

Transportation Service Center Analysis Using GIS Technology

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Abstract

Transportation Service Centers (TSCs) were conceived of as a way to organize the Michigan Department of Transportation (MDOT) to better serve the department's core business processes and improve customer service. The TSCs are local MDOT offices that will be multi functional, multi modal and the primary focus for MDOT's external customer contact. The department's goal is to locate TSCs so that no employee will drive more than one hour to get from their office to a work site and every customer will be within sixty minutes of a TSC.

The TSC concept originated as a result of the department's evaluation of its key business processes and its commitment to improve the quality of the goods and services it provides. Based on that evaluation it was determined that the best way to meet MDOT's objectives would be to realign the department's activities within the TSC framework. Each functional group within the department was asked to review the activities that they currently perform and determine which might be better handled at the TSC level. Realignment groups were formed so that proposals could be analyzed and implemented as quickly as possible.

Three pilot TSCs locations were put into service during August of 1996. They are 75% functional within the current labor agreements. In April 1997 an additional 12 TSCs will be implemented with a minimum of 50% of those being 100% functional. By March 1999 it is anticipated that all TSCs will be operational.

This paper and presentation outlines MDOT's Travel Demand Analysis Section (TDA) utilization of the Statewide Travel Demand Model and TransCAD's GIS and travel demand modeling capabilities to provide technical support to this reorganization effort. The combination of providing data and profiles along with the ability to illustrate this data with maps and graphs, was very useful in communicating the findings to MDOT management and the MDOT work force.

Included in this presentation and paper are what technical procedures worked and what didn't, what was effective in communicating results to others, and suggestions on how the process can be improved.

Analyses performed include geocoding and mapping the locations of potential TSCs, Regional Centers and employee home and business locations using TransCAD's address matching capabilities; using TransCAD's partitioning procedure to calculate the population within 10 minute travel time increments and the percent of the total state population served within these time bands; and calculation of the average travel time to work for existing employees.

The Transportation Service Center (TSC) concept originated as a result of the department's evaluation of its key business processes and its commitment to improve the quality of the goods and services it provides. TSCs are local Michigan Department of Transportation (MDOT) offices that are multi functional, multi modal and the primary focus for MDOT's external customer contact. The final goal is to locate TSCs so that no employee will drive more than one hour to get from their office to a work site and every customer will be within sixty minutes of a TSC. The original proposal required analyzing thirty-two locations.

The eight core business processes that provided the impetus for this concept include:

- Develop partnerships between MDOT and its customers in order to build a consensus on what transportation improvements are needed.
- Good, consistent communication internally and externally to increase understanding and confidence in MDOT.
- Focus on preserving and optimizing the existing system emphasizing safety and cost-effectiveness with a system wide, multi modal approach to project selection with an emphasis on value added.
- With a commitment to basic mobility, rationalize the transportation system at the state level adding or eliminating elements to ensure those of statewide importance are included.
- Seek agreements with partners which allow MDOT to provide policy direction for state-funded but locally-owned transportation facilities and services.
- Develop and implement innovative transportation system technologies including management systems, real-time traveler information, and intelligent transportation systems.
- Pro-actively seek more appropriate regulatory environments, alternative sources of funding and innovative methods to reduce costs.
- Prepare MDOT personnel to accept these challenges.

An examination of these processes suggested that the best way to meet MDOT's objectives would be to realign the department's activities within the TSC framework. Each functional group within the department was asked to review the activities that they currently perform and determine which might be better handled at the TSC level. Realignment groups were formed so that proposals could be analyzed and implemented as quickly as possible.

There are three pilot TSCs locations, Howell, Swartz Creek and Ishpeming) They currently offer only selected services. They were implemented in August of 1996 and are 75% functional within the current labor agreements. In April 1997 an additional 12 TSCs will be implemented with a minimum of 50% of those being 100% functional. By March 1999 it is anticipated that all TSCs will be operational.

This paper outlines the use of MDOT's Statewide Travel Demand Model and TransCAD's GIS modeling capabilities to provide technical support to this effort.

