# Introduction of Information Feedback Loop To Enhance Urban Transportation Modeling System

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The Urban Transportation Modeling System (UTMS) is a methodology used to estimate travel demand in response to changes in land use patterns, roadway characteristics, and socioeconomic factors. This demand is measured by the volume of traffic that flows through a system of streets and highways. Through the use of traffic assignment software, parts of UTMS have become automated. One of the newest automated processes is the extraction of a subarea from a larger regional model. This extraction process is important to the local planner because it maintains a link from the regional model to the local model and allows the planner to extract an already distributed trip table rather than build one from scratch. This subarea extraction process, as practiced, is a one-way information flow. The regional model is calibrated and its information is passed down to the subarea model. It is suggested that an "information feedback loop" should be inserted into the process. The subarea model information is looped back to the regional model and used in the regional calibration. The enhanced procedure is applied to a northern New Jersey network. The results show that the new methodology improved the calibration of the regional model, particularly in the vicinity of the subarea focus model. This new methodology is the key to developing subarea focus models with properly distributed trip tables. In addition, the results are used to develop general conclusions about the applicability of the feedback process.

The Urban Transportation Modeling System (UTMS) is a set of procedures used by transportation planners to estimate travel demand in response to changes in land use, roadway characteristics, and socioeconomic factors. UTMS is commonly referred to as the "four-step modeling process": trip generation, trip distribution, modal split, and route assignment (*1*). The UTMS process historically has focused on the regional impact of major transportation improvements and significant changes in land use. The regional models that have been developed to address these issues generally include only freeways, expressways, and major arterials. Roads that primarily serve local traffic are not included. Because of the desired accuracy levels, as well as technological limitations, detailed network coding for traffic signals, traffic control devices, and interchange configurations are not considered. Individual zones may be neighborhoods or even as large as municipalities.

More recently, environmental concerns as well as changes in the legislative and policy areas have resulted in closer scrutiny and analysis of smaller areas within the regional models. The need to respond to these issues, coupled with the availability of microcomputer transportation planning software packages such as QRS-II (*1*), MINUTP (*2*), and TRANPLAN (*3*), has led to the development of local area models. Compared with the regional model, the focus of the local area model is on the roadways that serve local traffic. Detailed network coding, including interchanges and traffic control devices is generally included. Individual zones may represent a residential subdivision, or a major employment center in a suburban area, or even a single block in an urban area. The questions to be answered by the local model concern the impacts of local zoning changes, major and minor residential or commercial development, and transportation system improvements such as improved traffic signal coordination and local roadway widenings.

Regional and local area models are developed to respond to different questions and to address different issues. However, they do share a large common pool of information regarding the physical characteristics of the network, as well as the demand for travel. The ability to "share" information between regional and local models has traditionally been a one-way flow. Network and travel demand information from the regional model is extracted and used as part of the development of the local area model. This paper outlines an improved flow of information that enhances the extraction process and uses the information from the local area model to create an "information feedback loop" to improve the regional model. This improvement results in a benefit at both the regional and local levels. The enhanced process is applied to a case study in northern New Jersey. The results of the case study are used to develop general conclusions about the applicability of the feedback process.

## BACKGROUND

At one time the development of local area models simply did not consider the impacts of any changes that occur outside the local area boundaries. It has now become evident that transportation planning on all levels is interconnected and that the "planning-in-a-box" method of local area model development is no longer acceptable. One way in which transportation planners have attempted to respond to this need is by expanding the capabilities of its computer models to include a new analysis tool called the "subarea focus model" or "subarea windowing." The subarea focus model is a technique of extracting a subset of a larger area for use in developing a local area model.

The subarea extraction process is straightforward. Given the graphic representation of a regional transportation network, defined as a set of links (highway, roads, etc.) and nodes (origins, destination, intersections, etc.), the user first defines the limits of the study

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area, or subarea, by drawing a cordon line around it. Then, each link that crosses the cordon line is specified. These cordon links become the external stations for the subarea region; the traffic volumes of these links will represent all travel demand originating from or destined to the world external to the subarea. Travel demand within the subarea is unaffected by the extraction process. The result of the extraction process is a highway network containing all of the information from the regional network (number of lanes, capacities, free-flow speeds, etc.) and a travel demand matrix, or trip table, for trips with origin or destination, or both within the subarea. The extracted highway network and travel demand matrix form the basis for the local area analysis. Local streets not included in the regional model may be added as well as more detailed link coding for interchanges and divided highways. Additional information for individual links with respect to traffic control devices, local speeds, and capacities may be added as well. The travel demand matrix may be subdivided to a finer zone structure to represent specific subdivisions or employment sites.

The benefits of the subarea extraction process are threefold. First, the local area model reflects changes external to the local area. These changes include land use patterns and traffic conditions on the regional level. Second, the local area model is developed in less time. The local planner can start with the extracted network and travel demand information rather than create these components from scratch. In addition, because of the utilization of the trip generation, trip distribution, and mode choice steps from the regional model, the need to conduct traffic counts and collect origin-destination data for through traffic (i.e., traffic that has neither origin nor destination within the local area) is minimized. Third and final, the local area model should have greater accuracy, because it reflects the calibration of the regional model.

