Conceptual Framework for Freight Movement Simulation Modeling at Urban scale

Duminda BANDARA[1] and Kazushi SANO[2]

[1]Student, Graduate School of Civil and Environmental Engineering, Nagaoka University of Technology
(1603-1 Kamitomiokamachi, Nagaoka, Niigata Prefecture, 940-2137, Japan)
E-mail: s147013@stn.nagaokaut.ac.jp
[2]Member of JSCE, Professor, Urban Transport Engineering and Planning Lab, Nagaoka University of Technology
(1603-1 Kamitomiokamachi, Nagaoka, Niigata Prefecture, 940-2137, Japan)
E-mail: sano@nagaokaut.ac.jp

The paper reports a modeling system to simulate goods movements at an urban scale. It allows joint analysis of choices made by end-consumers (assumed to be families) and retailers as well as producers/ suppliers. These push and pull movements are examined at two levels: analysis of commodity flows, in terms of quantity, generated by the consumption of commodities; analysis of commodity flows, in terms of vehicles, due to restocking. The first level allows us to calculate the goods quantity flows due to consumption and restocking; the second level allows us to determine the service, vehicles used and target time, as well as the route chosen for restocking sales outlets in order to estimate vehicle flows on the urban/metropolitan transportation network. The modeling system is a multi-step model and considers a disaggregated approach for each decisional level.

Key Words : *Urban goods movements Freight demand models, Data Constrains,*

1. INTRODUCTION

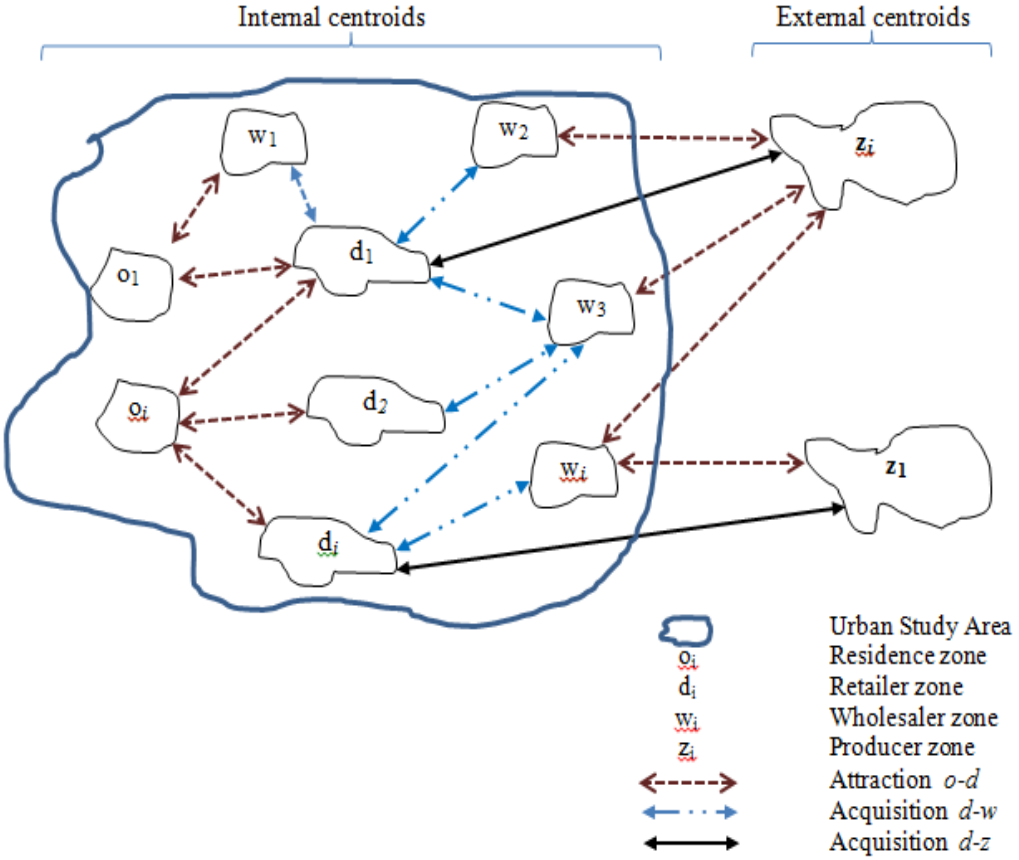
In the recent developments of urban transportation all around the world has laid an immense concern over the goods movements simply because of the substantial share it holds over traffic in urban/metropolitan areas. In this context, according to Russo & Comi (2010)[1], many European city administrators have implemented measures to mitigate the negative effects of freight transport, but they have often proved ineffective and insufficient. Accordingly a review of the various measures implemented and their results has been carried out within a large European project (BESTUFS 2007)[2]. One of the findings of this research project was that many measures have not yet solved the problem for which they were implemented. However it is thus considered crucial to have simulation models to analyze measures prior to implementation in order to evaluate *'ex ante'* the possible impacts that can be obtained. There have been few studies treating the overall problem of urban freight transport simulation; existing models mainly simulate some aspects of the restocking process and in particular consider inter-urban freight movements and partially ignored the impact of the supplier/ producer decisions over intra-urban freight movements. They focus on the movements between firms (producers) and distribution centres on a wide scale. In particular, they do not consider the possibility of combining freight and passenger flows, hence of representing the interacting behaviour of commodity consumers and commodity suppliers/shippers/ retailers. Thus there are difficulties forecasting the impacts and simulating the effects of transportation measures on an urban scale.

