STUDY OF OPERATIONAL IMPACTS OF DESIGNATED TRUCK LANES

V. P. Sisiopiku, PhD & O. Cavusoglu, MSCE
Department of Civil, Construction, and Environmental Engineering
University of Alabama at Birmingham
vsisiopi@uab.edu; ozge@uab.edu

ABSTRACT

There is an increased interest in the use of dedicated truck-lanes as a lane management technique for separating traffic streams to reduce turbulence and optimize network performance. This study examines the potential role of truck lanes strategies in addressing traffic congestion issues in the Birmingham, Alabama, USA metropolitan area. The objective of the study was twofold:

a. Better understand available options related to designated truck lane implementation, and
b. Quantify potential operational impacts from implementation of select options in the Birmingham region.

To meet these objectives, the paper first reviews the state of practice and best practices from earlier deployment efforts. Assessment of potential operational impacts from implementation of various truck lanes schemes along a common testbed in Birmingham follows. This involved traffic modeling and analysis using VISTA, a sophisticated mesocopic simulation and dynamic traffic assignment modeling tool. The study revealed that the optimal truck lane use strategy is the conversion of one existing general purpose lane to a shared use truck lane. The research methods used in this study and the findings from the analysis are expected to benefit both the scientific community and those agencies and authorities responsible for planning, designing, implementing, managing, and operating transportation facilities.

1. INTRODUCTION

Trucks are the backbone of logistics and economic success, and national projections are that freight shipments will double in the next ten years. This increase will have a significant impact on the level of congestion along our nation's transportation infrastructure creating new challenges and new opportunities for traffic management. Another issue to consider is that trucks have different acceleration and deceleration rates and weaving capabilities when compared to passenger cars. This often compromises the transportation network's operational efficiency and traffic safety, as well as the comfort and convenience of all users.

One approach in addressing these concerns is the introduction of dedicated truck lanes. The main purpose of this strategy is to separate trucks from general traffic in order to increase traffic safety and network throughput (1). Moreover, truck-only lane facilities may reduce travel time or increase time reliability for truck users, which is a very important consideration in freight transportation. Truck facilities have also some positive impacts on the environment. The literature review suggests that the implementation of truck facilities may reduce air and noise pollution, as well as fuel consumption. According to a study done by the TTI (2), if the average annual daily truck traffic (AADTT) reaches 5,000 trucks per day, a truck facility should be considered.

Urban areas in Alabama face traffic management and congestion mitigation challenges similar to those identified nationwide. In 2005, for example, 12.4 million person-hours were wasted in Birmingham alone due to congestion. This translates to a cost of congestion in the area of $234 million dollars, or nearly five times the figure reported twelve years earlier ($53 million in 1993). The 2005 Urban Mobility Study by the Texas Transportation Institute (TTI) listed Birmingham, AL as one of the medium-sized urban areas with higher congestion or faster increases in urban congestion than their counterparts (3). As some major corridors for freight travel traverse through urban areas in Alabama such as Birmingham, it is believed that some of the congestion and environmental issues faced there can be attributed to truck movements. In an effort to address these issues, a study was conducted to assess the potential impacts from management of truck movements through the use of truck lanes in the Birmingham area.

This paper provides an overview of available truck lane options, and describes the methods used, data gathered, assumptions made and outputs obtained from the feasibility analysis performed along a stretch of I-65 in Birmingham. The case study is expected to provide some useful insights on the potential use of truck-lanes as a lane management tool in urban settings.

1.1. Study Objectives

The objective of the study described in this paper was twofold:

a. Better understand available options related to truck lane implementation, and
b. Quantify potential operational impacts from implementation of select options in the Birmingham region.

These objectives were accomplished through an extensive literature and state-of-the practice review of truck lane facilities, traffic simulation modeling and comparison of selected truck lane design options considered along a common testbed.

The overall study objective was to develop a better understanding of truck lanes and their potential to address congestion issues in urban areas.

