Calgary Tour-Based Microsimulation of Urban Commercial Vehicle Movements

Case Example Resource Paper

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Abstract

This paper describes the representation of commercial vehicle movements in the Calgary Region provided by a tour-based microsimulation system, a working model with a history of use in practical forecasting and policy analysis. The model provides explicit representation of vehicle movements for transport and delivery of both goods and services, with ‘for-hire’ or ‘carrier’ services included as the transport sector providing the service of moving goods. The lack of an explicit representation of shipments per se allows some of the complexities associated with such representation to be avoided. Yet the model still accounts for truck routes and responds to truck restrictions and related policy. It includes all types of commercial vehicles, from light vehicles to heavier single unit and multi-unit configurations. All sectors of the economy are incorporated into the representation, including retail, industrial, service and wholesaling. The model has been connected with an aggregate equilibrium model of household-related travel, with the trips tables from the two models assigned jointly to the relevant network representations. The microsimulation processes in the model are performed using external Java applications.

Key Words

urban commercial movements; freight modeling; goods and services delivery; tour-based microsimulation; transportation modeling; policy analysis; forecasting; logit modeling; Monte Carlo techniques
Introduction

The City of Calgary in Canada has a Regional Travel Model (RTM) that covers the Calgary Region. The RTM is used in practical policy analysis and forecasting work by both the City of Calgary and the Province of Alberta Transportation Department. In recognition of the expected benefits, a system for modeling commercial vehicle movements has been developed to work with the RTM, providing representation of the full range of transport of goods and services. This paper presents, in order:

• an overview of the full Calgary RTM, providing an indication of the position and role of the commercial vehicle movement component within the full RTM;
• a detailed description of the commercial vehicle movement component using the tour-based microsimulation approach, covering the different elements of this microsimulation in some depth;
• a description of the calibration of the tour-based microsimulation component;
• an overview of the resulting capabilities of the full model; and
• some conclusions about what has been achieved and what has been learned in this work regarding the modeling of these movements.

Calgary Regional Transportation System Model

The Calgary Region is an area centered on the City of Calgary and extending out approximately 80 km in all directions to include a hinterland of largely agricultural lands dotted with satellite towns and smaller market centers. In 2001 it had a total population of just over 1 million.

The Calgary RTM includes three basic components, the personal travel demand model, the commercial vehicle model and the joint vehicle assignment process.

The personal travel model represents the behavior of travelers making trips for household purposes, covering about 85% of the vehicle trips and vehicle kilometers internal to the Calgary Region. The commercial vehicle model represents the movements of light, medium and heavy vehicles for commercial purposes, including transport and delivery of goods and services, covering about 15% of the vehicle trips and vehicle kilometers internal to the Calgary Region.

The personal travel model is an aggregate, equilibrium model. It includes representation of 25 travel segments based on person category and movement type. Various private vehicle and transit modes are considered, along with walking and cycling.

The commercial vehicle movement (CVM) model, the focus of this paper, is a disaggregate, microsimulation model. It includes representation of the tours generated by 5 categories of industrial activity on each of 5 different types of land use. The individual trips on each separate vehicle tour are simulated, providing a vehicle type, an origin, a destination and a time of trip, among other attributes, for each such trip.
The joint vehicle assignment process loads the trip tables generated by the above two demand models to a nodes-and-links representation of the road networks in the Calgary Region, establishing a network equilibrium loading taking account of the congestion on links. Five time periods are considered in the assignment process, including the busiest ½ hour (the ‘crown’) and the rest of the 1 ½ hours (the ‘shoulders’) for the AM Peak Period (from 7am to 9am); the similar busiest ½ hour and the rest of the 1 ½ hours for the PM Peak Period (from 4pm to 6pm); and the Off Peak Period covering the rest of the day. The congested travel times from the network for each of these time periods are fed back into these models, and the process is iterated until the travel times used by the models are consistent with those arising from the subsequent loading on the networks, thereby establishing a system equilibrium.

Within each iteration where the congested travel times are fed back, the personal travel model is run once to equilibrium and the resulting trip table output while the commercial vehicle model microsimulation is run 10 times and the results averaged so as to obtain expected values for the zone-to-zone trips in the trip tables. In the final iteration of the full modeling system, the microsimulation is run 30 times and the results averaged so as to obtain expected values with better statistical properties.

