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Demographic Allocation Tool White Paper

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Introduction

There has been much improvement in the field of land use modeling in recent decades. Many agencies use land use models to perform the task of allocating forecasted demographics to a zonal level. There are many models already in use from sophisticated socio-economic models to more simple land suitability models. Regardless of the level of sophistication of the model it has become a state of practice to use one. Agencies use various criteria to find the appropriate model such as the amount of time, staff, cost, implementation, planning context, etc. The Capital Area Metropolitan Planning Organization (CAMPO) evaluated its previous method along with other well known models before it decided to develop one of its own for the CAMPO 2035 Plan update in 2007. This white paper documents the development and applications of the new demographic allocation tool for the draft CAMPO 2035 Plan.

Problem Statement

In support of the long range transportation plan process a travel demand model (TDM) is commonly used to evaluate future transportation scenarios. In order to run the TDM, demographics on population and employment are required at a zonal level. In the previous CAMPO plan update it was a standard practice to test different transportation scenarios using a single set of demographics. The demographics did not change to reflect a change in the transportation scenario and therefore had little integration between transportation investment and the effect on growth. As the field has advanced so has the understanding of the connection between land use and transportation. The two policies integrally influence each other yet CAMPO was not able to explore this and test it in the TDM for development of a new long range transportation plan. Understanding the current practice by metropolitan planning organizations (MPOs) in developing demographic scenarios and the integration of such methodology with travel demand modeling has become a pursuit of CAMPO staff for applications in the transportation plan updates.

Previous Options

As was the case for most small and many large MPOs the commonly used method for developing a single demographic scenario was the Delphi technique. The Delphi process originally developed by the RAND Corporation has been used for decades in forecasting. The basis of the process is that a panel of experts develops a consensus through a series of questionnaires. The Modified Delphi process used at CAMPO was developed in 1997.

The base year data on population, number of households, employment, and median household income by traffic analysis zone was provided by CAMPO staff. The initial process of selecting criteria of suitability analysis was performed by a consultant. The consultant met with CAMPO staff to discuss the local growth policies, development constraints, anticipated land development projects, and other factors that may influence patterns of future growth. An initial working scenario of future growth on population and employment was presented by the consultant at an open house. City and county planning staff reviewed the population and employment forecasts. Specific growth and development projects and corrections to technical errors due to geo-coding were incorporated into the forecasts. Iterations of meetings were hosted to discuss the revised

forecasts with the city and county staff. After the draft final forecasts being performed by the consultant, a quality assurance review panel was formed to review such forecasts as the final forecasts. The panelists included staff from major cities and county, and individuals who were knowledgeable of market forces, current trends, and local growth policies. The final population and employment forecasts were then used in the TDM process for the CAMPO 2025 Plan update. A similar process performed by different consultants led to the development of the CAMPO 2030 Plan update five years later.

Solution

There are many ways to develop demographic forecasts whether it is a model or the Delphi technique. The Delphi technique produces reasonable results but is subject to many shortcomings and weaknesses. One of the biggest drawbacks in Delphi type techniques is that it relies on expert knowledge for plotting future growth trends. It is a significant challenge to replicate results by those who were not involved in the previous process. Also, it takes many months using the Delphi process to conclude final forecasts. CAMPO staff's prior experiences in the CAMPO 2025 and 2030 Plan updates clearly indicated that the need to develop multiple demographic scenarios for the development of the draft 2035 Plan in weeks makes it impractical to rely on the Delphi type techniques. With advances in technology some MPO's are able to develop multiple demographic scenarios supporting different transportation scenarios. MPO's choose a model based on many characteristics, including: how long it will take to have a fully running model, the availability of data, staff resources, cost, etc. All of these factors went into consideration when CAMPO chose to develop its own method of allocating demographics.

The Demographic Allocation Tool (the Tool) was developed to replace the Delphi technique and was an alternative to acquiring a land use model for many reasons. At this time CAMPO staff was not be able to handle a more sophisticated socio-economic model in large part due to the lack of additional staff, data requirements, time constraints, and cost. The development of the Tool allows CAMPO to do what is needed while avoiding the drawbacks of other models and the previous methods. Among other benefits from developing the Tool, it 1) allows CAMPO to have an in house knowledge of the Tool, 2) combines GIS and technical knowledge in TDM and land use policies to make allocations, and 3) successfully creates multiple demographic scenarios in an efficient amount of time.

First, the Tool was developed by a consultant but the knowledge was transferred to CAMPO staff for full implementation and use. Working with the consultant while developing the Tool allowed CAMPO staff to have an in depth understanding of the working of the Tool and consequently to possess a full ownership the Tool.

