.0	0.8	100.0
TCU <sup>a</sup>	42.1	--- <sup>c</sup>	0.0	0.3	56.7	0.9	100.0
Wholesale Trade	71.7	0.1	0.0	26.0	0.0	2.2	100.0
Retail Trade	9.1	88.9	--- <sup>c</sup>	0.7	0.0	1.2	100.0
FIRE <sup>b</sup>	98.0	0.0	0.0	0.0	0.0	2.0	100.0
Services	32.3	16.7	42.2	0.1	--- <sup>c</sup>	8.6	100.0
Public Administration	65.2	0.0	34.4	0.0	0.0	0.5	100.0
All Industries	36.0	23.8	17.3	15.6	3.0	4.3	100.0

<sup>a</sup> Transportation, Communications, and Utilities.

<sup>b</sup> Finance, Insurance, and Real Estate.

<sup>c</sup> Less than 0.05 percent.

Note: Row percentages may not add to 100.0, due to rounding.

Source: Southeast Michigan Council of Governments

dustrial class for the period 1990 to 2020. Job changes were forecast by medium-sized areas called forecast districts. A separate procedure was then used to allocate these changes to the TAZs into which the districts are subdivided. Vacant holding capacity, the number of jobs that can be accommodated on currently vacant land planned for future nonresidential uses, is one of the inputs to the allocation method. However, plans for the future development of land are of course in terms of land use classes rather than industrial classes. By transforming census employment data at the zonal level into industrial class by land use class matrixes, it has been possible to translate the EMPAL forecast of change in employment by industrial class into a forecast of demand for future development by land use class. Currently SEMCOG is investigating the possibilities of directly forecasting employment by land use class subsequent to a conversion of census employment data from industrial class to land use class.

### Testing of the Method

Concerning the testing of the method, the greatest problem is that no other set of small-area employment data by land use class exists for Southeast Michigan with which to compare the results. The one quantitative comparison that has been possible to date is with data on employment by land use class collected in SEMCOG's 1994 household travel survey. Table 2 compares the two data sets. Considering the differences in data collection method, date, and coverage area, the two sets of numbers are quite close. In addition, visual comparisons have been made using maps of 1990 existing physical land use; generally excellent correspondence was found between those patterns and zone-level census employment data by land use class. Other possibilities for testing and improving the method using Southeast Michigan data

are being explored. However, full testing and refining of the assignment method would require the creation of special tabulations of census data in several other metropolitan areas. Ideally, these selected areas would have circa-1990 lists of establishments (by name, address, SIC code, and number of employees) to which land use class had been or could be added.

The major apparent limitation of SEMCOG's land use assignment method involves the occurrence of establishments of the same industrial class but different land use class within the same zone, for example, one or more restaurants and the administrative office of the restaurant chain. In its current form, the assignment method would identify the plurality land use class and then assign all employment in the industrial class (eating and drinking places) to either commercial land use or office land use. With further work, it should prove possible (in instances of larger employment numbers) to use the occupational distribution to disaggregate the restaurant employment from the office employment and assign them to separate land use classes. With smaller numbers, the "usual" land use class, for example, commercial for the industrial class of eating and drinking places, would be automatically assigned without reference to the occupational mix. In the meantime, this limitation appears to cause no more than minor misclassification.

In summary, SEMCOG has obtained a special tabulation of 1990 census data on employment by zone of work. A method has been developed that uses the industrial class in conjunction with the occupational class of workers in this file to assign the workers to a land use class and to make this land use class a dimension of the cross-tabulation. This in turn allows other demographic data items contained in the cross-tabulation to be organized and analyzed by land use class. The special tabulation used in conjunction with the land use assignment method represents a significant extension of the usefulness of decennial census employment data.

**TABLE 2 Comparison of Employment by Land Use Class,  
1990 Census and 1994 SEMCOG Household Travel Survey**

<u>Employment (%) by Land Use Class</u>		
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 <sup>a</sup>	3.0	2.4
Residential	4.3	6.9
Totals	100.0	100.0

<sup>a</sup> Transportation, Communications, and Utilities.

Note: Percentages may not add to 100.0, due to rounding.

Source: Southeast Michigan Council of Governments

## INDISPENSABILITY OF CENSUS EMPLOYMENT DATA

### Impetus for Creating Employment-Land Use Classification Method

A method to assign land use classes to decennial census employment data has been described. The impetus to create such a method was the desire to extend census data via a new dimension, land use class, and thereby connect census data with both the spatial distribution of nonresidential land uses and the locational determinants that underlie these patterns.

The decennial census is by far the single most important source of information on employed persons and jobs and their interrelationships. First, the census describes the nature of the employment itself: labor force status, workplace location, travel to work, hours worked, and kind of job activity. Second, the census contains data on a multitude of other, non-job-related characteristics of workers. These characteristics include basic facts not only about individual persons (including age, sex, race, marital status, and educational attainment), but also about the workers' households (size, relationships, presence of children, income, among others) and housing (structure type, size, cost, vehicles available, etc.).