## EXISTING METHODOLOGY

The subarea extraction, or subarea windowing, process is a significant step in transportation planning applications because it provides a connection between regional and local area models. In the process however, the connection is in one direction only: information from the regional model is used to develop and improve the calibration of local area models. No information from the local area models is used to improve the regional model calibration. Furthermore, the calibration of the regional model may be significantly worse for an individual area than for the region as a whole. As a result, although the local area model may benefit from the calibration of the regional model, it may also contain any biases or errors inherent in the regional model.

The traditional subarea extraction methodology, within the UTMS context, is illustrated in Figure 1. As indicated in the figure, the calibration of the regional and local area models are discrete steps within the process and the flow of information is from the regional model to the local area model only. The process starts with the calibration of the regional model, typically through iterative application of regional area trip generation, trip distribution, and route assignment steps. Once the calibration of the regional model is complete, the local planner extracts the local highway network and travel demand volumes. Other information that may be extracted include population and employment estimates, trip generation equations, and existing traffic count data. This extracted information forms the basis of the local area model. The local area network is then adjusted to better reflect local conditions. The travel demand matrix is adjusted to match existing traffic counts. The calibration of the local area model is performed, again typically through iterative application of local area trip generation, trip distribution, and route assignment steps.

## PROPOSED METHODOLOGY

The proposed enhancement to the subarea extraction process adds an information feedback loop. As mentioned earlier, the calibration of the regional model may be significantly worse or biased for an individual area than for the region as a whole. As a result, it may be problematic to calibrate an extracted local area model. The proposed enhancement alleviates this problem by incorporating improvements to the regional model as part of the local area calibration process. Information from the local area model is used, or looped, to improve the regional model calibration.

The proposed methodology is shown in Figure 2. In contrast to the existing methodology, the calibration of the two models is merged into a single step. In addition, information now flows from the local area model to improve the regional calibration. The proposed methodology also begins with the calibration of the regional model, typically through iterative application of regional area trip generation, trip distribution, and route assignment steps. However, in contrast to the traditional methodology, the calibration of the regional model is not considered complete before the subarea extraction. The calibration of the local area model is performed, and the results are used to improve the regional model calibration as well. This process, or loop, is repeated until the regional model is sufficiently calibrated in the vicinity of the subarea, as well as regionally. The remainder of this paper concentrates on the application of this enhanced process to a case study in Bergen County in northern New Jersey.

## CASE STUDY

The New Jersey Department of Transportation (NJDOT) currently possesses two regional highway transportation models: the North Jersey model, which includes the northern 13 counties of the state and adjacent areas in New York and Pennsylvania and the South Jersey model, which includes the southern 6 counties of the state and adjacent areas in Pennsylvania and Delaware. The development and calibration of these models is an ongoing process. Changes in technology as well as improved information sources including the U.S. Bureau of the Census and the New Jersey Department of Labor and new telephone, mail, and interview origin-destination surveys have all contributed to improve accuracy and sophistication.

The North Jersey model covers an area of 13 counties and over 200 municipalities. The network includes most of the freeways, expressways, and major arterials in the northern portion of the state: it consists of 1,377 internal traffic analysis zones and 9,970 network links, representing more than 17,773 lane-km (11,055 lane-mi) of roads. The case study uses a previously extracted portion of the North Jersey model, the Northwest Bergen County model, or Northwest model, which is shown in Figure 3. This model covers an area of one-quarter of one county and 16 municipalities. The network consists of 210 internal traffic analysis zones and 1,629 network links, representing 730 lane-km (454 lane-mi) of roads. The Northwest model includes population and employment matrixes, trip production and attraction formulas, trip distribution methodology,