The TransCAD analysis performed included:

- Geocoding the locations of potential TSCs, Regional Centers, employee home and business locations using TransCAD's address matching capabilities.
- Using TransCAD's partitioning procedures to calculate the population within 10 minute travel time increments and calculating the percent of total state population served within these time bands.
- In addition to the population service issue the department was also concerned with the impact decentralization would have on its employees. MDOT's Statewide Travel Demand Model and

TransCAD procedures were used to calculate the average travel time to work of existing employees.

Technical Process

MDOT completed the analysis for this project with the Caliper Corporation's 3.0 Windows version of TransCAD. TransCAD is a complete travel demand modeling package within a GIS framework. TransCAD embodies a concept known as "Tight Integration." A tight integration design bundles together geographic information techniques, database techniques, and modeling techniques into one bundle. TransCAD also includes a procedural tool kit and a scripting language for integrating procedures developed outside of TransCAD into the TransCAD environment.

MDOT'S statewide model zonal and network database layers provided the input data required for most of the analysis used in this project. Maps and reports were generated within TransCAD and outputs were sent to other databases or spreadsheets for further analysis or graphing.

Michigan's statewide model divides the state into 2307 geographic areas called traffic analysis zones (TAZ's). In addition, TAZ's for the rest of the United States, Canada, and Mexico are included. Within Michigan's urban areas the Statewide zones are combinations of urban model zones. In non-urban areas, the zones are typically Minor Civil Divisions. Population and employment data from the Census and other sources are aggregated into the individual TAZ's for use by the travel demand model and for other analysis. For this project, zone numbers were attached to the MPO, Transit Agency and Region address records as well as the employee home and work addresses.

The Statewide Model network includes 9,600 miles of state trunkline system and 11,600 miles of county roads and city streets. There are 7,625 nodes (intersections) and more than 11,000 links (road segments). A zone to zone travel time matrix was created using the length and speeds on the highway network allowing for the calculation of home to work travel times from the employee address file.

The technical process includes:

The input data files contained the employees home and business address locations, as well as the addresses of potential TSCs and the addresses of client agencies (transit agencies, MPO's and Planning and Development Regions). TransCAD's address matching procedures were used to geocode all address locations. The latitude and longitude for unmatched addresses were manually determined. TransCAD's network partitioning procedures were used to calculate the population within a 10, 20, 30, 40, 50 and 60 minute travel time bands. TransCAD charting and mapping procedures were used to summarize the percent of the total state population served by time bands and regions. The travel time matrix from the statewide model was used to estimate the travel time to work for MDOT employees.

Address Matching / Geocoding

In order to ensure the address matching would go as smoothly as possible all data bases were edited to resemble the Caliper CD address format (the street number street name city and zip code are in separate columns). A data base of existing state employees which included both the home and work address (TransCad\Network\Stwd\Emp_site.dbf) was created from personnel files.

MDOT client address files were also generated. They included transit agencies (Taz\Mast_Trans.dbf), MPO's (Taz\3C.dbf) and Planning and Economic Development Regions (Taz\region.dbf). The format of each file follows.

While address matching in TransCAD is relatively simple, the outcome is not always satisfactory. This may be for one of a number of reasons including:

- The address format was incorrect
- The street name was not contained within the street file
- The employee address was misspelled
- The P.O. Box was non-uniform format
- The zip code was not contained within the Geographic file
- The zip code was incorrect

(Note - With ALL of the files, the address match procedure was used first *and then* we resorted to other procedures using ONLY the remaining unmatched records.)

TransCAD Address Matching Procedures

Locate by Address Procedure:

The process of address matching often requires several iterations. The first iteration used TransCAD's automated address matching procedures. The procedure checks for matches by referring to the database and the street file for the number of the house, the street name, the city name, the state name and the zip code. When a match is found then that longitude and latitude are automatically assigned to the record. To resolve near identical matches the user may exercise the option to select manually. A selection set called "unmatched records" is created to store any records that are not matched. Manual tactics were used alternatively to assist the packaged address matching procedures to find matches and to geocode the remaining records (address matching failures are attributed to quality of the census file.)