2. TRUCK LANE FACILITIES OPTIONS AND IMPLEMENTATION REQUIREMENTS

2.1. Types of Truck Lane Facilities

According to a study by TTI in 1985 (4), there are seven typical types of truck lane facilities. The first type is a minimum median truck lane. It consists of a 12-ft inside truck lane with 5-ft inside shoulders. The non-truck traffic uses the outside lanes, and the lanes are not barrier separated. The second type has a similar configuration to the first type except from the presence of 10- to 12-ft long shoulders. The third type refers to a truck lane that is on a 12-ft outside lane with 12-ft outside shoulders. These lanes are also non-barrier separated. The next type is a four-lane facility. The two 12-ft inside lanes are designated for trucks with 5-ft-long inside shoulders. This type also is not barrier separated from the outside car lanes. The fifth type of truck lanes design is similar to the second type. The only difference is a depressed median. Trucks travel on 12-ft lanes with 10-ft shoulders. Another option is a protected lane with a passing lane. In this configuration, 12-ft lanes are used with a 4-ft inside shoulder and a 10-ft outside shoulder. This type of truck facility is a barrier-separated facility. Figure 1 also shows the configuration of the protected truck lane with a passing lane. The last type is an elevated truck lane, which has the same configuration as the protected truck lane.

The best option for potential implementation should be chosen according to the availability of Right-of-Way (ROW), local travel patterns, geometric characteristics of the roadway of interest, and capital and operational cost considerations.

2.2. Traffic Control Devices for Truck Lane Facilities

On a truck facility, trucks tend to follow each other closely, causing signs to be blocked by the lead vehicle. For that reason, the placement of traffic signs should be considered carefully to enhance visibility. Oversize and overhead signs should be preferred. Detailed traffic control guidelines are available for truck facilities in the Manual of Traffic Control Devices (MUTCD). Traffic signs are used to inform truck drivers about lane restrictions, safe passing, merging, and diverging movements, as well as weight limits (5).

2.3. Operation Strategies and Enforcement of Truck Lane Facilities

Differences in acceleration rates, stopping distances, weaving capabilities, and roll stability are special characteristics of trucks that cause them to behave differently than other modes. Separating trucks from other traffic can be done spatially and/or by time of day. Spatial separation can be performed by placing trucks on exclusive truck lanes. Truck lane restrictions can also be applied to certain hours of the day. For example, trucks are not allowed on I-10 Highway in Texas on weekdays during daylight hours when traffic flows are heaviest.

Various operation strategies are commonly used for truck traffic management. The first strategy allows trucks to remain in the mixed traffic stream but restricts them to certain lanes. Alternatively, trucks may be restricted from certain lanes. In other words, when trucks are restricted from the far left lane or right lane, they are allowed to use the other lanes in mixed traffic. There should be at least three lanes on each side to apply truck lane restrictions.

According to a study performed by TTI (4), truck lane restrictions improve traffic operations and reduce the potential truck-car conflicts by separating low-speed vehicles from faster moving ones. An example of a successful implementation of such type of truck traffic management is in Broward County, FL where vehicles with 3 or more axles were restricted from the far left lane on I-95 on a 25-mile segment, during the morning and afternoon peak hours (6).

Another truck traffic management strategy involves truck roadways or truck-only facilities that are completely separated from other traffic. Cars are not allowed on truck roadways. Such treatment is particularly beneficial when the number of trucks and the crash rates involving trucks are high. With the introduction of truck facilities, the roadway section turns to a dual facility where there is an inner and outer roadway in each direction. One example of a truck-only facility is the New Jersey Turnpike. While the inner roadway in the New Jersey Turnpike is reserved for non-trucks, the outer roadway is a truck-preferred facility, which serves truck traffic, along with passenger vehicles. Generally speaking, truck-only facilities are not widely used due to high cost and mixed public perception (4).

2.4. Implementation of Truck Lane Facilities

No universally accepted implementation criteria exist for truck lane implementation. For example, TxDOT has developed specific criteria for lane restrictions for trucks; e.g. the facility should have at least three lanes in each direction, and an engineering study should be conducted before implementation (4). A cost effectiveness analysis should be performed before implementation as well.

2.5. Evaluation of Truck Lane Facilities

The literature review indicates that truck traffic management in the U.S. primarily involves truck lane restrictions or dedicated truck lanes on shared-traffic facilities (6). Several states are currently considering the implementation of truck-only lanes. The Missouri State 2007 Long Range Transportation Plan, for instance, includes dedicated truck lanes on I-70 as a potential strategy to meet future needs. The expected cost of the investment is approximately $7.2 billion (7). In Georgia, the GDOT conducted a preliminary study in 2007 that includes the construction of truck-only lanes on I-75 North, I-85 North, I-75 South, I-20 West, and I-285 in the metro Atlanta. The first phase includes the construction of truck-only lanes on I-75 North, I-285 West, and I-75 South (8). Examples of truck management facilities currently in operation are briefly introduced next.