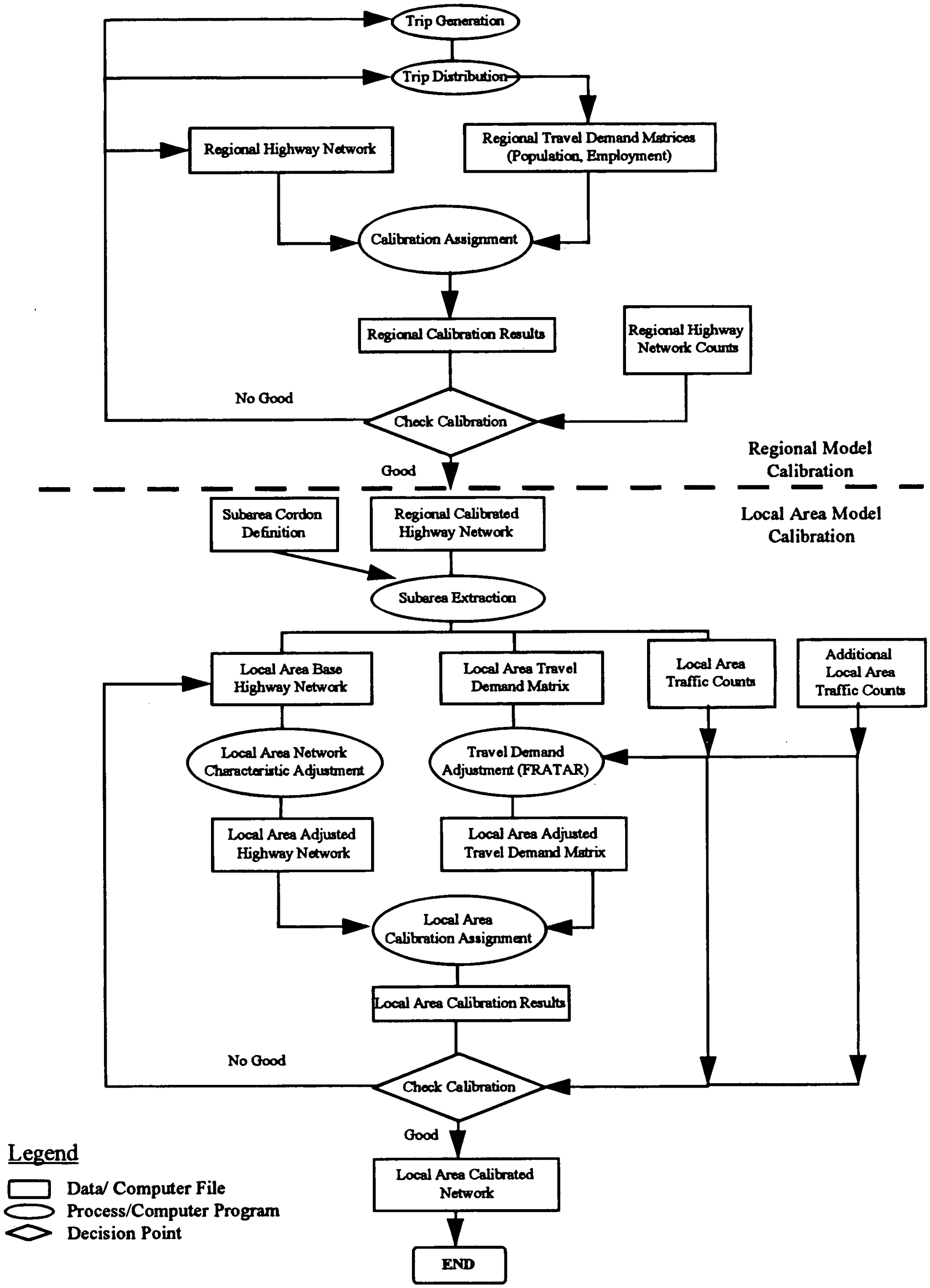


**FIGURE 1 Traditional subarea extraction process.**

existing travel demand matrix, roadway inventory by facility type and area type, free-flow speed and capacity information by facility type and area type, existing traffic counts, and a calibrated network.

For the case study, the northwest model had been calibrated previously as part of ongoing work being done by Bergen County. First, information is extracted from the northwest model to create the subarea model. This is accomplished through application of a route assignment with a defined subarea cordon. The output is a subarea highway network focused on the Route 4–Route 17 interchange, shown in Figure 4, and travel demand matrix.

Second, existing traffic counts to be used in the subarea model calibration are identified. To achieve good calibration of the subarea network, adequate local traffic count information must be available. As part of the subarea extraction process described above, traffic