Search on a Single Address Procedure:

Because the final goal is to find a latitude and longitude for all the records, we proceeded to experiment with other forms of geocoding for unmatched records. Search on a Single Address was one of those procedures used to match the unmatched records. This search allows the user, to search for a single address. Although the information required is identical to that of the Locate by Address Procedure, this approach was successfully used to increase the number of matches.

Within the 1995 Caliper Street CD Layer several street attributes are missing. For example some streets which have names fall outside of the known address ranges and the address ranges are not current. This problem is attributed to the quality of available census data. Efforts are underway to correct this problem in the state of Michigan (Michigan Frameworks Project). Other problems that required additional efforts are: the existence of "unmatched streets links", incorrect spellings and missing address house numbers. In these types of situations the user may match to the closest address. This is not a program glitch, but an insufficient information problem, within the Caliper 1995 Street.cdf. These "unknown" links also appeared in the address match procedure, but only when the option, "ask if uncertain" was chosen before running time. Unknown links were not

chosen. The project team could not reliably determine which of the many unknown links to select without looking at the Caliper 1995 Street.cdf. This would have required a considerable investment in man-hours.

Locate by Zip Procedure:

In this procedure the software refers directly to the zip codes in the Caliper Geographic database. This geocoding approach is not as geographically specific as the Locate by Address procedure. When entering the zip code to be located, the person has a choice of the following locating options: locate at zip code area center, scatter inside the zip code area, or scattered near the center. Next the procedure uses the selected unmatched records to compare against Caliper’s geographic file to find additional zip code matches. This option was used to complete the employee location map for unmatched records as the product was only intended to give a general picture of the distribution of state employees and specific locations for all records were not considered critical.

The information in Table 1 provides a sense of the relative efficiency of the various approaches used.

The Do’s and Don’ts of Address Matching

The Must Do’s:

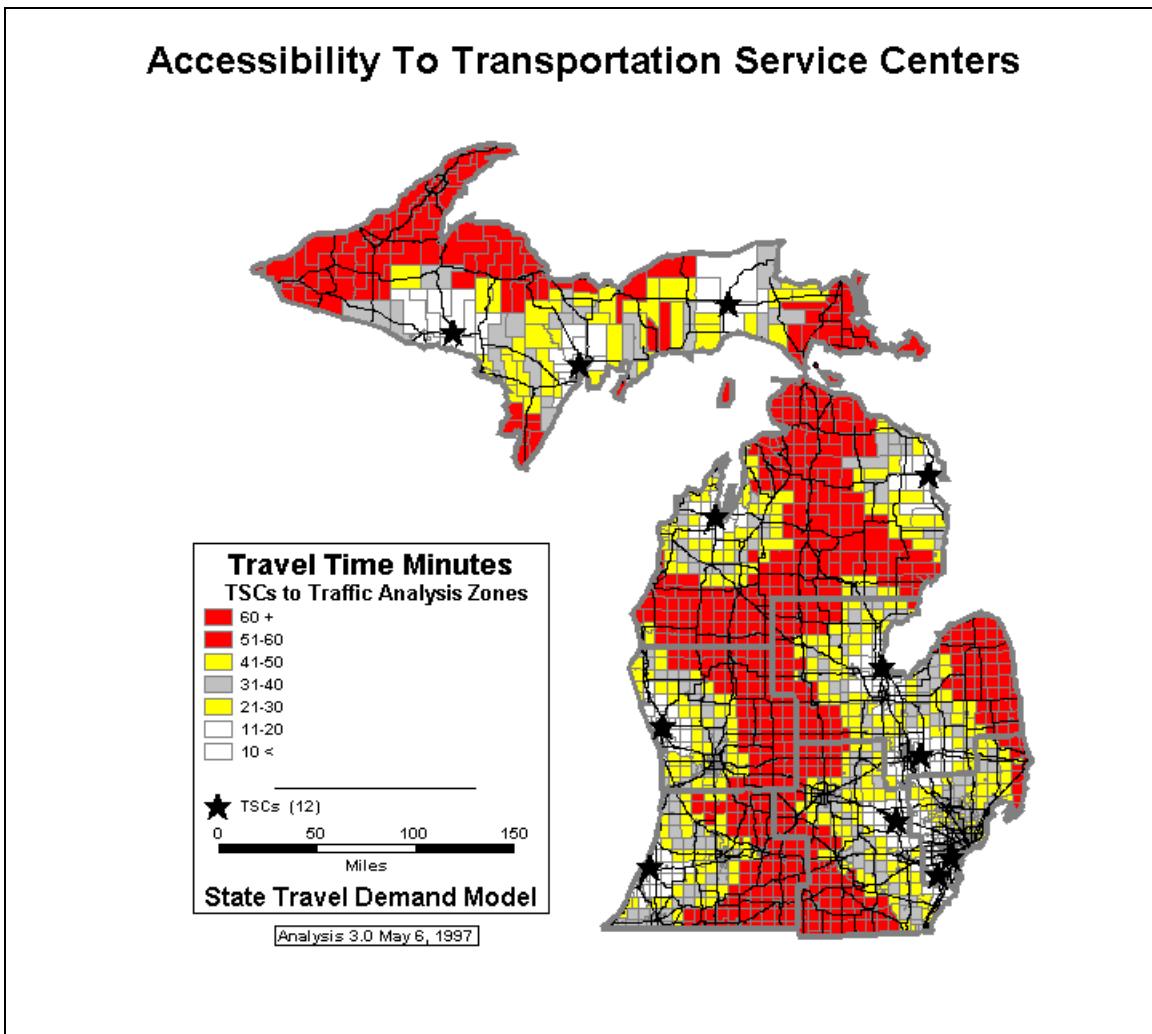
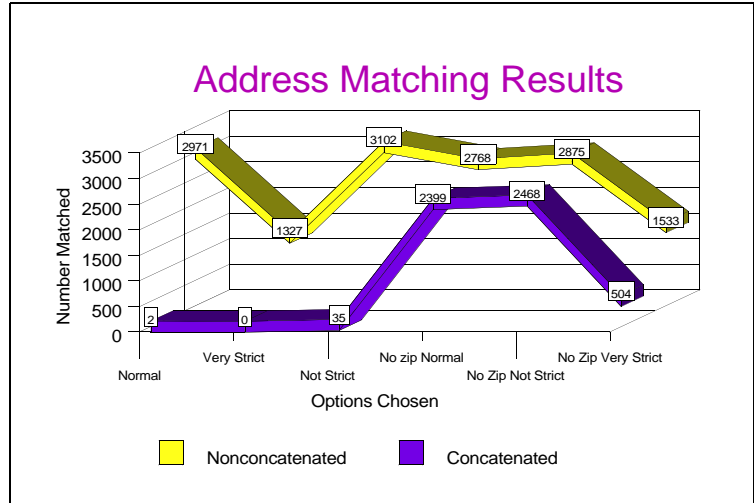
- Edit all addresses in the master database so that the direction of the street comes before the street name, and do not use periods after the direction.
- When a record comes up unmatched check the spelling of all components in the address and check to see if the zip code is correct.
- Make sure that all P.O. Box addresses are uniform to the Information source, to which it will be matched. (For example using a period after the direction of the road: S. Smith Street vs S Smith Street)
- After running the address match procedure save the unmatched records data view. It is more efficient than repeatedly reselecting, with the select by condition function, those without latitude or longitude.
- If the procedure crashes repeatedly and your on a server, that may be the source of a conflict. Try signing off the server and repeating the process.