2.5.1 Los Angeles, CA

The State of California has operated a 2.42-mile truck roadway near Los Angeles since the 1970s. To provide a truck roadway, the California Department of Transportation (CALTRANS) used an old roadway parallel to I-5 north of Los Angeles and just north of the I-5/I-405 interchange. Cars are allowed to use all of the truck facilities (4). Another truck traffic management strategy implemented in the Los Angeles area is truck bypass lanes at high volume interchanges. Truck bypass lanes are considered at locations where safety is a concern due to speed differentials or where weaving capacity is exceeded. Lane restrictions on bypass truck facilities in California require trucks to remain in the right lanes to avoid weaving maneuvers. There are three truck bypass lanes at interchanges in the Los Angeles area namely, I-5 at I-405 north of Los Angeles; I-5 at I-405 in Orange County, and I-405 at I-110/SR-91. The trucks exit the main lanes upstream of the first exit ramp and reenter the main lanes downstream of the interchange. After the implementation of truck facilities on I-5, the number of crashes involving trucks decreased by 85% (4).

2.5.2 Newark, New Jersey

The New Jersey Turnpike has a dual-dual roadway configuration between Interchange 8A and Interchange 14 that extends for a distance of 32 miles. While only cars are allowed to use the inside roadway of the facility; cars, trucks, and buses use the outer roadway, as shown in Figure 2 (4). Approximately 40% of total traffic uses the outer roadways. The total annual truck traffic volume on the New Jersey Turnpike was 27,649,048 vehicles in 2001 with an estimated rate of growth of truck traffic on the facility of 7% annually. According to turnpike authority personnel, safety concerns and congestion on New Jersey roads led to the implementation of the dual-dual facility. The New Jersey Turnpike Authority works closely with the state police and contracts towing and emergency response services for incident management on the turnpike. Wreckers, ambulances, and fire-fighting equipment and personnel are available for emergencies 24 hours a day and a specialist is on call for any emergency involving trucks that carry hazardous materials (4).

2.5.3 Atlanta, Georgia

The first attempt to restrict trucks to right lanes (except to pass or to make a left-hand exit) was made in Georgia in 1986 (9). Twenty years later, Georgia's State Road and Tollway Authority (SRTA) considered constructing separate truck-only lanes as a measure to ease traffic congestion in the Metro Atlanta region, and a statewide truck lane needs identification study was completed. It was found that, with the introduction of truck-only lanes and the shift of truck traffic to those lanes from general-purpose lanes, the congestion experienced would be reduced as a result of the reduction of the percentage and number of trucks in the general purpose (GP) lanes. Moreover, a reduction in the number of crashes was projected (8).

2.5.4 New Orleans, Louisiana

The Port of New Orleans, Louisiana (Port NOLA) receives 70% of the cargo arriving in Louisiana, and 80% of this freight is carried by trucks. In 1983, the city restricted trucks from this historic area. To address the needs of freight transportation, the Tchoupitoulas truckway was built as an exclusive truck facility. The facility had one 12-ft lane in each direction and 8-ft shoulders on both sides and was able to handle 2,000 trucks per day.

2.5.5 The Netherlands

In Netherlands, unmanned trucks carry sea containers on a Combi-Road Driverless Truck Guideway. Trucks are driven on dedicated tracks with active longitudinal guidance from seaports to inland terminals. (9).

3. STUDY DESIGN

3.1. Study Area

As mentioned earlier, the objective of this case study is to determine the impact of truck lane implementation on traffic operations in the Birmingham, AL region. The section of I-65 extending from I-459 to I-20/59 was chosen for further analysis. The section is within the area that shows greater promise for truck lane implementation as per the recommendations of an earlier regional fatal flows study (10). The following paragraphs provide information about the geometric design, demand, and operational characteristics of the study site.

3.1.1 Geometric Characteristics

The I-65 freeway is an interstate facility of major importance to the mobility of Alabamians and also a north-south route of national significance for the movement of people and goods. Extending as far north as Lake Michigan, I-65 connects the city of Birmingham with Nashville, TN, and Indianapolis, IN, to the north, and Montgomery and Mobile, AL, to the south. It also provides direct access to the Birmingham freeway system, including interstates I-20, I-59, and I-459, which serve local mobility needs as well as connect Birmingham to Atlanta, GA, to the east and Tuscaloosa, AL, and New Orleans, LA, to the west and south.