There is a fourth component dealing with vehicle trips with at least one end external to the Calgary Region. It is a fairly modest set of singly-constrained gravity models considering the exogenously forecast vehicle flows passing through the model external cordon entry and exit points, which accounts for about 6% of the total vehicle trips in the entire Calgary Region. This generates additional vehicle trip tables for each of the light, medium and heavy vehicle categories for each time period in assignment, and these trip tables are combined with those from the personal and commercial models before the assignment performed in each iteration.

**Structure of the Microsimulation of Commercial Vehicle Movements**

The microsimulation of commercial vehicle movements in the CVM considers the tour-based movements using Monte Carlo techniques to assign the attributes to each tour in a list of tours generated for each zone, including tour purpose, vehicle type, next stop purpose, next stop location, and next stop duration.

**Overall Structure**

The overall framework of the microsimulation process is illustrated in Figure 1.

First, the number of tours based in each zone is established using an aggregate trip generation model. This number of tours value establishes the length of the list of tours whose specific attributes are identified one after another as the microsimulation progresses. Then, using Monte Carlo processes, considering each tour in the list for each zone, one at a time, the vehicle type and purpose for the tour are identified, followed by the specific tour start time, and which point the characteristics for the stops on the tour are identified, iterating stop-by-stop until the tour is finished.
Tours are ‘grown’ incrementally by having a ‘return-to-establishment’ alternative within the next stop purpose allocation: if the next stop purpose is not ‘return-to-establishment’, then the tour extends by one more stop. This ‘growing’ approach is more consistent with the nature of tour-making in urban commercial movements – where there are a comparatively large number of equally important stops in many tours. This is in contrast to the ‘rubber-banding’ process typically used with household tour-based modelling, where first a primary destination for the tour is established out from the base and then perhaps one or two intermediate stops on the trips between the base and this primary destination are identified – analogous to first stretching a rubber-band between two points and then pulling it wider along the lengths in-between (Jonnalagadda et al., 2001). The selection probabilities used in the microsimulation processes are established using logit models estimated using the choice data collected in the surveys for different segments of the full range of commercial movements.

Time is treated as a continuum, rather than in discrete periods, and both start and end times are established for each trip and each stop on each tour.

**Development Data**

The primary source of the data used in development is an extensive set of interviews about own-account commercial vehicle movements conducted at just over 3,100 business enterprises in the Calgary Region – analogous to household trip diary interviews – that collected information on tours made on a typical weekday in 2001 (Hunt and Morgan, 2001). Sampled establishments provided information on the movements of their entire fleet over a 24 hour period, including origin, destination, purpose, fleet and commodity information. The resulting sample provided choice behavior information on just over 64,000 commercial vehicle trips for use in the estimation and further calibration of the model components. The data were expanded by industry, size and location to represent the total population of commercial enterprises, which was...
challenging in itself because of the uncertainty surrounding the total population of employment at establishments (Hunt et al., 2006).

Terms, Categories and Basic Values

Three categories of vehicle are considered:
- Light vehicles: small four-tire vehicles (cars, vans, pick-ups and SUVs);
- Medium vehicles: single-unit trucks with six tires; and
- Heavy vehicles: multi-unit trucks with more than six tires.

Four stop and related trip purposes are considered – in much the same way that work and school purposes are considered in personal travel modeling:
- Goods: goods delivery and/or pick-up, including goods handling and transport activities;
- Services: service delivery, including any incidental materials handling (such as an electrician picking-up electrical supplies);
- Others: all non-direct goods and services activities not included in the above or at the point where the tour started, including breaks, meals, vehicle fuelling, etc; and
- Return to Establishment: returning to the starting point of the tour, either at the end of the day or during the day, for any reason.

These different commercial movement purposes relate to different types and distributions of activities, which imply different types of companies with different options, objectives, influences and choice structures.

The business establishments and the associated employment at these establishments are segregated into five establishment categories based on the 2-digit sector-level categories in NAICS (Statistics Canada, 1998) as follows:
- Industrial;
- Wholesale;
- Retail;
- Transport; and
- Services.