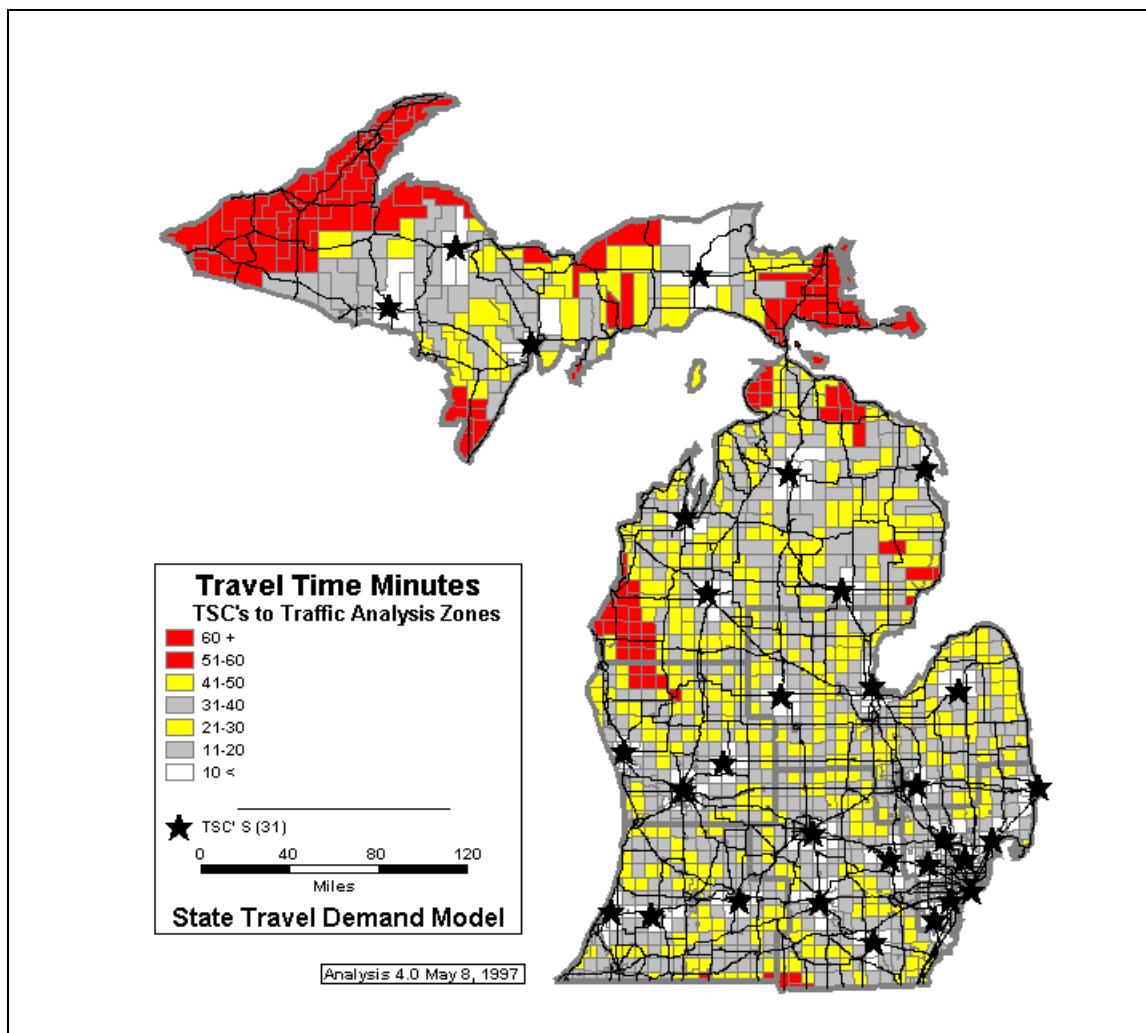
Table 1: Efficiency of various address matching procedures

Procedure	Matched Employee Res	Unmatched Employee Res	% Matched
Add_match (normal)	2971	748	73%
Add_match (normal.c)	2	3717	.05%
Add_match (strict)	1327	2392	36%
Add_match (strict.c)	0	3719	0%
Add_match (n-strict)	3102	616	83%
Add_match (n-strict.c)	35	3648	94%
Add_match (no zip) & (normal)	2768	951	74%
Add_match (no zip) & (normal.c)	2399	1320	65%
Add_match (no zip) & (n-strict)	2875	844	77%
Add_match (no zip) & (n-strict.c)	2468	1251	65%
Add-match (no zip) & (strict)	1533	2186	41%
Add-match (no zip) & (strict.c)	504	3215	14%

