Available online at www.sciencedirect.com
ScienceDirect
Transportation Research Procedia 12 (2016) 5 – 13
Transportation Research Procedia
www.elsevier.com/locate/procedia

The 9th International Conference on City Logistics, Tenerife, Canary Islands (Spain), 17-19 June 2015

New opportunities and challenges for city logistics

Eiichi Taniguchi[a]*, Russell G. Thompson[b], and Tadashi Yamada[a]

[a]*Kyoto University, Kyotodaigaku-Katsura, Kyoto 615-8540, Japan*
[b]*The University of Melbourne, Parkville 3010, Australia*

Abstract

The information revolution is creating both opportunities and challenges for improving the sustainability of urban freight systems. A range of vehicle movement data can now be automatically collected from low cost sensors that are able to assist in improving understanding distribution systems and increasing their efficiency. Vehicle monitoring technologies that have the potential to charge both passenger and goods vehicles for using the road system, allow a new array of pricing schemes to be introduced. However, E-commerce (B2C) is creating a surge in home deliveries that is increasing the social and environmental costs of goods distribution systems. This paper describes some applications of big data systems and decision support systems that can be used to enhance the design and evaluation city logistics schemes. The need to develop improved tools for understanding logistics sprawl and reducing its effects are described. Developments in alternative fuel vehicles and advanced manufacturing systems are also presented.

Peer-review under responsibility of the organising committee of the 9th International Conference on City Logistics

Keywords: big data; e-commerce; decision support systems; road pricing; logistic sprawls; co-modality; alternative fuel vehicles

1. Introduction

City Logistics is based on the systems approach that involves a number of technical processes including modelling, evaluation and the application of information technologies (Taniguchi and Thompson, 2014). Advances in Information and Communication Technology (ICT) provide opportunities for improving the performance of urban freight systems. ICT also creates the potential for developing more advanced urban freight management systems such as joint delivery

* Corresponding author. Tel.: +81-75-383-3229; fax: +81-75-950-3800.
E-mail address: taniguchi@kiban.kuciv.kyoto-u.ac.jp

Peer-review under responsibility of the organising committee of the 9th International Conference on City Logistics
doi:10.1016/j.trpro.2016.02.004

systems and road pricing schemes.

2. Big data and analysis

Thanks to the development and deployment of ICT (Information and Communication Technology) and ITS (Intelligent Transport Systems), we can easily collect “big data” of pickup-delivery truck movements or goods movements in urban areas at lower costs. Global Positioning Systems (GPS) devices are typically equipped in trucks allowing the location of trucks to be precisely measured every second. Fig. 1 shows a GPS device which is used for recording the routes of urban trucks.

Fig. 1. GPS device which is equipped in a pickup-delivery truck

The analysis of big data of truck movements in urban areas allows us to gain insights into the behaviour of drivers. Ehmke and Mattfeld (2010) highlighted data provision of time-dependent travel times for city logistics routing demands. Telematics based traffic data collection and conversion from legal empirical traffic data into information models are discussed. Lin et al. (2013) applied data mining technique to find routing patterns from the past cases of vehicle routing plans of truck drivers. They designed a real time mobile intelligent routing system, which was installed on drivers’ smart phone. It was demonstrated that the proposed method was successful in reducing the travel times on congested urban road networks in case studies. Xu et al. (2014) undertook a study where data was used to design a high-efficient flow path using Petri-Nets and offered a city logistics model based on a cloud based platform. Teo et al. (2015) analysed probe data of pickup-delivery trucks data with a multi-layered Geographical Information System (GIS) in Osaka using vehicle routing and scheduling with time windows (VRPTW) model. They indicated that considering the land use in particular the residential zone into the optimisation of VRPTW to understand how freight carriers can help to improve on their deliver operations under the existing land use plans while providing a better urban environment, especially for city dwellers within the residential zones.

3. Decision support systems

Decision support systems have been studied for choosing appropriate policy measures for city logistics. Developing decision support systems require several steps: (a) identifying problems, (b) choosing candidate approaches and policy measures or scenarios, (c) duplicating behaviour of stakeholders, and (d) evaluating policy measures. Multi-agent models are often used for representing the behaviour of stakeholders and evaluating policy measures in terms of economic, financial, social, environmental, and energy impacts based on the estimation of effects of policy measures.