The study site is an approximately 10-mile long median-divided freeway section and extends from Valleydale Road (Exit 247) to I-20/59 (Exit 261). The mainline has typically three 12-ft lanes of traffic per direction with auxiliary lanes added near ramp locations. The posted speed limit along the I-65 study corridor is 60 mph and 45 mph on the ramps.

3.1.2 Birmingham Area Travel Patterns

Among U.S. metropolitan areas with populations greater than 500,000, Birmingham ranks third in the number of vehicle miles driven per day per capita with an average of 34.8 mpd (Schrank, et al. 2005). Between 1995 and 2000, the total travel vehicle miles in Jefferson County increased by 8.5%, while the increase in Shelby County was 18.8%.
Birmingham serves as a hub for goods movement within Alabama. Historically the city has had strong rail freight service, due mostly to the steel and coal industries. The convergence of Interstates 20/59 and 65 have also contributed to the area's growing truck freight industry (10).

3.1.3 Operational Characteristics of I-65 Corridor

Based on traffic counts reported by the Alabama Department of Transportation (ALDOT), the 2005 daily traffic volumes along the study segment of I-65 ranged from 75,000 to 125,000. By 2030, daily traffic volumes are expected to exceed 125,000 along the entire I-65 study section. The percentage of truck traffic on I-65 is nearly 8% of all vehicle traffic during peak hours based on 2005 traffic count data collected by the ALDOT (10).

3.2. Alternatives Analysis

Prior to a potential implementation of truck-only lanes along the I-65 corridor, a detailed alternatives analysis should be performed that uses traffic analysis tools to predict the impact of these strategies on traffic operations in the Birmingham area. Such analysis is the main objective of this study and requires the following steps:

1. *Model Selection*. Model selection refers to the selection of appropriate traffic analysis tools with the ability to model truck lanes.
2. *Data Collection and Processing*. Collection of required data (such as traffic volumes, geometric data, etc) and development of a model of I-65 and selected transportation facilities in the Birmingham area, using the simulation tool identified in Step 1, and
3. *Data Analysis.* Use of the simulation model developed in Step 2 to examine traffic operations with and without the presence of truck lanes strategies as well as assess different configurations of designs. The impact from implementation could be measured using selected measures of effectiveness (MOEs), such as travel speeds, travel times, delays, and fuel consumption.

The following sections provide details on simulation model selection, data collection and processing and data analysis for the Birmingham case study.

3.3. Simulation Model Selection

A detailed review of the model approaches, capabilities and limitations, along with considerations related to the availability of models and other resources, led to the selection of the Visual Interactive System for Transport Algorithms (VISTA) as the simulation tool for this study. VISTA utilizes a mesoscopic simulator called RouteSim and a dynamic traffic assignment (DTA) routine to emulate the behavior of individual drivers and how they distribute themselves into the transportation network. RouteSim is based on an extension of Daganzo's cell transmission model introduced by Ziliaskopoulos and Lee (11). In this model, the roadway is divided into small cells where the cells are adjustable in length; larger cells are used for a mid-section of a long highway segment, and smaller cells are used for intersections and interchanges. Vehicles are considered to be moving from one cell to another in platoons. The simulator keeps track of the flow in each cell and, every time step, calculates the number of vehicles that are transmitted between adjacent cells.

Initially, the RouteSim simulator in VISTA is run with vehicles assigned to the free flow shortest paths. The link travel times resulting from that assignment pattern are then used to calculate a new set of shortest paths, and the simulation is repeated with vehicles assigned to a combination of the paths in the previously calculated path set. At first, the link flows generated by the free flow shortest paths vehicle assignment can be different from the link flows generated by the simulation using the new set of calculated paths. Thus, iterations continue between the mesoscopic simulation and vehicle assignment until the link flows converge. This procedure accounts for vehicle path choice with changes in traffic conditions.

VISTA simulation model can be used for a wide range of applications in transportation engineering and planning. Some of the capabilities of VISTA are as follows (12).