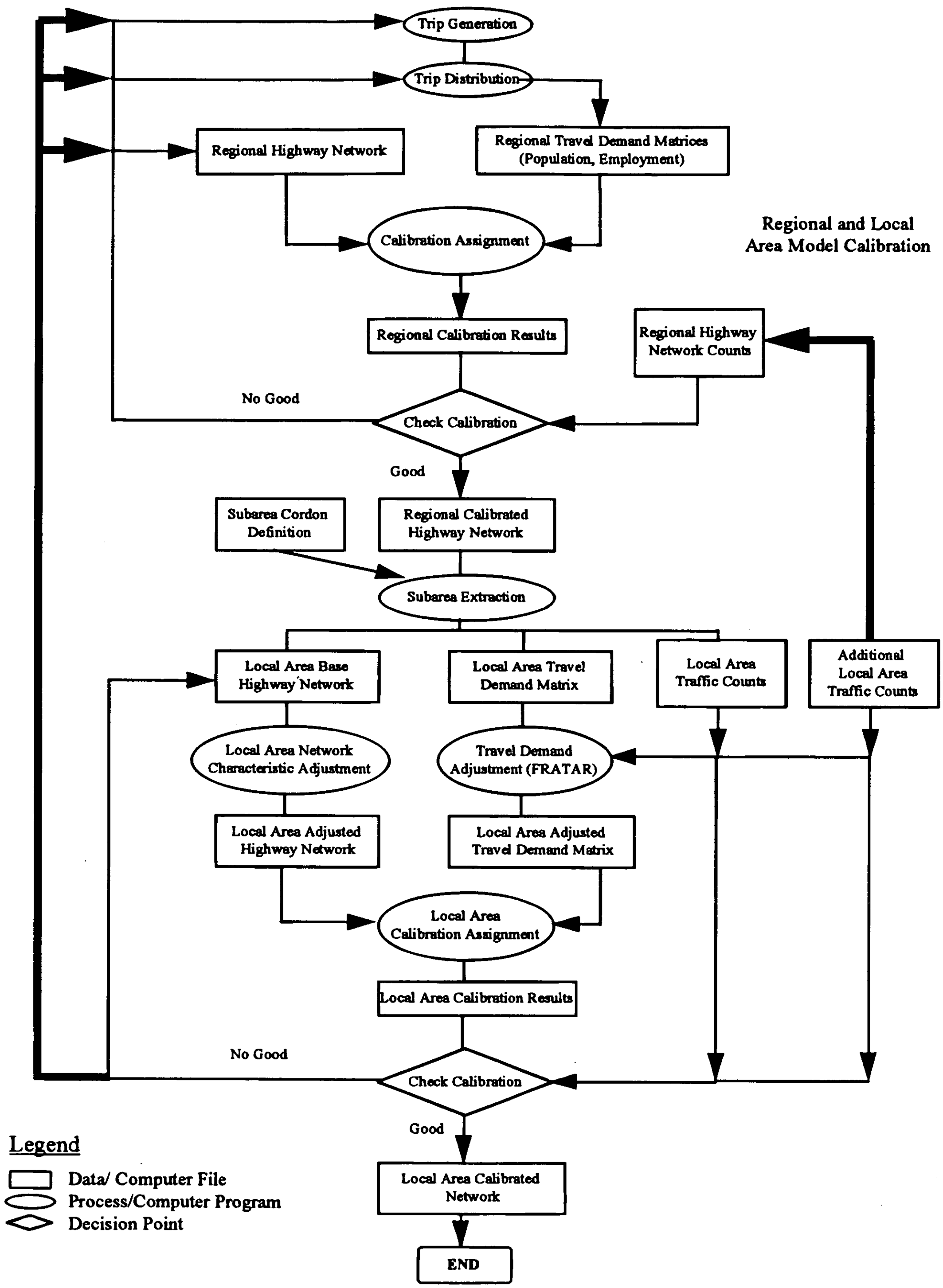


**FIGURE 2** New subarea extraction process.

counts are extracted as part of the highway network. The locations of these extracted counts are noted in Figure 4. These counts alone are not sufficient to ensure good calibration because they do not include all cordon points, specifically the local road system. The subarea focus region must model the behavior of the outside world through the cordon points. Consequently, accurate traffic counts are required on all cordon points, especially in this case study because of its large "through-traffic" component, that is, traffic that neither begins nor ends within the subarea. The extracted traffic count data base is enhanced through conducting additional counts and by collecting information from local sources such as the municipal police departments and local traffic impact studies. The locations of these additional counts are also noted in Figure 4.

The traffic counts at each of the cordon points are then used as "target values" to adjust the extracted travel demand matrix. This adjustment process is typically done using the FRATAR process


**FIGURE 3 Northwest Bergen County model network (*5*).**

(*2*). FRATAR is a method used to adjust the trip distribution by iteratively applying factors to adjust origin and destination totals. Its shortcoming is that it is purely mathematical in nature and thus does not have a mechanism that allows it to account for network topology and performance. Hence, errors or bias in the regional trip distribution in the vicinity of the subarea would then be exacerbated. Herein lies one of the problems of the traditional methodology: it provides no ability to check the impact of the FRATAR method on trip generation or distribution. This problem is alleviated by providing a feedback loop to improve the regional calibration in the vicinity of the subarea before performing the FRATAR process.

Once the subarea travel demand matrix has been adjusted, free-flow speed and capacity adjustments are made to the extracted subarea highway network. Link speeds and capacities in the regional model are typically based on facility type (freeway, expressway, major arterial, minor arterial, etc.) and area type (central business district, urban, suburban, rural, etc.) only. This method of estimating speed and capacity is generally accurate for most links in a regional model. Consequently, it is not warranted to determine the impacts of geometric or physical attributes on each link in a regional model. However, attributes other than facility and area types do have a significant impact on both speed and capacity for individual links. For a local area model therefore, it may be warranted to identify individual links with extraordinary attributes. Consider two links representing an Interstate freeway in a suburban area. The first link is located several miles from adjacent interchanges; the second link is located in a weaving section between adjacent ramps of a major interchange. The base free-flow speed and capacity of both links would be similar; however, the effective speed and capacity of the second link is clearly significantly less. The attributes of links