Each of these five categories of establishment is handled separately throughout the microsimulation, each with a largely unique set of coefficients throughout the process, so the results are different, with different behaviours and reactions to policy changes, for these different categories. The framework itself is also slightly different for the Transport category in particular. The Transport category includes what are called ‘for-hire’ or ‘private’ carriers, in essence trucking companies that sell transportation service. These are different in that the ‘goods’ and ‘services’ stop and tour purpose categories are combined into a single ‘business’ purpose – in recognition of the fact that Transport establishments provide the service of handling goods, which blurs the definitions.

The zones in the model are classified into five land use types based on specific zonal attributes as follows:
Low Density;
Residential;
Retail and Commercial;
Industrial; and
Employment Node.

These land use types are used to differentiate coefficient values and resulting model sensitivities at various points in the microsimulation. As part of this, they work in combination with the establishment categories to separate the blue-collar and white-collar components of given industries, which allows the microsimulation to differentiate between the patterns of commercial movements arising from these different components.

Travel utilities that are weighted combinations of travel times and travel distances are used throughout in the representation of travel conditions for movements between zones. The weights used vary by vehicle type and are always negative, consistent with travel having a general cost. In this sense the travel utility for a trip as used here is the negative of the generalized cost for the trip.

Vehicles in the medium and heavy categories are subject to truck route restrictions on the road network in Calgary. Drivers of these vehicles must minimize the distance they travel on the portions of the road network that are not designated truck routes. For links that are not designated truck routes, a large fixed penalty is added to the generalized cost faced by medium and heavy trucks for each additional 50 metres of the link used, so that the network assignment process respects these restrictions. The penalty portions of the resulting travel times are then removed from the network skims so that representations of the actual times and are used in the rest of the microsimulation process.

Tour Generation

In this first step, the aggregate number of tours generated by each category of establishment is determined for each time period in each model zone. These aggregate numbers of tours are used to form lists of discrete tours considered in the rest of the model.

The tour generation rate (tours per employee) is first determined for the entire day for each category of establishment for each zone using an exponential regression equation with zonal attributes as the independent variables. This rate is multiplied by the number of employees in the relevant category of establishment in the zone to produce a total number of tours generated in the zone by that industry for the entire day. The attributes represented in the exponential regression equations include the land use type for the origin zone; the percent of zonal employment in the same establishment category in the origin zone; and accessibilities to total employment for the origin zone.

These numbers of tours for the entire day are then split among time periods covering the day, to establish the number of tours in each time period by each category of establishment in each zone. The time periods considered are:

- Early Offpeak: midnight - 7 AM;
• AM Peak: 7-9 AM;
• Midday Offpeak: 9 AM - 4 PM;
• PM Peak: 4 - 6 PM; and
• Late Offpeak: 6 PM - midnight.

The splits among time period are determined using a logit models, with utility functions that include the same sorts of zonal-level attributes used in the exponential regression equations indicated above.

In each case the resulting number of tours in each time period by each category of establishment in each zone becomes the length of the list of corresponding discrete tours of that type, whose remaining attributes are established in the rest of the microsimulation process.

Tour Purpose and Vehicle Type Allocation

In this second step, each tour in the lists for each zone is assigned both a primary purpose and a vehicle type. A Monte Carlo process is used to assign both simultaneously, where the selection probabilities are determined using single-level logit models based on establishment category with utility functions that include zonal-level land use, establishment location and accessibility attributes.

The alternatives for the primary purpose for a tour are:

• Goods;
• Service;
• Other; and
• Fleet Allocator.

The first three of these categories are consistent with the stop purpose definitions indicated above. The last, ‘fleet allocator’, includes tours by vehicles where the data collection process sought indications of more general vehicle use statistics rather than indications of each stop and the travel to and from it – in recognition of the very large collection burden that would be imposed, as is the case for newspaper delivery, postal services and refuse collection, as examples.

The alternatives for the vehicle type for a tour, again consistent with the vehicle category definitions indicated above, are:

• Light;
• Medium; and
• Heavy.

Tour Start Time

As described above, in tour generation lists of tours are allocated to one of five time periods. In this step, each tour in the list for each time period is assigned a precise start time. This is done using a Monte Carlo process with sampling distributions based on the weighted sample of observed start times differentiated by establishment category and time period. A cumulative
percentage distribution function was calculated by industry and time period based on a curve fit to observed data.