- VISTA runs over a cluster of Unix/Linux machines and is easily accessible to any authorized users via Internet/ Intranet. This allows access to and use of the model by a variety of users and eliminates the need to install new software and software upgrades.
- VISTA uses a universal database model that can be accessed through a web interface or GIS interface. The GIS interface enables users to edit on the network.
- VISTA has excellent capacity for handling large networks. The model provides DTA capabilities. Dynamic User Equilibrium (DUE) is the main traffic assignment technique employed in VISTA. As a result, no user can switch path to decrease his/her travel time.
- VISTA is capable of distinguishing between informed and non-informed road users, as well as user classes, such as normal passenger cars, buses, and trucks in terms of operational characteristics.
- Congestion management strategies such as incident management, ITS technologies, and work zone management activities can be modeled easily.
- VISTA offers a number of pre-confined reports to provide information on various types of MOEs such as travel time, delays, and VMT. VISTA also offers other customized outputs by running queries to database directly in the web interface.

As a mesoscopic simulation-based DTA model, VISTA can meet the requirements of the study tasks by modeling the route choice of individual drivers and other important driver behaviors but limiting the level of detail when modeling driver interactions with the infrastructure and other drivers. This is accomplished by using various modules, a brief description of which follows. Additional details are available at www.vistatransport.com (13).

3.4. Truck Lane Scenarios

Three scenarios were designed to analyze their operational effectiveness of truck lanes. A consistent naming scheme was devised for easy reference. The name of each test scenario starts with 3 letters referring to the type of truck lane strategy considered (BNT=base case-No Truck Lane, ETL=Exclusive Truck Lane-No passenger cars allowed, or STL=Shared Truck Lane-Passenger cars allowed), followed by a numerical referring to the number of lanes per direction (3=3 lanes, or 4=4 lanes). More specifically:

- *Scenario BNT3* describes network operations under current conditions to provide the baseline for comparisons.
- *Scenario BNT4* assumes that a lane is added to the current network, and all lanes are available to be used by mixed traffic.
- *Scenario STL3* assumes that a lane is converted to a truck lane. Trucks are required to use the truck lane, while passenger cars may elect to use it as well.
- *Scenario ETL3* assumes that a lane is converted to a dedicated truck lane to be used exclusively by truck traffic.
- *Scenario ETL4* assumes that a dedicated truck lane is added to the network to be used exclusively by truck traffic.

A sensitivity analysis was performed in all scenarios to consider the impact of various percentages of truck traffic in the traffic stream. Truck traffic considered ranged from 4%, to 12% in increments of 4%. Table 1 summarizes details of the scenarios tested in this project.

Table 1 - Case Study Scenarios

Scenario	Total Number of Lanes per Direction	Number of Truck Lanes	Truck Lane Type	Sensitivity Analysis Performed (%trucks)
BNT3	3	0	-	Yes (4%, 8%, 12%)
BNT4	4	0	-	Yes (4%, 8%, 12%)
STL3	3	1	shared	Yes (4%, 8%, 12%)
ETL3	3	1	exclusive	Yes (4%, 8%, 12%)
ETL4	4	1	exclusive	Yes (4%, 8%, 12%)

3.5. Data Analysis

Network models were developed in VISTA to represent the conditions in the scenarios discussed above. In truck lane networks, a series of links were added in parallel to the general purpose links to represent the truck lane. When a scenario called for lane addition such links represented the added lanes. When a scenario simulated general purpose lane conversion to truck lane, the general purpose lanes along the I-65 mainline were reduced by one to accurately model the proper number of lanes. This approach was followed to overcome a difficulty created by the fact that the RouteSim simulator's working principle is based on links and not lanes, and thus a lane-by-lane analysis is not feasible.

Ten Variable Message Signs (VMS) were also added to selected locations throughout the study corridor to inform both truck and passenger car drivers about the truck lane option and divert the truck traffic while letting passenger car drivers to choose the shortest path during their journey as in real life as long as it is permitted throughout the scenario. For the purpose of choosing the shortest path some routes were defined as truck lane routes and others as general purpose routes and comparisons between their operational characteristics were allowed. Four of the VMS were located on the southbound direction, and 6 VMSs were on the northbound direction of the study corridor.

4. SIMULATION RESULTS

4.1. Base Case Results (BNT3 and BNT4 Scenarios)

Table 2 presents results from the sensitivity analysis performed under the current configuration (BNT3). Consideration of the network total delay time shows that the network performs optimally for 8% truck traffic. When a general purpose lane is added (BNT4) significant savings in delay time (43%) and total travel time (4%) are realized- as expected, along with a slight increase in average travel speed.