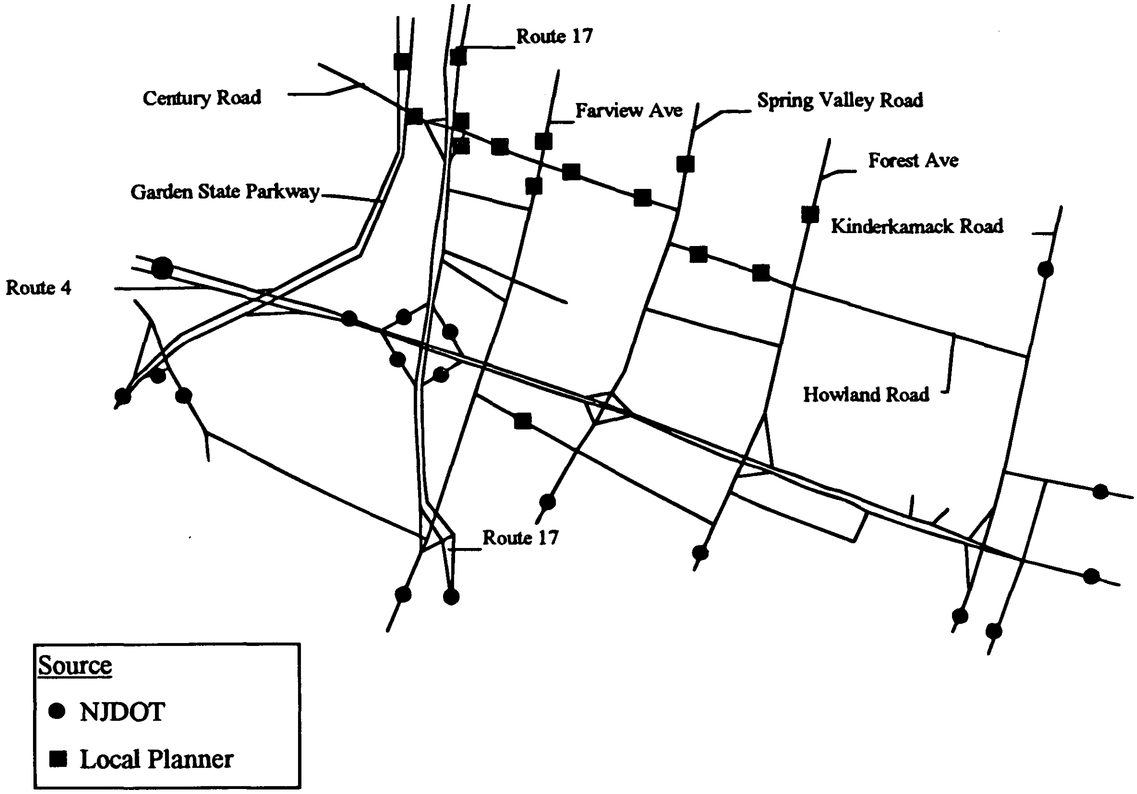


FIGURE 4 Subarea traffic count locations (*5*).

with the poorest calibration, generally the links with the lowest volumes, are adjusted first, whereas the best calibration, or highest volume links, is done last.

The subarea link attribute changes are used in the local area model calibration. Once the local area model calibration has been completed, these link changes are applied to the regional model. Also, the travel demand extraction and adjustment process may have uncovered errors—that is, too many, too few, or poorly distributed trips—in the subarea focus region. If these errors exist, they may be corrected by adjusting the trip generation or trip distribution in the regional model. The regional calibration process is then repeated using the improved information from the subarea model that is fed back to the regional model.

Once the revised regional calibration assignment has been done, statistics on two levels are checked. If the calibration is improved in the subarea focus region as well as for the regional model as a whole, the process continues with the subarea extraction and local area calibration. If the calibration improvement in the subarea focus region is at the expense of the regional model as a whole, the magnitude of the changes to the highway network or travel demand, or both, will need to be reduced. The process is an iterative one as the local planner seeks to improve the calibration at both the regional and local levels.

Finally, the subarea network and travel demand matrix are again extracted from the regional model. At this point, the revised travel demand distribution is compared with the initial extraction from the northwest model. Again, the FRATAR method is used to adjust the extracted trip table to match the traffic counts. However, the improvements to the regional model calibration in the vicinity of the subarea will result in an improved extracted trip table distribution. Consequently, the FRATAR process will have less impact on the subarea trip distribution. Enhancements to the local area network have already been incorporated in the regional model. Hence, no changes are required to the local area network. The local area assignment is then performed and the process is complete.

## CASE STUDY RESULTS

To assess the success of the new methodology, calibration results of the case study are compared with the traditional method of subarea extraction. This is done for the whole Northwest model, and for the region of subarea focus—the Route 4–Route 17 subarea. The calibration is evaluated on both levels to check that better calibration in the subarea is not gained at the expense of calibration accuracy at the regional network level. The following are five ways in which the U.S. Department of Transportation (DOT) compares traffic assignment accuracy (i.e., model calibration) (*4*).

1. A comparison of total counted volume versus assigned volume across some aggregation, such as total study area or screenlines.
2. A comparison of total vehicle kilometers of travel from ground counts to vehicle kilometers of travel from the assignment results.
3. Developing a total weighted error between ground counts and assigned volumes.