These sampling distributions are static, which has the implication that changes in the temporal distribution for the starts of tours established by the microsimulation in response to changes in travel conditions (or any other potential policy options for that matter) are limited to the changes in the time period allocations in trip generation. But there is further potential for travel conditions to influence the times for the rest of a given tour. The microsimulation keeps track of the precise times for the arrival and departure at each subsequent stop on each tour. This includes using the travel time between each stop. To the extent that travel times on the network are changing in response to policy inputs (or any other influences), the arrival times at subsequent stops will also change, which can lead to changes in the decision made regarding the next stop purpose as described below. Further, as tours continue the microsimulation will allow them to cross into the next time period. For example, a vehicle can start a tour in the AM Peak and then eventually find itself in the Midday Offpeak, where improved travel conditions can further impact the purposes and locations of subsequent stops.

After the tour start time has been assigned to a given tour, the microsimulation then begins the iterative process of ‘growing’ the tour by assigning sets of ‘next stop purpose’, ‘next stop location’ and ‘next stop duration’ until the ‘next stop purpose’ is ‘return to establishment’.

**Next Stop Purpose**

The purpose for each subsequent stop is assigned from the following alternatives, with restrictions on availability as indicated:

- Goods: available if the primary purpose of the tour is Goods;
- Service: available if the primary purpose of the tour is Service;
- Other: available if the primary purpose of the tour is Goods, Service or Other; and
- Return to Establishment: if the next stop is not the first stop on the tour.

The term ‘business stop’ is used here to refer to stops that are either Goods stops (when the tour primary purpose is Goods) or Service stops (when the tour primary purpose is Service).

Again, a Monte Carlo process is used to assign the next stop purpose, with the selection probabilities determined using single-level logit models based on a ‘segment’ category. With so many observations of next stop purpose available, it was possible to estimate utility function coefficients for 13 different segments of commercial movements based on combinations of industry category, vehicle type and tour primary purpose, consistent with differences in the influences on next stop choice behaviour, as follows:

- S-S-L: service tours by Services establishments using light vehicles;
- S-S-MH: service tours by Services establishments using medium or heavy vehicles;
- G-S-LMH: goods tours by Services establishments using any vehicle type;
- S-R-LMH: service tours by Retail establishments using any vehicle type;
- G-R-LMH: goods tours by Retail establishments using any vehicle type;
- S-I-L: service tours by Industrial establishments using light vehicles;
- S-I-MH: service tours by Industrial establishments using medium or heavy vehicles;
• G-I-LMH: goods tours by Industrial establishments using any vehicle type;
• S-W-LMH: service tours by Wholesale establishments using any vehicle type;
• G-W-L: goods tours by Wholesale establishments using light vehicles;
• G-W-MH: goods tours by Wholesale establishments using medium or heavy vehicles;
• B-T-LMH: business tours by Transport establishments using any vehicle type; and
• O-X-LMH: other tours by any establishments using any vehicle type, including fleet allocator tours.

The utility functions for the next stop purpose alternatives in the logit models include representation of the following attributes:
• the number stops for business purposes made previously in the tour;
• the number of stops for other purposes made previously in the tour;
• the number of stops for any purposes made previously in the tour;
• the ‘elapsed total time’ for the tour to that point, which is the total time that has been spent on the tour up to that point, including all times spent at stops and in travel between stops up to that point;
• the ‘elapsed travel time’ for the tour to that point, which is the total time that has been spent travelling on the tour up to that point, including all times spent in travel between stops but not including all times spent at stops up to that point;
• the travel utility associated with making the trip from the current location zone to the zone where the tour began for the vehicle type being used; and
• the accessibility for the current location (zone) to all categories of employment in all zones for the vehicle type being used.

Next Stop Location

After the next stop purpose has been assigned, the next stop location is assigned – assuming the next stop purpose is not ‘return to establishment’. The available alternatives for the next stop location are the 1,447 model zones.