Table 2 - Base Case Scenarios Results (BNT3 and BNT4 Scenarios)

Scenario	Total Travel Time (veh-hrs)	Total Delay Time (veh-hrs)	Avg. Travel Speed (mph)	Delay Time (min/veh-mile)	Total Time (min/veh-mile)
BNT3 (4%)	131,715.14	10,328.23	45.426	0.129	1.434
BNT3 (8%)	131,947.14	9,832.21	45.321	0.126	1.432
BNT3 (12%)	136,938.75	14,627.06	45.159	0.166	1.473
BNT4 (4%)	126,051.90	5,941.87	45.761	0.094	1.395
BNT4 (8%)	126,123.11	5,883.47	45.714	0.094	1.396
BNT4 (12%)	126,663.44	6,363.93	45.631	0.098	1.401

4.2. Converting Lane Case Results (STL3 and ETL3)

4.2.1 Simulation Results

Table 3 summarizes the results obtained when converting an existing general purpose lane into a truck lane for shared (STL3) or exclusive (ETL3) use. The results are from simulation studies performed in VISTA assuming that the users continue to use their regular paths when the truck lanes are first implemented and demonstrate the network performance soon after the implementation of the truck lane scenarios.

Several observations can be made from the analysis of the results. First, it becomes apparent that for the same % of truck traffic the dedicated truck lane works better under the shared traffic option (i.e., when cars are allowed to use the truck lane) rather than the

Table 3 - Converting Lane Case –Simulation Results (STL3 and ETL3 Scenarios)-
Unfamiliar Users

Scenario	Total Travel Time (veh-hrs)	Total Delay Time (veh-hrs)	Average Travel Speed (mph)	Delay Time (min/veh-mile)	Total Time (min/veh-mile)
STL3 (4%)	135,030.45	14,091.21	44.426	0.155	1.468

STL3 (8%)	131,261.44	11,156.70	44.447	0.134	1.452
STL3 (12%)	128,917.38	10,494.17	44.440	0.139	1.461
ETL3 (4%)	128,883.84	14,782.31	44.064	0.162	1.479
ETL3 (8%)	126,101.80	11,915.19	44.087	0.141	1.463
ETL3 (12%)	124,199.39	11,858.29	44.081	0.149	1.475

exclusive truck-use option. For instance, for 12% trucks in the traffic stream, the shared truck lane option yielded total network delay time of 10,494 veh-hrs, or 13% less than the exclusive truck lane option (11,858 veh-hrs). A likely reason for this is that in the ETL3 scenario the dedicated truck lane is underutilized for the % truck considered in the analysis. It should be noted, that the performance of the exclusive truck lane option improves as the percentage of truck users increases (from 14,782 veh-hrs of total delay in ETL3(4%) to 11,858 in ETL3(12%), or a 20% improvement). The comparison of the converting lane case results to the base case (BNT3) in Table 2 further indicates that the conversion of a general purpose lane to a truck lane can only be justified for the 12% truck option.

4.2.2 DTA Optimization Results

Table 4 summarizes the results obtained when converting an existing general purpose lane into a truck lane for shared (STL3) or exclusive (ETL3) use, assuming that the users are now familiar with the treatment. The results are from optimization studies performed in

Table 4 - Converting Lane Case –Optimization Results (STL3 and ETL3 Scenarios)-Familiar Users

Scenario	Total Travel Time (veh-hrs)	Total Delay Time (veh-hrs)	Average Travel Speed (mph)	Delay Time (min/veh-mile)	Total Time (min/veh-mile)
STL3 (4%)	127,124.26	5,963.21	45.649	0.092	1.396
STL3 (8%)	128,216.35	6,365.45	45.480	0.097	1.403
STL3 (12%)	129,229.16	7,218.21	45.329	0.105	1.412
ETL3 (4%)	131,310.41	9,313.17	44.899	0.119	1.429
ETL3 (8%)	131,005.33	8,914.61	44.964	0.118	1.428
ETL3 (12%)	131,749.71	9,385.40	44.958	0.123	1.433

VISTA using its DTA capability assuming that the users have been considering new path options to further optimize their travel in the presence of the truck lanes. These results demonstrate the network performance in the long term, when the users become familiar with the implementation and impact of the truck lanes on local traffic operations.