**TABLE 1 Performance Measures for Subarea Using Traditional Methodology**

| Volume Range | | Number of | Total Volume | | Difference | | Square Error | |
|---|---|---|---|---|---|---|---|---|
| Lower | Upper | Records | Counted | Assigned | Assigned - Counted | Percent (%) | Root-Mean | Percent (%) |
| 0 | 5,000 | 9 | 27,864 | 41,075 | 13,211 | 47.41 | 2,421 | 78.19 |
| 5,001 | 10,000 | 32 | 238,105 | 263,352 | 25,247 | 10.60 | 3,644 | 48.98 |
| 10,001 | 30,000 | 15 | 188,026 | 201,260 | 13,234 | 7.04 | 4,755 | 37.93 |
| 30,001 | 50,000 | 9 | 417,948 | 409,157 | -8,791 | -2.10 | 3,790 | 8.16 |
| 50,001 | 60,000 | 8 | 478,220 | 513,846 | 35,626 | 7.45 | 6,672 | 11.16 |
| 60,001 | 70,000 | 15 | 1,003,512 | 1,011,102 | 7,590 | 0.76 | 5,200 | 7.77 |
| All Links | | 88 | 2,353,675 | 2,439,792 | 86,117 | 3.66 | 4,262 | 15.93 |

4. The calculation of the root-mean-square (*RMS*) errors comparing ground counts to assigned volumes by link within volume range stratification, such as

$$RMS = \sqrt{\frac{\sum_i (X_{gc} - X_{ta})^2}{N - 1}}$$

where

$X_{gc}$ = ground count on link $L_i$,
$X_{ta}$ = volume assigned on link $L_i$,
$N$ = total number of links in observations group, and
$i$ = index 1 through $N$.

The *RMS* error measures the deviation between two distributions—in this case counted and assigned link volumes. The percentage *RMS* error is derived by dividing the *RMS* error by the average group count for a particular group.

5. A graphic comparison of ground counts versus assigned volumes For this discussion, the Methods 1 and 4 are used as assignment calibration measures.

Using the new methodology at the Northwest model level, the planner realizes an improvement of 0.05 percent, or 3,321 vehicles (224,555 versus 221,234) in total counted versus total assigned volume. The *RMS* error improves by 13 vehicles (from 4,124 to 4,111), whereas the *RMS* percentage improves by .08 percent (28.28 percent versus 28.19 percent. Because of the minor nature of the network edits (20 out of 1,629 links) in the subarea region, one would not expect the calibration results to improve by much. But the fact that they do improve is enough to proceed with the comparison of the local area calibration results.

Table 1 presents the calibration statistics for the Northwest model in the region of the subarea focus as received from NJDOT. The absolute difference of total counted volume to total assigned volume is 86,117 vehicles, or 3.66 percent. The *RMS* error for the subarea focus region is 4,262 vehicles, whereas the *RMS* percentage is 15.93 percent. Table 2 indicates calibration statistics of the same network using the new methodology. The absolute difference of total counted volume to total assigned volume is 73,185 vehicles or 3.11 percent. The RMS error for the entire network is 4,144 vehicles, whereas the *RMS* percentage is 15.49 percent. Using the new methodology, the user has realized an improvement of 0.34 percent, or 12,932 vehicles in total counted versus total assigned volume. The *RMS* error has improved by 118 vehicles (from 4,262 to 4,144), whereas the *RMS* percentage has improved by 0.44 percent (from 15.93 to 15.49 percent). The improvements are relatively small, but by an order of magnitude greater than they were at the Northwest model level.

The third and most conclusive measure of validation of the new methodology is a comparison of the extracted subarea trip tables. Table 3 is a compressed district trip table for the traditional methodology. The 11 districts are represented in Figure 5. For this discussion, all internal zones are compressed into the first district because the subarea process does not affect them. This fact will be borne out in a comparison of the extracted trip tables.

Table 3 indicates that the total trips extracted for the subarea are 473,133. Table 4 is a compressed district trip table from the new methodology. It indicates that the total trips extracted for the subarea are 482,437, which is only 2 percent greater than the figure generated by the traditional methodology. However, the importance of the new methodology is seen in Table 5, which contains the differences between the two extracted trip tables and indicates that the distributions of each table are vastly different. As an example, the total number of trips destined to District 6 in Tables 3 and 4 is identical and equal to 9,316. However, an examination of Table 5 indicates that the origins of these trips are quite different. Using the new

**TABLE 2 Performance Measures for Subarea Using New Methodology**

| Volume Range | | Number of | Total Volume | | Difference | | Square Error | |
|---|---|---|---|---|---|---|---|---|
| Lower | Upper | Records | Counted | Assigned | Assigned - Counted | Percent (%) | Root-Mean | Percent (%) |
| 0 | 5,000 | 9 | 27,864 | 25,824 | -2,040 | -7.32 | 1,447 | 46.75 |
| 5,001 | 10,000 | 32 | 238,105 | 231,941 | -6,164 | -2.59 | 3,092 | 41.56 |
| 10,001 | 30,000 | 15 | 188,026 | 206,182 | 18,156 | 9.66 | 4,897 | 39.06 |
| 30,001 | 50,000 | 9 | 417,948 | 411,087 | -6,861 | -1.64 | 2,843 | 6.12 |
| 50,001 | 60,000 | 8 | 478,220 | 536,782 | 58,562 | 12.25 | 7,574 | 12.67 |
| 60,001 | 70,000 | 15 | 1,003,512 | 1,015,044 | 11,532 | 1.15 | 5,201 | 7.77 |
| All Links | | 88 | 2,353,675 | 2,426,860 | 73,185 | 3.11 | 4,144 | 15.49 |