But because census data do not include the land use class of the employed person's workplace, it has been impossible to link this unmatched wealth of demographic data with the variety of noncensus physical data about workplaces, including building type, floor space, acreage, and assessed value. Furthermore, as Putman

has explained, the lack of a land use dimension in decennial census data has meant that demographic forecasting for a variety of applications, including transportation planning, has been seriously handicapped. Demographic forecasting, of course, cannot be done without census data, the richest source of information on both workers and nonworkers. However, the absence of a land use dimension has meant that worker characteristics in census data cannot be connected to a prime locational determinant of jobs, that is, the land use classes of the establishments that contain the jobs. The land use classification method described in this paper provides the link between workers, with all their census-determined characteristics, and establishments by land use class.

### Recommendations for 2000 Census

To conclude, a proposal for incorporating land use class assignment into the procedures for the 2000 census has been presented. As illustrated in Figure 6, this work would be done in three phases. First, 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. This phase would combine efforts of the Census Bureau and urban and transportation planning agencies. Second, the Census Bureau would use an improved version of the assignment method to give each individual worker a workplace land use class. Third, the Census Bureau would incorporate this land use attribute into a variety of census files and products, including the parent file and the CTPP.

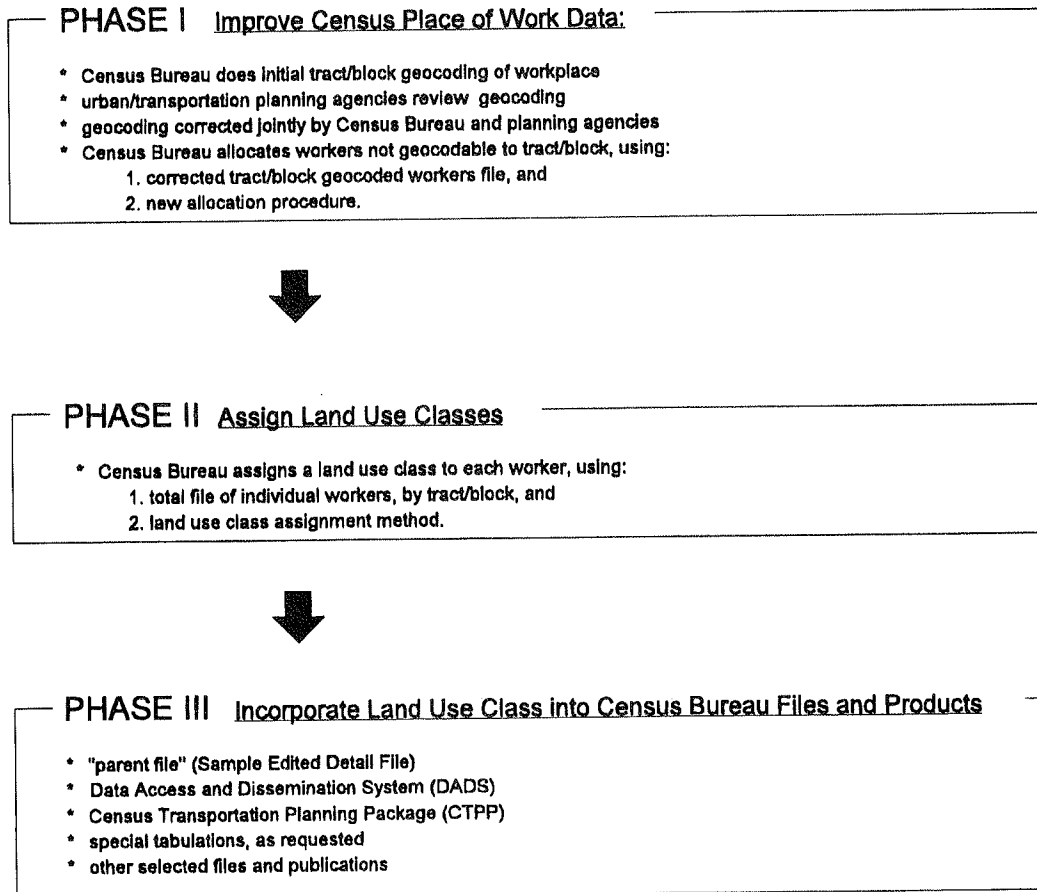


FIGURE 6 Proposal for incorporating place-of-work land use class into procedure for 2000 census.

The 2000 census would ask no question about the land use of the workplace. Nevertheless, through the incorporation of the land use assignment method into the overall census procedure, land use class would become a 2000 census answer.

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#### REFERENCES

1. *1990 Census of Population, Social and Economic Characteristics, Michigan*. 1990 CP-2-24, Section 2. Bureau of the Census, U.S. Department of Commerce, Sept. 1993, pp. E-8, E-14, E-15.
2. *1990 Census of Population, Social and Economic Characteristics, Michigan*. 1990 CP-2-24, Section 2. Bureau of the Census, U.S. Department of Commerce, Sept. 1993, pp. B-19, B-20.
3. Putman, S.H. Integrated Transportation and Land Use Models: An Overview of Progress with DRAM and EM-PAL, with Suggestions for Further Research. Presented at 73rd Annual Meeting of the Transportation Research Board, Washington, D.C., 1994.
4. *Standard Industrial Classification Manual 1987*. Executive Office of the President, Office of Management and Budget, Springfield, Va., pp. 13-15.