Address Match Analysis Results

The Figure at the right shows all of the options available while using the address match procedure. It also shows which options produced the highest matched results. Two different address structures were used in running the procedure, a concatenated address which has the house number and street name in one field and a nonconcatenated address which has the house number and the street name in two separate fields. Having these two different formats of the address allowed us to use additional information during the address matching procedure. The concatenated address matched fewer records in every case.





Network Partitioning Procedure

TransCad's network partitioning procedure was used to identify distance bands for each of the TSCs and the population served within each distance band. Distance bands used were 10, 20, 30, 40, 50, and 60 minutes. This procedure was also used to produce maps of accessibility and too evaluate the effectiveness of the proposed TSCs in serving the general population. The steps used in the procedure are described in four phases.

Phase I

Setup

Select nodes that represent TSC locations

Build network based travel times

Phase II

Run network partition procedure setting time bands set at 600, 60, 50, 40, 30 20 and 10 minutes.

Build selection sets for each time band

Phase III

Run select by location procedure. This procedure identifies the zones nearest to each network based time band.

Combine travel time set to establish travel time intervals.

Phase IV

Create subsets by regions for each time band. There are 7 regions and 7 time bands.

Build spread sheet to determine % population served by travel time.

Results and Observations

The following maps and tables show the results of the partitioning process. The network travel time represents total door to door trips under typical conditions and congestion levels. It also assumes that drivers do not exceed the speed limit. Travel is to the center of the traffic analysis zone and population is based on the 1990 census block data and aggregated to Michigan's traffic analysis zones. This project analyzed two scenarios.

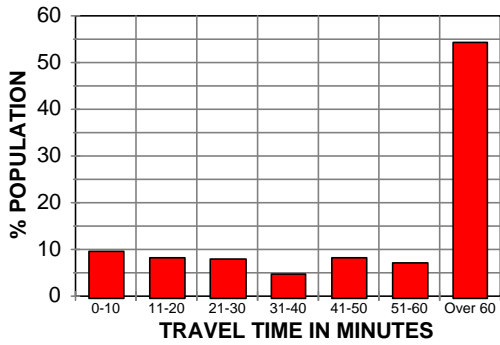
The first scenario evaluated 12 potential Transportation Service Center locations and the second scenario evaluated 31 TSC locations to determine customer and employee accessibility. The goal of the analysis was to determine if the potential TSC locations provide a maximum 60 minute drive time to a TSC for most Michigan citizens. As shown in analysis group 3.0 and analysis group 4.0 approximately 8.5% and 1.3% respectively, of the population have drive times to TSCs that are greater than 60 minutes.

Next Steps and Future Directions

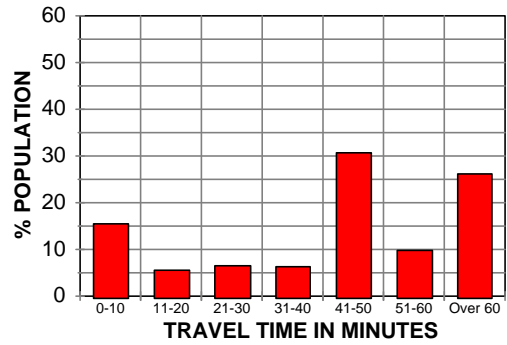
The next step and future direction will be to further automate the network partitioning process. This will enable the STWD planning unit to reduce the time required to provide MDOT's management with a powerful and robust spatial analysis decision making support tool.