TABLE 3 Extracted Subarea Trip Table Using Traditional Methodology

| | | Destination District 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O | 1 Internal | 10950 | 1818 | 442 | 10777 | 4204 | 2890 | 8540 | 7178 | 5729 | 7285 | 14371 | 74184 |
| r | 2 Century | 1074 | 0 | 0 | 3134 | 575 | 299 | 319 | 483 | 956 | 833 | 0 | 7673 |
| i | 3 GSPNorth | 1577 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42592 | 863 | 45032 |
| g | 4 Rt17Nrth | 7421 | 2827 | 0 | 209 | 1647 | 473 | 17521 | 5245 | 26848 | 72 | 5116 | 67379 |
| i | 5 ParamusW | 4607 | 604 | 0 | 1750 | 172 | 156 | 1970 | 1378 | 1179 | 2196 | 1826 | 15838 |
| n | 6 ParamusE | 3365 | 37 | 0 | 296 | 398 | 0 | 1494 | 2292 | 626 | 1007 | 1517 | 11032 |
| | 7 Rt4East+ | 7975 | 327 | 0 | 18320 | 1007 | 1172 | 2594 | 8703 | 807 | 3513 | 10873 | 55291 |
| D | 8 SthEast | 6623 | 480 | 0 | 5300 | 863 | 1875 | 9147 | 1553 | 2368 | 3267 | 5150 | 36626 |
| i | 9 Rt17Sth | 5975 | 1545 | 0 | 24520 | 1097 | 526 | 891 | 2467 | 0 | 638 | 7810 | 45469 |
| s | 10 GSPSth | 7638 | 0 | 40050 | 0 | 1520 | 941 | 4112 | 3626 | 676 | 0 | 7255 | 65818 |
| t | 11 Rt4West+ | 11004 | 0 | 9816 | 0 | 2343 | 987 | 9762 | 4524 | 6282 | 4073 | 0 | 48791 |
| | Total | 68209 | 7638 | 50308 | 64306 | 13826 | 9319 | 56350 | 37449 | 45471 | 65476 | 54781 | 473133 |

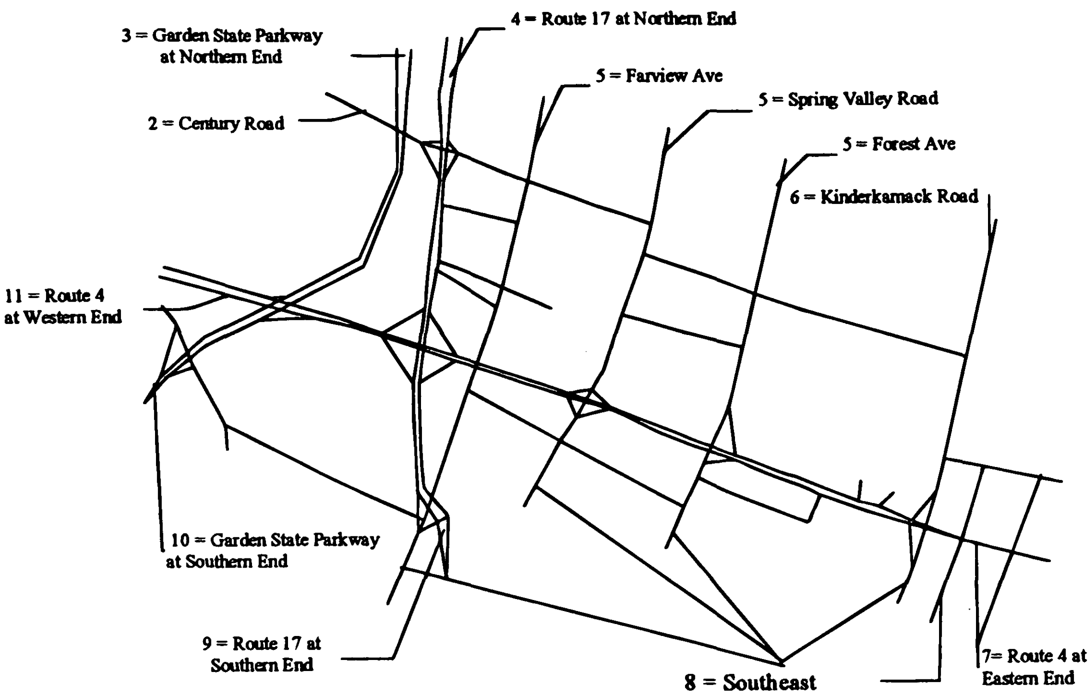


FIGURE 5 Subarea trip table reporting districts (*5*).