Davidsson et al. (2005) pointed out that agent-based approaches are very suitable for freight logistics. Duin et al. (2007) discussed auctioning of shippers and carriers using agent based modelling. Taniguchi et al. (2007) dealt with dynamic vehicle routing and scheduling problems using multi-agent models. Donnelly (2009) developed a multi-agent model with micro simulation of freight flows that was applied in Portland, Oregon. Tamagawa et al. (2010) analysed the interaction between shippers, carriers, administrators, and residents using multi-agent models with reinforcement learning for evaluating city logistics measures, and pointed out that win-win situations for stakeholders are possible by implementing truck flow restrictions and joint delivery systems. Roorda et al. (2010) presented a conceptual framework for agent-based modelling of logistics services. Duin et al. (2012) presented multi-agent simulation models for analysing the dynamic demand of urban distribution centres (UDC). Teo et al. (2012, 2014) used multi-agent models for evaluating city logistics policy measures, including road pricing, load factor controls and building motorways on urban road networks and clarified the effects of pricing and provision of motorways on the efficiency of vehicle operations and CO_2, NOx and SPM (Suspended Particle Material) emissions generated by trucks. Anand et al. (2014) discussed decision making using ontology based multi-agent models for city logistics. Wangapisit et al. (2014) investigated joint delivery systems with UDC and parking management using multi-agent models. These models allow an understanding of the response behaviour of stakeholders to actions taken by other actors and effects of policy measures. However, the validation of multi-agent simulation is a challenging issue and more experience and case studies of practical application of multi-agent models is needed.

Recently the Internet of Things (IoT) can provide a platform for decentralized management for city logistics. Reaidy et al. (2015) discussed bottom up approach based on Internet of Things for order fulfilment in a collaborative warehousing environment. They used multi-agent systems and integrated a bottom up approach with decision support mechanism such as self-organisation and negotiation protocols between agents based on “com-peration = competition + cooperation” concept.

The behaviour of stakeholders highly affects the results of policy measures. Stathopoulos et al. (2012) studied the reaction of stakeholders to urban freight policies using nested logit model based on surveys in Rome. Gatta and Marcucci (2014) discussed an agent-specific approach to increase decision-makers’ awareness and ability to make better decisions in case of Rome’s Limited Traffic Zone.

Multi-Criteria Decision Making (MCDM) models have also been studied for choosing city logistics policy measures. Awasthi (2012) presented a hybrid approach using affinity diagrams, the Analytic Hierarchy Process (AHP) and fuzzy TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) for evaluating city logistics initiatives. Tadic et al. (2014) introduced hybrid MCDM model using fuzzy method and applied this in the city of Belgrade. Bouhana et al. (2015) highlighted intelligent decision support systems which integrate ontology supported case base reasoning and multi-criteria decision making approaches with the Choquet integral for sustainable urban freight transport. Rao et al. (2015) discussed location selection of city logistics centres using fuzzy multi-attribute group decision making (FMAGDM) technique.

4. E-commerce

E-commerce has become more popular in business using Internet. The growth of Internet shopping Business to Consumer (B2C) affects urban delivery systems. Taniguchi and Kakimoto (2004) studied the effects of e-commerce on the urban freight transport using vehicle routing and scheduling problem model. They pointed out that the penetration of B2C e-commerce may increase the truck flows for home delivery with time windows but this can be alleviated by introducing joint delivery systems and pickup points where customers visit to pick up their commodities. Campbell (2006) investigated incentives to influence the consumer behaviour to reduce home delivery costs. Hong et al. (2013) studied the optimisation of vehicle routing and scheduling for B2C e-commerce logistics distribution systems. Ehmke (2014) discussed customer acceptance on home deliveries with tight time windows at customers on congested road networks. Using simulation they analysed the effects of travel time information on decision making investigating whether the delivery requests could be accommodated.

All authors are required to complete the Procedia exclusive license transfer agreement before the article can be published, which they can do online. This transfer agreement enables Elsevier to protect the copyrighted material for the authors, but does not relinquish the authors' proprietary rights. The copyright transfer covers the exclusive rights to reproduce and distribute the article, including reprints, photographic reproductions, microfilm or any other reproductions of similar nature and translations. Authors are responsible for obtaining from the copyright holder, the permission to reproduce any figures for which copyright exists.

5. Energy saving technologies

Internal combustion engine vehicles (ICEVs) have widely been used for urban freight transport, such as trucks and vans, where gasoline or diesel fuel is combusted to create mechanical energy that provides the power to move the vehicle forward. These vehicles generally consume considerable oil-based energy, and hence, alternative vehicle technologies are being strongly demanded to reduce the dependence on oil for last-mile deliveries. Even in the field of City Logistics, technical innovations of vehicle design offer a high potential for energy savings in the future.

Energy savings can be achieved using low-energy and low-emission vehicles. Recently there have been rapid advances in alternative fuel vehicles (AFVs), including electric vehicles (EVs), hybrid vehicles (HVs), natural gas vehicles (NGVs), and fuel cell vehicles (FCVs). EVs are vehicles in which some or all of the driving energy is supplied through electricity from batteries. HVs use two or more distinct power sources, where small electric batteries are typically utilised to supply electricity to the drivetrain for enhancing the efficiency of combustion engine. NGVs can run on compressed natural gas (CNG) or liquefied natural gas (LNG). FCVs are another type of electric vehicle, in that the fuel cell generates electricity through an electrochemical process in the fuel cell stack.