We have developed a new conceptual framework for an integrated modeling system capable enough to simulate freight movement from the producer to the final customer considering both pull and push factors. Accordingly, application possibilities are to be tested on case studies based on Tokyo Metropolitan Goods Movement Survey (TMGMS), collected by the Ministry of Land, Infrastructure and Transport which survey the movement of goods by firms in the Tokyo Metropolitan Area approximately every 5-10 years.

2. Modeling framework

As per the objective of this study it was proposed a modeling system to simulate goods movements at an urban scale with the capability of 'ex ante', which allows joint analysis of choices made by end-consumers (assumed to be families) and retailers. These movements are examined at two levels: a) analysis of commodity flows, in terms of quantity, generated by the consumption of commodities; and b) analysis of commodity flows, in terms of vehicles, due to restocking.

Figure Error! No text of specified style in document.**-1: Geographical area definition**



Defining the geographical area was the first initiative, thus proposed to be divided into traffic zones and approximate all points at the beginning and end of trips in each zone with one point (centroid). Different zones can be defined as {o},{d},{w},{z} whereas; {o} is the set of internal zone centroids in which the end-consumer consumes the goods and the residences and services (offices) are located; in these zones the freight is consumed/used; {d} is the set of internal zone centroids in which the end-consumer can purchase the goods which the retailer sells; the shops are located in these zones; {w} is the set of internal zone centroids to which the retailer can bring goods sold in her/his shops from wholesalers; {z} is the set of zone centroids outside the study area where the retailer and/ or wholesaler can bring the complementary goods sold in her/his shops.

There are two types of freight movements; attraction and acquisition. Attraction -the connection between *zone d* in which the goods are bought by the end-consumer and zone o where the goods are consumed (o-d, end-consumer trips). Acquisition - the connection between zone w/z where the retailer takes the freight and *zone d* where he/she sells them (d-w/z). Acquisition analyses restocking trips (for example, the trip that takes freight from the distributor to the retailer).

Figure 2: Conceptual framework

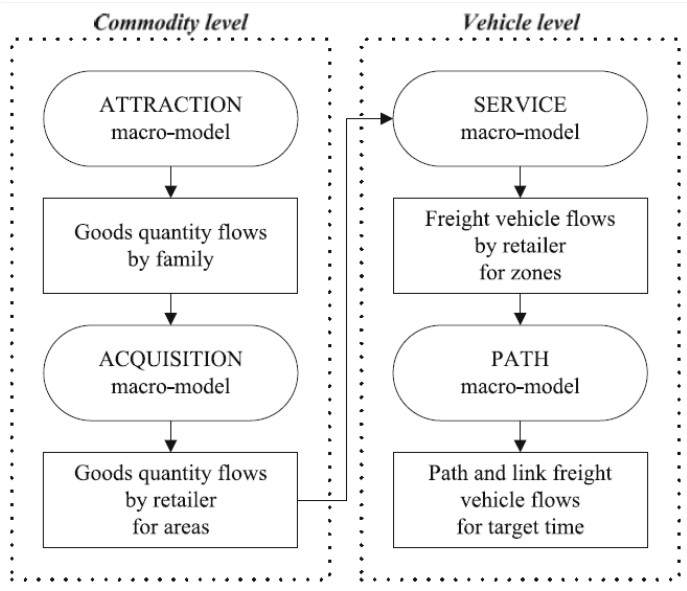


Table 1: Proposed Modeling structures and data required.

	Proposed model	Required data
1. Path and link of freight vehicle flows for target time periods starting from producers/ suppliers	Route choice model	• vehicle flows originated by supplier to wholesaler/ retailer • freight type • path • producer/supplier – wholesaler region pair
2. Freight vehicle flows by wholesaler for zones for target time periods	path macro-model	• determination of the service, • vehicle used, • time used • path chosen for restocking sales outlets
3. Freight vehicle flows by Retailer for zones	service macro-model	
4. Goods quantity flows by Retailer for areas	acquisition macro-model	• freight type, • consumption amount, • producer- consumer region pair, • producer-wholesaler/ retailer restocking region pair • Socio economic data of consumers
5. Goods quantity flows by end consumers	attraction macro-model	

3. CONCLUSIONS AND RECOMMENDATIONS

The proposed modeling system is developed with extension of 'push- movements' as well. It currently considers for freight distribution only wholesalers/consolidation points, but there is a possibility of e-commerce to be considered. Translating Input/ Output data (in monetary value) to freight quantity data was a bit challenge. However, this modeling system should be considered a response to urban policy needs and is a useful tool for urban policy-makers involved in designing urban freight measures: they have to deal with a large number of trucks and vans delivering goods in the urban area whilst preserving the economic viability of city businesses and also ensuring environmental sustainability. The proposed modeling system is a tool developed to support ex-ante assessment to simulate goods movements and capture the effects due to urban freight transport measures on producer/ supplier and end-consumer/ retailer behavior.

REFERENCES

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