The results in Table 4 show that the conversion of an existing lane to a truck lane yields best results under the shared traffic mode of operation as compared to exclusive truck traffic use. The total travel time and total delay are lower in STL3 scenario and travel speeds as slightly higher than in ETL3 for similar percentages of truck traffic. Comparison of results in Tables 4 and 2 further clearly demonstrates that both lane conversion options (STL3 and ETL3) clearly result in improved network performance, compared to the base line (BNT3) for any % truck traffic considered. Among the two lane conversion options tested, the STL3 option is preferable as it leads in greater gains in network operational performance (up to a 50% reduction in total delay for 12% truck traffic). Furthermore, comparison of findings in Tables 4 and 3 indicates that while no to moderate improvement in network performance should be expected soon after the implementation of the lane conversion strategy, significant gains will be realized in the long run, as users become familiar with the treatment and seek ways to further optimize their travel routes.

4.2.3 Adding Lane Case Scenario Results (DTL4)

Scenario DTL4 assumed that a lane is added to the network to serve truck traffic. A sensitivity analysis was performed where the percentage truck usage was varied incrementally to evaluate short- and long-term performance measures (i.e., unfamiliar and familiar users). The results from the analysis are summarized in Table 5.

Table 5 - Add Lane Case- Simulation and Optimization Results (DLT4)

Scenario	Modeling Option	Total Travel Time (veh-hrs)	Total Delay Time (veh-hrs)	Avg. Travel Speed (mph)	Delay Time (min/veh-mile)	Total Time (min/veh-mile)
DTL4(4%)	Simulation	120,984.90	6,392.01	44.957	0.103	1.420
DTL4(8%)	Simulation	119,349.74	6,483.14	44.923	0.107	1.426
DTL4 (12%)	Simulation	117,101.70	6,572.37	44.832	0.111	1.433
DTL4 (4%)	Optimization	126,724.59	6,052.51	45.689	0.095	1.398
DTL4 (8%)	Optimization	126,515.50	5,847.69	45.676	0.094	1.398
DTL4 (12%)	Optimization	128,551.25	6,872.44	45.388	0.102	1.408

The comparison of total delays and speeds in Table 5 (DLT4) and Table 2 (BNT4) reveals that in the case of a lane addition no improvement in system performance is achieved by designating the lane as a truck lane for any % of truck traffic within the study range. In other words, the added capacity serves well the needs of all users and no further improvement is expected from separating truck traffic from the rest of the traffic stream. Thus, a designated truck lane is not justified under the study assumptions when a lane is added on the study facility.

5. CONCLUSIONS

This paper first investigated the impacts from conversion of a freeway lane to truck lane for shared or exclusive use by trucks along a testbed in Birmingham, AL. Then addition of a lane was considered with the added lane being a general purpose lane or a lane designated for truck use. The VISTA environment was employed to construct the models. VISTA allowed for consideration of near- and long-term impacts from potential implementation as it allows for both simulation and DTA/DUE optimization. Analysis of the study findings revealed the following:

- In the short term, a general purpose lane conversion to a truck lane is justified only for 12% truck traffic and above. However, in the longer term, significant gains in delays and travel time are to be realized as drivers become familiar with the new treatment and seek alternative routes to optimize their travel. Thus the lane conversion to a truck lane is justified, on the basis of operational impacts.

- Should a general purpose lane be converted to a truck lane, shared use of the truck lane would lead to greater benefits in network performances compared to those expected from exclusive use of the truck lane by trucks.
- Addition of a lane on the study network further improves the overall network performance, however, designation of the added lane as a truck lane has little to no impact on traffic operations, and thus is not justified.

It is recommended that further calibration and validation studies are performed to improve modeling accuracy and the confidence in the model findings. Moreover, additional analysis can be performed to explore alternative congestion management strategies that may be more appropriate to address current and future travel needs in the Birmingham area. Examples include High Occupancy Vehicle lanes (HOV), speed harmonization, temporary shoulder use, and dynamic signing and rerouting.

Moreover, the success of implementation greatly depends on public support for the project and positive public perception. Thus, the role of public education in the early planning stage is critical and should not be overlooked. Focus groups, open public discussion forums, public information sessions, and media coverage are useful tools that can assist local agencies to obtain input from the public and other local stakeholders and educate truck drivers and other road users about the new treatment.

Finally, it is recommended that a cost-benefit analysis be performed to estimate potential benefits and costs, including capital, operation, and maintenance costs for the public and private sectors from the implementation of truck lane strategies in the Birmingham region.