Second, the Tool is a GIS based technical approach to allocating demographics. It is both quantitative and qualitative in nature. The Tool incorporates the existing growth trends and relies on the available land use control data regulating growth while allowing technical staff in the region to make changes based on professional judgment. The Tool allocates growth based on a geography's (a grid cell of 36 acres) attractiveness to development. The attractiveness measures are similar to other models in the industry; however, the main parameter comes from the TDM. The TDM uses base year demographics to assign travel times to every traffic analysis zone (TAZ) then in the

forecast year those travel times are used to assign a level of attractiveness by auto and transit accessibility. A TAZ's attractiveness to development will increases over time when a new transportation project is developed. This parameter is updated in a stepwise manner using the previous forecast year results as the base line input for the next allocation, with the idea that development lags behind transportation. This parameter feedback is an effort to integrate the effects of transportation investment policy with land use allocation.

Third, the Tool successfully created multiple demographic scenarios in its short existence. The Tool began development in early 2007 and was functioning in early 2008. Successive improvements were made to the Tool in 2008. The Tool was in full implementation and used to create multiple rounds of scenarios for the development of the CAMPO draft 2035 Plan between January 2009 and February 2010. Each round created population and employment (basic, service, and retail) allocations for three interim years and one horizon year (from 2008 to 2010, 2015, 2025, and 2035) for the five counties in Austin Metropolitan Statistical Area (MSA). Each round had a specific development pattern based on the transportation system used.

Round 1 focused growth around a no-build transportation system. Round 2 allowed CAMPO staff to test a trend demographic scenario on an automobile focused transportation system (Trend) and a high density demographic scenario on a transit oriented transportation system at 37 designated activity centers (Centers). Round 3 narrowed the focus to two variations of transit oriented transportation systems with a high density demographic scenario (modified Centers). Using those results a fourth round was created using the transportation projects in the Draft Plan and a high density demographic scenario set to meet specific growth targets in population and employment. All of these rounds were accomplished in about one year leading to adoption of the plan.

There were 420 allocations made for the four rounds mentioned above. Each forecast year required four separate allocation runs (population and three employment types) per county. An automation to run the four allocations successively by county for each forecast year was established in Round 2. One complete round of one growth scenario for the five counties with four forecast years produces a total of 80 allocations. Round 3 produced 20 extra allocations to differentiate two sets of transportation projects for the forecast year 2035 proposed by CAMPO's Technical Advisory Committee. Each one of these allocations can be recalled and replicated by anyone by pulling up the Tool interface.

Implementation

Implementation of the Demographic Allocation Tool requires the following steps.

I. Selecting an Allocation Geography:

Implementation of the Tool begins with the selection of an allocation geography. The allocation geography is the unit that growth is allocated. The current allocation geography is based on a 36 acre grid cell with nine acre grid cells in activity centers. The grid cells are also split along TAZ boundaries in order to sum up the results back to the TAZ level.

II. Developing Base Year Data:

Developing the base year in 2005 was done at the TAZ level using available data to estimate number of households and jobs. Households were estimated using an E-911 phone database by geographically locating households with phone lines. The same E-911 data used to estimate households were then used to designate number of households by grid cell in the base year. Jobs were estimated using available Texas Workforce Commission ES 202 data which was geographically located to an address. The 2005 base year jobs were summed to the TAZ level but were not designated to the grid cells for use in the Tool.

III. Collecting Input Data:

Collecting input data is the most crucial step in the allocation process because the results will directly reflect what is entered into the Tool. There are several types of input data needed. First, it is important to collect data that will act as restraints to development. Secondly, it is important to collect data that will then determine the type of development. The data that acts as restraints are flood plains, steep slope, parks, preserves, cemeteries, right of ways, etc. The data that determines the type of development are the land use and the zoning plans, site plans, subdivision plans, and other information adopted by cities and counties.

IV. Applying Input Data to Geography:

Equally important to collecting the input data is applying it to the allocation geography. The allocation geography has several attributes that CAMPO staff needs to fill in. The attributes include: base year households and household size, future developable acres, future household and/or employment density, and future household size. Every forecast year has the same set of attributes that need to be filled in (e.g. future household density for 2010, 2015, 2025, and 2035). The input process can be continually updated with new information until the forecast allocation begins. After each round in the 2035 Plan update process improvements were made to the input data making the next round more accurate than the last.

V. Deciding County Forecast Totals:

Deciding the county forecast totals can be done at any step in the process. Leading to the 2035 plan update the county totals were approved by CAMPO board at the beginning of the process. Several forecast assumptions were reviewed and the board adopted an averaged scenario of the State Demographer's highest (1.0) and medium growth (0.5) scenarios for all counties.