Region summaries: Analysis Group 3 (12 TSCs)
Percent of population served by travel time

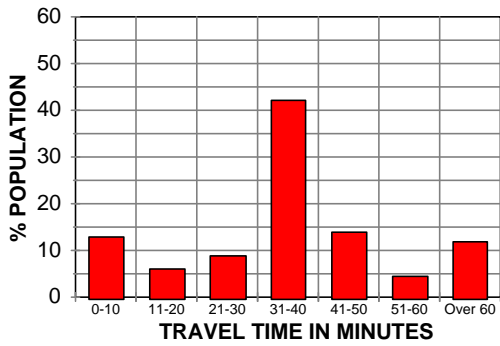
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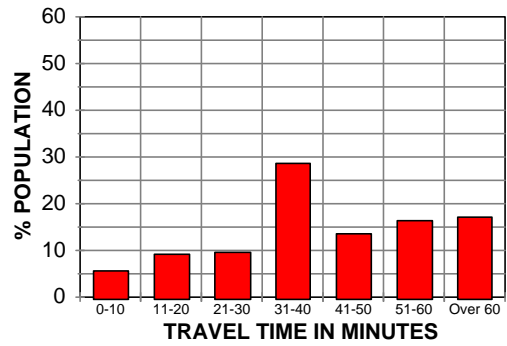
NORTH



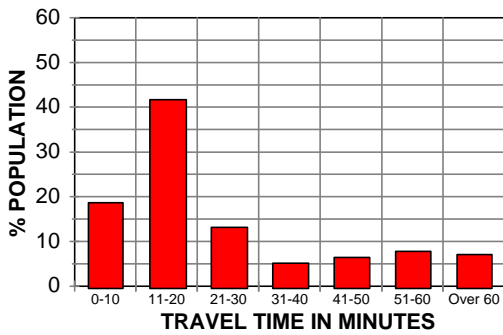
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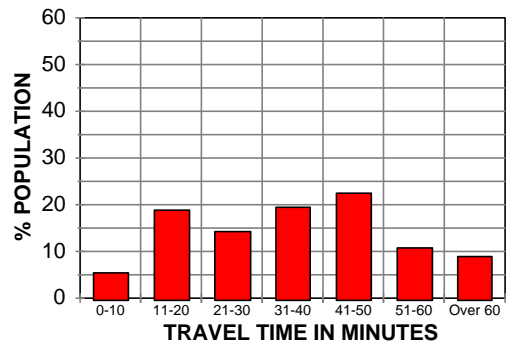
SOUTHWEST



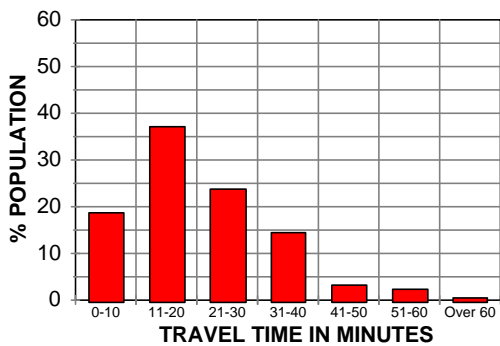
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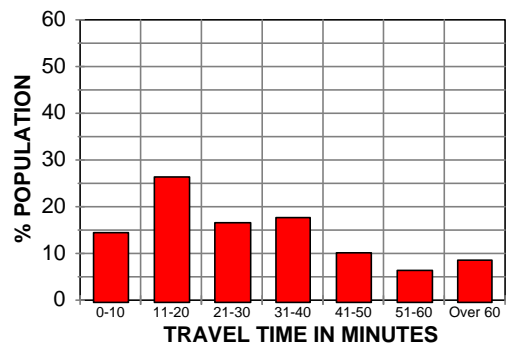
UNIVERSITY