As van Duin *et al*. (2013) indicates, use of EVs is an efficient and promising strategy for urban freight. Leonardi *et al*. (2011) presented details of a trial of a major stationery and office supplies company making deliveries from the urban micro-consolidation centre to customers in central London using electrically-assisted tricycles and electric vans. Jorgensen (2008) reported that fuel efficiency of a traditional ICEV is 15-18%, while that of an EV can be as high as 60-70%. Among AFVs, plug-in hybrid electric vehicles (PHEVs) have accounted for a growing share of the vehicle market as they combine the advantages of EVs and ICEVs to save gasoline consumption as well as to reduce emissions. Liu *et al*. (2014) insists that the random power demand of large PHEV fleets would impose significant stress on power system operation, even though PHEVs can utilise excess power at night for their regular charging cycles. The increasing penetration of PHEVs is also crucial to the construction of Smart Grid to energy savings and emission reductions (e.g., Minghong *et al*., 2012). NGVs have been adopted far slower in most OECD countries than expected, although they were among the first mature and marketable technologies. Von Rosenstiel et al. (2015) shows that this is due to market failure in the NGV-market, including coordination failure in complementary markets, legal regulations on service stations on motorways, and imperfect information.

Despite the expected effects of introducing low-energy and low-emission vehicles, there are still several obstacles towards their widespread use, such as lack of infrastructure, high cost of introducing them, insufficient maintenance and servicing system. In addition, reduction in gasoline consumption by replacing ICEVs with AFVs may result in decrease in fuel tax revenues that can fund transport projects (e.g., Hajiamiri and Wachs, 2010).

6. Co-modality

Co-modality involves combining the range of services offered by transport modes that can include using public transport vehicles such as trains, trams, buses or taxis for transporting goods as well as passengers (Thompson and Taniguchi, 2014). Public transport vehicles often have considerable underutilised capacity during off peak periods.

Public transport organisations can benefit from gaining income from carrying goods by utilizing space on less crowded vehicles. Revenue from transporting goods on public transport vehicles can be used to increase the number of services for passengers. Shippers can also benefit by having lower transport costs and more frequent and reliable deliveries. There are also benefits for residents who experience less congestion as well as reduced emissions and noise from fewer trucks travelling on urban road networks. However, using traditional public transport vehicles for transporting goods involves extra handling costs due to transhipment and can require additional handling equipment and labour for loading/unloading vehicles and security.

The Yamato Transport Company has been using a tram system for delivering goods to Arashiyama in Kyoto, Japan since May 2011 (JFS, 2011). A two carriage tram consisting of one carriage for passengers and another carriage is used for transporting goods. Electric bicycles are then used from the Arashiyama station to deliver parcels to customers.

This system has reduced CO_2 emissions as well as almost halved the number of trucks used for delivering parcels.

Subways trains have recently been used to transport express home delivery packages in Sapporo, Japan (Kikuta et al., 2012). A pilot project involved the service operating during the midday period when passenger demand is low. Two delivery workers load special boxes and travel with carts that are position in wheelchair spaces on selected carriages on trains. This service reduced deliveries by trucks in the inner city area and was well received by the public.

Integrating on-demand passenger and freight transport systems is becoming more feasible due to recent developments in information and communication technologies (ICT) such as smart phones and global position systems (GPS). Benefits for both operators and passenger/customers have been estimated using simulation modelling (Ronald et al., 2015).

7. New manufacturing technologies

7.1 3D printing

3D printing is an emerging manufacturing technology can be used to create specialized products at distributed locations such as retail outlets or even within households. Goods can be built using 3D printers on-site and on-demand. 3D printers have the potential to replace traditional manufacturing and change the structure of manufacturing industries and supply chains. They can be used commercially (i.e. mass production), in retailing (i.e. in shops) and for personal use (i.e. at home).

3D printers can reduce freight transport particularly the distribution of goods. They can also reduce storage at warehouses and retail outlets as well as waste such as packaging. However transport is still required for the materials for producing goods (e.g. plastic and metal) as well from the supply chain for the manufacturing and distribution of 3D printers.

It is difficult to estimate the environmental impacts of 3D printing on urban freight. In many cities 3D printing devices will need to be imported, and this will create freight transport. However, products made by 3D printers will reduce the need for goods to be distributed to shops and homes as well as personal shopping trips.

7.2 Modular offsite construction

Recently a number of construction companies have developed systems for constructing prefabrication building modules that are built off-site and then transported to the final construction site. A combination of advanced manufacturing and construction technologies are used to substantially lower construction times and costs. Since the interior of buildings are fitted out remotely there is reduced congestion near the construction site.