VI. Deciding Attractor Settings:

The attractor settings are used to determine the allocation geography's attractiveness to development. The higher its attractiveness the more likely it will be allocated to with household or job growth. The attraction parameters were decided during development of the Tool by the consultant with feedback from CAMPO staff. Along with the Accessibility measures from the TDM there are also Attractor Points, Attractor Constants, and Activity Center class ratings. Each parameter has to be created for each run. An attractor point designates a higher level of attractiveness at the

center of the point then gradually decreases outwards. The location of the point is subject to professional judgment but serves the purpose to increase an areas attractiveness that otherwise is not covered in the Accessibility parameter (i.e. proximity to schools, hospital, the CBD, etc.). The Attractor Constant is any additional value given to a specific allocation geography in order to increase its attractiveness without affecting the one next to it. These constants can be used to increase the allocation geography's likelihood of allocation when the other parameters do not account for other reasons for its attractiveness. The attractor constants were added to Round 4 in order to rank grid cells higher in attractiveness if they contained known residential developments. The final parameter gives an additional value to grid cells that were designated as Activity Centers. The belief is that growth would be encouraged to occur within Activity Centers based on transportation investments. A weight can also be applied to each parameter to make one parameter account for more attractiveness. In the first application of the Tool all of the parameters were given an equal weighting.

VII. Running and Analyzing the Results:

After setting up the input data and the Tool parameters there is one more step required before it can be run and analyzed. The last parameter in the Tool is setting up the Distribution Curve. The distribution curve controls how focused or spread-out the growth is allocated. The steeper the curve the more growth is available for the top ranked cells, therefore having a more focused allocation. The lower the curve the more growth is reserved for the lower ranked cells, therefore having a more spread-out allocation (assuming the highest ranked cells are Urban and the lowest are Rural). Each county can have a different curve theoretically based on its degree of urbanization. CAMPO staff applied the same curves for all five counties with minor adjustment to the slope of curves for out years. It may take several runs using different curves to find the distribution suitable for each county. After the allocations are done there are various ways to analyze the results. A place to start could be checking to see if any TAZs grew at an abnormally large rate. If a few did it may be a result of the distribution curve being set too steep. A more qualitative approach is to see if known developments reached expectations or grew at a reasonable rate.

Future Improvements

For future implementation there is not much that needs to be changed. However there are several changes that can improve the whole allocation process.

I. Parcel Level Geography

A major improvement to the process should be changing the allocation geography. The geography can be at any geographic unit; but, for future implementation it would be beneficial if it could be improved at the parcel level. When all of the input data is at the parcel level, it makes it easier not having to translate it to the grid cell geography. Advancements in this dataset would allow for an accurate estimate of households for future base years by parcel instead of grid cell. Available tax appraisal data and other sources of data would also be available to designate the parcel's status in the base year.

Another improvement from changing the allocation geography allows the allocation geography for population and employment to be the same. Having both

household and job allocations at the parcel level allows them to coordinate by being designated as residential, commercial, or mixed-use.

By having the allocations done at a parcel level it makes it easy to sum up the results for population and employment by jurisdictional boundaries. Most jurisdictions that forecast for their city limits can then easily compare the results to their own.

II. Testing of Parameters

A second potential improvement is to conduct further tests to find out how to reflect actual market growth patterns using the attractor parameters. Also, there may be a need to develop distribution curves spatially and temporally. Various distribution curves would allow for various degrees of urbanization by county spatially. The temporal variations in distribution curves would allow the tool to account for the progression of urbanization in each county.

III. Calibration of the Tool

A third possible refinement is to develop a calibration procedure comparable to the base year model calibration in TDM. This could extend the current function of the Tool from a planning scenario tool to a fully functional model comparable to land use models used by the large MPOs.

Summary

In summary, the Demographic Allocation Tool meets expectations in its ability to allocate future growth while staying within staffing, budget, and time constraints. The ability to make multiple scenarios in conjunction with alternative transportation scenarios outperforms the old method using the Modified Delphi technique. The Tool accomplishes many things sophisticated models can while staying open and transparent to the process. By maintaining the Tool in house, integrating the travel demand model in the process, and successfully using the Tool in the 2035 planning process the Tool has proven its worth. By outlining the process from data collection to data interpretation CAMPO staff can assure the successful implementation of the Tool in future plan updates. In order to achieve successful implementation of the Tool an ongoing effort must be made to implement each step from base year to plan adoption. Upon Peer Review of CAMPO's modeling process it was stated that the Tool is the right direction and above and beyond most MPO's current practice. In the end, the Demographic Allocation Tool is capable of producing numerous scenarios and is a capable scenario planning tool.

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