Again, a Monte Carlo process is used, with the selection probabilities determined using single-level logit models based on 13 ‘segment’ categories similar to those used in the selection of next stop purpose. In this case the 13 segment categories are based on combinations of industry category, vehicle type and next stop purpose (not tour primary purpose) with the ‘goods’, ‘service’ and ‘other’ categories still being used, but in this case for the assigned next stop purpose (rather than the assigned tour primary purpose). The 13 category definitions remain the same – apart from using stop purpose rather than tour primary purpose – so the designations for the categories still apply: thus, for example, the S-I-L category in this case indicates ‘service stops made on tours by industrial establishments using light vehicles’ (whereas previously, in the case of next stop purpose, it indicates ‘service tours made by industrial establishments using light vehicles’). With these 13 different segments, different logit models are used for the assignment of next stop location depending upon whether the next stop purpose is ‘goods’, ‘service’ or ‘other’, thereby allowing for the appropriate spatial distribution of opportunities to be taken into account, even on the same tour.
The utility functions for the next stop location (zone) alternatives in the logit models include representation of the following attributes:

- the land use type for the possible next zone;
- the accessibility to all categories of population for the possible next zone for the vehicle type being used;
- the accessibility to all categories of employment for the possible next zone for the vehicle type being used;
- a numerical score representing the relative attractiveness of the possible next zone for stops made during tours generated by Transport establishments, which is determined as described further below; and
- the ‘enclosed angle’ for the possible next zone, which is the angle (in degrees) enclosed by (a) the straight line from the current zone to the zone containing the establishment and (b) the straight line from the current zone to the possible next zone; an example of this angle is shown in Figure 2; a value of 0° indicates that the possible next zone is in the same direction as the zone containing the establishment and a value of 180° indicates that the possible next zone is in the opposite direction from the zone containing the establishment.

Stop Duration Model

In this step, the stop being considered is assigned a precise duration. This is done using a Monte Carlo process with sampling distributions based on the weighted sample of observed durations differentiated by the 13 segments also considered in the assignment of next stop purpose and next stop location.

The microsimulation uses the precise duration assigned to the stop to advance the clock keeping track of start and end times, and then begins another iteration for the next stop.

![Diagram](image)

**Figure 2:** Example of ‘enclosed angle’ for possible next zone

Calibration of the Microsimulation of Commercial Vehicle Movements
After all the elements of the microsimulation process were assembled and the values for the various coefficients established, the entire process was calibrated to appropriately match various aggregate targets.

An iterative approach was used where the process was run, the match of the output values to specific aggregate targets assessed and the associated category-specific constants adjusted in order to improve the match. With Monte Carlo processes like the one being described here, in general the results are different with each run. So multiple runs were done and the results averaged in order to get values that indicate the central tendencies of the outputs. Initial experimentation showed that in this case averaging over 10 runs provided highly stable results, with variations in the order of 1%, related to the aggregate targets being considered.

The elements of the microsimulation are interdependent, which means that adjustments to the values of the coefficients in one element can alter the output values for other elements. For example, if the tour generation is adjusted, establishment locations are changed, which affects the decision to return to establishment and therefore tour lengths. This led to the use of an approach in calibration where the matches to different sets of targets were considered consecutively over a series of iterations until the adjustments to the coefficients and the resulting changes in the output values were small enough to be of no consequence. The sets of aggregate targets considered, in the order they were considered, are as follows:

- tour generation by industry and geographic area;
- proportions of tours starting in the AM, PM and combined offpeak periods;
- vehicle type and tour purpose proportions;
- number of stops per tour by 13 segments;
- total trip destinations in each of 13 superzones by vehicle type (for example, the proportion of all trips by heavy vehicles that are destined to the southeast industrial area);
- intra-superzonal proportions of trips within each of the 13 superzones by vehicle type (for example, the proportion of light vehicle trips with destinations within the CBD that also originated within the CBD); and
- total trips by vehicle type and industry.

The matches to observed aggregate values were within reasonable margins in all cases, and within a fraction of a percent in a large majority of cases. Figure 3 shows the results of the calibration regarding the intra-superzonal proportions of trips for the 13 superzones. Figure 4 shows the results after calibration regarding the number of stops for the 13 segments. Figure 5 shows the changes in match for tour purpose and vehicle type proportions by employment category as the iterations in calibration proceeded.
Figure 3: Match of tour-based microsimulation results to intrasuperzonal proportion of trips (medium vehicle) targets at start and end of calibration.

Figure 4: Match of tour-based microsimulation results to number of stops by segment at start and end of calibration.
**Figure 5:** Changes in match of tour-based microsimulation results to proportions of tours by tour purpose and vehicle type targets over early series of iterations in calibration.