METRO

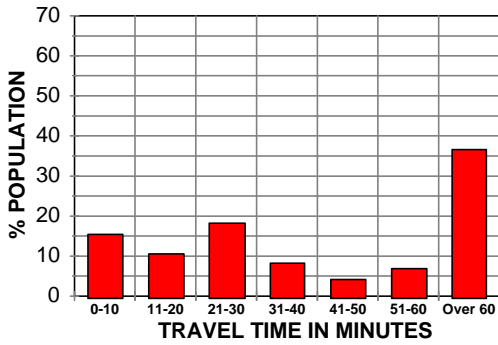


STATEWIDE SUMMARY

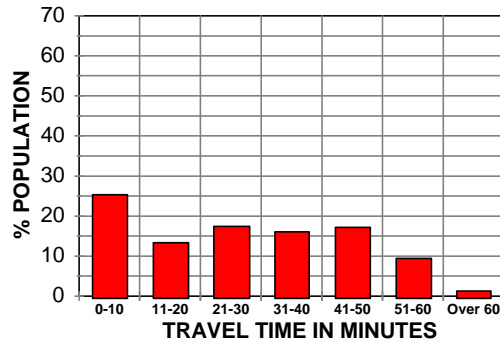


Region Summaries: Analysis Group 4 (31 TSCs)
Percent of population served by travel time

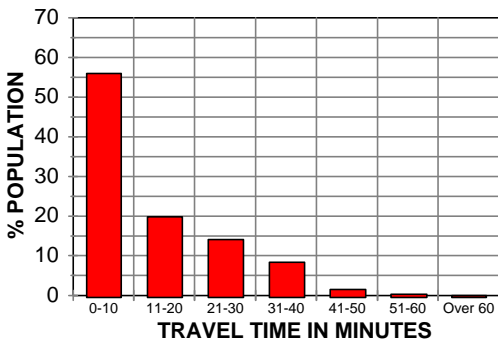
SUPERIOR



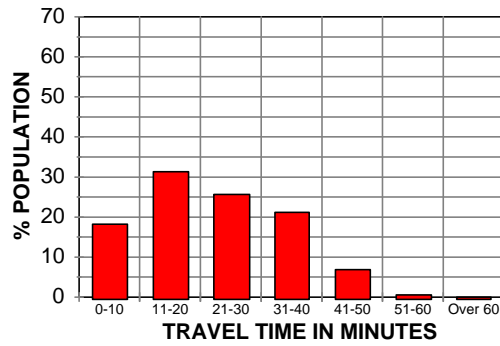
NORTH



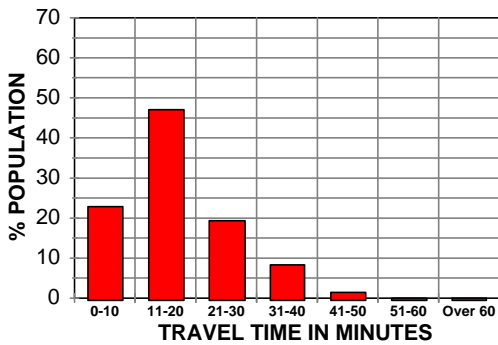
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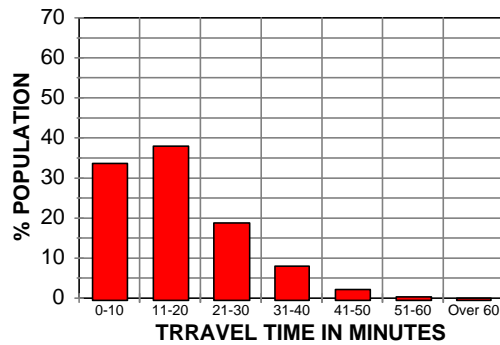
SOUTHWEST



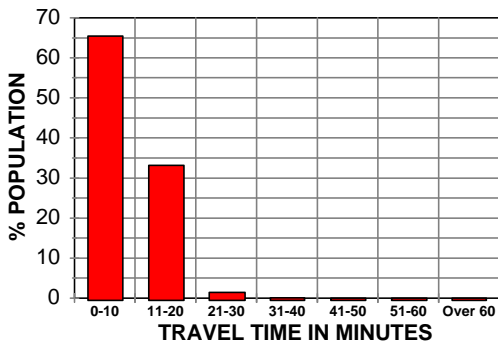
BAY



UNIVERSITY



METRO



STATEWIDE SUMMARY