TABLE 4 Extracted Subarea Trip Table Using New Methodology

| | | Destination District 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O | 1 Internal | 9895 | 1707 | 442 | 10740 | 4473 | 2521 | 8242 | 6928 | 5529 | 7285 | 16422 | 74184 |
| r | 2 Century | 1012 | 0 | 0 | 3134 | 572 | 21 | 319 | 483 | 956 | 833 | 0 | 7330 |
| i | 3 GSPNorth | 1483 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43242 | 844 | 45569 |
| g | 4 Rt17Nrth | 7556 | 2827 | 0 | 209 | 1626 | 2 | 18206 | 5455 | 27070 | 72 | 5106 | 68129 |
| i | 5 ParamusW | 5622 | 579 | 0 | 1568 | 202 | 896 | 2103 | 1535 | 1179 | 1546 | 1879 | 17109 |
| n | 6 ParamusE | 1565 | 26 | 0 | 0 | 1549 | 0 | 1494 | 2292 | 626 | 1007 | 2473 | 11032 |
| | 7 Rt4East+ | 4451 | 327 | 0 | 18012 | 1128 | 1172 | 2594 | 8703 | 807 | 3513 | 14584 | 55291 |
| D | 8 SthEast | 4679 | 480 | 0 | 5168 | 958 | 1875 | 9147 | 1553 | 2368 | 3267 | 7131 | 36626 |
| i | 9 Rt17Sth | 5975 | 1545 | 0 | 24595 | 1097 | 526 | 891 | 2467 | 0 | 638 | 7735 | 45469 |
| s | 10 GSPSth | 7638 | 0 | 40050 | 0 | 1520 | 941 | 4112 | 3626 | 676 | 0 | 7255 | 65818 |
| t | 11 Rt4West+ | 18333 | 0 | 9796 | 0 | 2404 | 1365 | 9242 | 4407 | 6260 | 4073 | 0 | 55880 |
| | Total | 68209 | 7491 | 50288 | 63426 | 15529 | 9319 | 56350 | 37449 | 45471 | 65476 | 63429 | 482437 |

**TABLE 5 Trip Differences Between Extracted Subarea Trip Tables**

| | | Destination District | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Total |
| O | 1 Internal | -1055 | -111 | 0 | -37 | 269 | -369 | -298 | -250 | -200 | 0 | 2051 | 0 |
| r | 2 Century | -62 | 0 | 0 | 0 | -3 | -278 | 0 | 0 | 0 | 0 | 0 | -343 |
| i | 3 GSPNorth | -94 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 650 | -19 | 537 |
| g | 4 Rt17Nrth | 135 | 0 | 0 | 0 | -21 | -471 | 685 | 210 | 222 | 0 | -10 | 750 |
| i | 5 ParamusW | 1015 | -25 | 0 | -182 | 30 | 740 | 133 | 157 | 0 | -650 | 53 | 1271 |
| n | 6 ParamusE | -1800 | -11 | 0 | -296 | 1151 | 0 | 0 | 0 | 0 | 0 | 956 | 0 |
| | 7 Rt4East+ | -3524 | 0 | 0 | -308 | 121 | 0 | 0 | 0 | 0 | 0 | 3711 | 0 |
| D | 8 SthEast | -1944 | 0 | 0 | -132 | 95 | 0 | 0 | 0 | 0 | 0 | 1981 | 0 |
| i | 9 Rt17Sth | 0 | 0 | 0 | 75 | 0 | 0 | 0 | 0 | 0 | 0 | -75 | 0 |
| s | 10 GSPSth | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| t | 11 Rt4West+ | 7329 | 0 | -20 | 0 | 61 | 378 | -520 | -117 | -22 | 0 | 0 | 7089 |
| | Total | 0 | -147 | -20 | -880 | 1703 | 0 | 0 | 0 | 0 | 0 | 8648 | 9304 |

methodology, 740 vehicles have shifted from highways to local roads. A large number of these trips (471) shifted from Route 17.

If it is assumed that the regional trip table has a good trip distribution, and the calibration statistics indicate that the calibration in this area is improved, then it is safe to conclude that the distribution of the new methodology is superior. These comparisons support the claims that the new methodology is more sound.

## CONCLUSIONS

The case study used to demonstrate the new methodology involves a regional model and a subarea of the regional model. It has been shown that by using the new methodology, improvement was realized in the calibration of the regional model, and trip distribution was improved in the vicinity of the subarea. This improved calibration process is the key to developing subarea focus models with properly distributed trip tables.

The authors believe that the new methodology with an information loop will work at all levels of the modeling process. The state DOTs in general, and NJDOT, in particular, could require that any transportation model that is funded or reviewed by the state DOT must have its basis on the DOT's statewide model. Planners would set up and collect data specific to their area and replace these new attributes back into the regional model, attempting to gain a better calibration for their specific area. Once this information has been processed by the local planner, the data can be channeled back to the state DOT. Modifications can then be made to the statewide modeling chain which would translate into new link attributes or new coefficients for production and attraction equations.

This new set of data, which is now tailored to the subarea region, would be incorporated into the modeling process. As the process continues, some of the realized benefits would be

- An enhanced statewide traffic count data base,
- Updates for the trip generation equation coefficients,
- Standardized data collection techniques,
- Incrementally better trip distributions,
- Standard statewide screenlines,
- Reduction in duplication of data collection,
- Improvements of calibration results at all levels,
- More efficient use of planning budgets, and
- Better dialogue between federal, state, and local officials.

Consistency and greater frequency between calibration updates would draw the modeling community closer to responding to changing issues in a reasonable length of time. This would eliminate the excuse of the model being "out of date." Better calibration logically yields better forecasts, and better forecasts provide planners with the needed insights to perform the land use and infrastructure planning process.

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