REFERENCES

1. The California Department of Transportation (CALTRANS) Web Page. Available online at: http://www.dot.ca.gov/hq/traffops/trucks/ops-guide/truck-lanes.htm (February, 2008).
2. TTI the Texas A&M University System (2003), "Truck Accommodation Design Guidance: Policy Maker Workshop", *Report 4364-3,* October 2003. http://tti.tamu.edu/documents/4364-3.pdf (Accessed on February, 2008).
3. Schrank, D. and Lomax, T. (2005). "The 2007 Urban Mobility Report", *Technical Report of Texas Transportation Institute, the Texas A&M University System.* Available online at: http://tti.tamu.edu/documents/mobility_report_2007_wappx.pdf (Accessed on August 7, 2007).
4. TTI the Texas A&M University System (2003), "Truck Accommodation Design Guidance: Final Report" *Report 4364-1,* October 2003. Available online at: http://tti.tamu.edu/documents/0-4364-1.pdf (Accessed on February, 2008).
5. U.S. Department of Transportation, Federal Highway Administration (FHWA) (2003). *"Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways 2003 Edition."*
6. Center for Urban Transportation Research (2002), "The Potential for Reserved Truck Lanes and Truckways in Florida", *Report 21-17-422-LO,* May 2002. http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_PL/FDOT_BC353_16_rpt.pdf (Accessed on February 2008).
7. Missouri Department of Transportation (MoDOT) (2007), "Missouri's Long-Range Transportation Plan" April 2007. Available online at: http://www.modot.mo.gov/ExpressLane/documents/LRTP.pdf (Accessed on March 2008).
8. Summary of Mid-Georgia/South Georgia Public Meeting, "GDOT Truck Lane Needs Identification Study" October 23, 2007, Macon State College – Macon, Georgia. Available online at: http://www.gatrucklanestudy.com/pdf/Macon%20Public%20Meeting%20Summary.pdf (March, 2008).
9. FHWA (2003), "Freeway Management and Operations Handbook" Technical Report. http://ops.fhwa.dot.gov/freewaymgmt/publications/frwy_mgmt_handbook/chapter8_01.htm (March, 2008).
10. Regional Planning Commission of Greater Birmingham (RPCGB) (2006). "Magic 65: Existing Conditions Technical Memorandum." Available online at http://www.magic-i65.com/pdf/ExistingConditionsMemo.pdf (Accessed on June 2007).

11. Ziliaskopoulos, A. K., and Lee, S. (1996). ‘‘A Cell Transmission Based Assignment simulation Model for Integrated Freeway/Surface Street Systems’’. Proc., 75th Transportation Research Board Annual Meeting, Washington, D.C.
12. Sisiopiku, V.P., Acharya, A., Anderson M., and Turner D. (2009). “Evaluation of Traffic Signal Performance under Oversaturated Conditions Using VISTA”. Proceedings of the 2009 Transportation Simulation Symposium (TSS 09), Spring Simulation Multiconference 2009, San Diego, CA.
13. Vista Transport Group Inc., (2005). “Visual Interactive System for Transportation Algorithm - Software Walk Through.” Available online at: http://www.vistatransport.com (Accessed on June 2007).

ACKNOWLEDGMENT

This work was funded by the Research and Innovative Technology Administration (RITA) - U.S. Department of Transportation (US DOT) through the University Transportation Center for Alabama. The authors gratefully acknowledge the support from these sponsors.

INFORMATION ABOUT THE AUTHORS

Dr. **Virginia Sisiopiku** is an Associate Professor of Transportation Engineering in Civil, Construction and Environmental Engineering at the University of Alabama at Birmingham (UAB). She holds MSCE and PhD degrees from the University of Illinois at Chicago and has extensive experience in traffic management and control systems, emergency management, Intelligent Transportation Systems, and transportation simulation modeling. She is an active member of TRB, ITE, ALSITE, and the faculty advisor of the UAB ITE Student Chapter.

Ms. **Ozge Cavusoglu** is a Research Assistant at the University of Alabama at Birmingham (UAB). She holds a B.S. degree in Urban and Regional Planning from Mimar Sinan University, an M.Sc. degree in Urban and Regional Planning from Gebze Institute of Technology (GIT), and an MSCE degree in Civil Engineering from UAB. She is currently pursuing a PhD degree in Transportation Engineering at UAB.