Figure 6 shows the link-level flows of just heavy vehicles obtained when running the full Calgary RTM, including the CVM, the personal travel model and external-internal component, for the model base year. This resulting assignment provides a good fit with observed patterns – closely matching observed flows and displaying a focus on industrial areas (those with darker shade) and an adherence to truck routes.
Figure 6: Plot of heavy vehicle flows resulting from full Calgary Commercial Vehicle Movement Model. The simulated patterns closely match observed flows, and display a focus on industrial areas (shown in darker shade) and an adherence to truck routes.

Model Capabilities

The calibrated tour-based microsimulation process for the commercial vehicle movement component, together with the other calibrated components of the Calgary RTM, provide a representation of the transportation system in the Calgary Region that can be used in both forecasting and policy analysis. Its application in forecasting requires inputs regarding population, employment and transport supply conditions similar to those required for the forecasting of household travel alone, along with specific information regarding truck route policy and vehicle-specific values of time and distance-based operating costs for commercial components.

For the analysis of policy impacting commercial movements, this representation will respond to changes regarding:

- road network capacities and connectivity;
- truck route policy;
- road tolls;
- fuel taxes;
- household travel (resulting in changes in roadway congestion);
- population level and spatial distribution; and
• employment level, composition and spatial distribution.

The responses to such changes will occur in multiple elements of the microsimulation. Tour generation, the allocation to start time period, tour purpose and vehicle type choice, next stop purpose and next stop location all respond to changes in travel conditions. Thus, if travel conditions become more onerous for commercial movements – perhaps because the network becomes more congested, or because a key part of the truck route system is removed – then commercial vehicles will not just travel shorter distances; they will also make fewer stops per tour and more tours in order to fulfil the demand.

Conclusions

The commercial vehicle movement model described here demonstrates the practical feasibility of using a tour-based microsimulation approach in the modeling of these movements in a novel way that allows the incorporation of representations of these influences.

Some of the notable aspects of the model described here are:
• a tour generation element that includes a response to changes in transport conditions such that (in the short run) more tours arise when travel times increase;
• variation in tour primary purpose and vehicle choice across a broad spectrum of activities and in response to changes in employment, population and resulting accessibilities;
• a ‘growing’ of tours more consistent with the nature of commercial movements with potentially larger numbers of equally-important stops, as opposed to the ‘rubber-banding’ process typically used in the representation of tours of household movements;
• representation of the influence of tour duration and, at least partially, the time of day on tour patterns;
• consideration of the physical shape of tours;
• responsiveness to changes in truck route policy as well as infrastructure and cost changes specific to three categories of commercial vehicle;
• separation of the fleet allocator and shipment-focused components of commercial movements;
• a range of interactions among the elements such that changes to the inputs impact the simulated behaviour in a variety of dimensions; and
• a set of alternative specific constants for each element that allows calibration of the full microsimulation system to aggregate targets.

One of the specific advantages of this modeling approach is that it does not rely on any explicit representation of shipments or related transactions. Dealing with shipments, translating from commodity flows to shipment sizes to vehicle allocations, introduces a number of complexities. Some very impressive work has been done by others seeking to represent these complexities. The approach used here bypasses much of the need for this additional complexity by focusing on vehicles using generation rates and vehicle allocation models that implicitly take much of this into account parsimoniously. It is important to acknowledge that a complete and accurate representation of the full range of factors influencing the translations from commodity flows to shipment sizes to vehicle allocations would provide a model with a more robust policy
responsiveness, but in a practical setting, the model described here is in many cases a more realistic solution.

At this point the current system is being used in practical policy analysis work. The expectation is that more will be learned about the capabilities of the model and its use as this work progresses, and that the need for further specific improvements will be identified. In addition, the successful implementation of this model in Calgary suggests the potential for successful implementation elsewhere – in fact, models based on this approach and structure are currently under development for Edmonton in Canada and the state of Ohio in the USA. This has included reusing (with suitable recalibration) the destination choice components in particular – where the greatest amount of data manipulation and work arises.

Notwithstanding further specific improvements, the current system provides a very useful tool, taking both the representation and the associated understanding of urban commercial movements well beyond the ‘freight-only’, ‘large-truck-only’ and ‘regional-level’ approaches used previously. It permits a much richer treatment of relevant aspects such as the importance of trip chaining and less-than-load hauling, the significance of service delivery as a motivator for travel, and the role of light commercial vehicles. As such, it points a useful way ahead in the modeling of the commercial vehicle sector of the urban transportation system.

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