Such unitised building modular technology as potential to reduce the number of vehicles required for transporting construction materials associated with the construction of new buildings in inner city areas. Higher consolidation of building materials are achieved when suppliers transport their materials directly to warehouses and factories. This reduces the frequency of deliveries as well as the disruption to traffic near construction sites.

8. Land use and freight

Since urban freight transport is a derived demand it is largely influenced by the distribution of land use and associated activity patterns within cities. However, land use planning within urban areas often neglects freight and logistics considerations. There is a need to develop improved modelling procedures for predicting the freight related impacts of future land use patterns.

8.1 Logistics sprawl

Logistics sprawl is the trend for logistics terminals to move from the inner city to the metropolitan areas (Dablanc, 2014). Recently in many cities logistics facilities such as warehouses have moved away from central city areas to the fringes of metropolitan areas typically near highways or outer ring roads. Cheaper land values and increased availability of land has encouraged this. Warehouses have also become larger.

Logistics sprawl can increase the distance travelled by freight vehicles who service retail, commercial and residences in inner city areas. Many cities are experiencing growth in the population living in the central city areas and the drift of freight facilities to the outer metropolitan region can add to congestion and environmental impacts.

As industrial land in inner city areas becomes more expensive it is common for it to be rezoned for commercial or residential uses. There is a need to understand and quantify how this affects logistics networks and the impacts of freight transport.

Dablanc and Rakotonarivo (2010) investigated the effects of logistics sprawl and estimated that an additional 15,000 tonnes of CO_2 emissions were caused from the change in location patterns of parcel and express transport terminals in Paris since the 1970's.

There is a need to investigate the benefits of preserving areas that are freight intensive in inner city areas to reduce the distance travelled by freight vehicles. Models need to be developed to determine the number, size and location of major freight logistics precincts within metropolitan regions. Consolidating freight activities in larger areas create co-location related benefits by reducing freight transport as well as allowing higher capacity links between them to be more practical.

Improved models are required for investigating the freight movement impacts of associated with new terminals such as seaports, airports, intermodal terminals, public logistics terminals as well as the high intensive freight areas in cities.

9. Road pricing

Traffic congestion in cities is leading to higher economic costs and environmental impacts. Road pricing has the potential to be used as a demand management tool for reducing the economic and environmental costs of freight transport in cities. Trucks and passenger vehicles compete for road space in urban areas. Whilst public transport systems can provide an alternative for private travel, goods transport has few options apart from road in most cities. There is a need to develop improved models for predicting the changes in freight as well as passenger related costs from road pricing schemes.

Many suppliers and retailers are often forced to establish multiple warehouses or distribution centres in large metropolitan areas to allow frequent and reliable deliveries of goods to customers. Direct road charges such as tolls can lead to more efficient utilisation of freight vehicles and avoid the need for additional warehouses to be established.

Longer periods of congestion known as peak spreading is being experienced on traffic networks in many urban areas. This is leading to higher operating costs for freight carriers as well as increased environmental costs from freight vehicles. More vehicles and tours are required for daily operations resulting in longer distances travelled by freight vehicles in urban areas. Peak avoidance for freight vehicles is becoming impractical due to peak spreading.

Road pricing can create benefits for carriers from lower travel times. Reduced travel times for freight vehicles will lead to more stops per route as well as less routes that will decrease number of vehicles required as well as labour costs. Since labour costs account for a significant proportion of freight vehicle operating costs for carriers these savings may exceed any road user charges from road pricing schemes (Hicks, 1977).

Assessment of the impacts of the Port Authority of New York New Jersey's time of day pricing initiative found that carriers had multiple responses including productivity increases, cost transfers as well as changing the use of facilities (Holguin-Veras et al, 2006). A study undertaken of freight carriers relating to their usage of electronic toll collection (ETC) in New York and New Jersey found that preference depended on the frequency of travelling through the facilities, awareness of ETC features and a number of attributes of the carriers and goods transported (Holguin-Veras and Wang, 2011). Another study that investigated the potential of freight road pricing to move truck traffic out of the congested hours, highlighted the need to better understand the interaction between carriers and receivers (Holguin-Veras, 2008). This study concluded that freight road pricing by itself was not likely to induce a significant switch to off-hours for trucks.

The continued interest in reform of road user charges for freight distribution in many countries is linked to a desire to improve economic efficiency as well as recognition of the declining revenue base from traditional sources, especially fuel excise.

An assessment framework was used to identify the impact of alternative access charges on freight vehicle utilisation, by vehicle class, as well as a suite of direct and cross elasticities (Hensher et al, 2013). Data was collected in Australia in 2010-11 on attitudes towards alternative access charge regimes. A stated choice experiment was used to estimate mixed logit models that were calibrated on vehicle market shares to derive direct and cross access charging elasticities for a number of different types of access charging schemes including distance, mass and location.

The efficiency, equity and the environmental impacts associated with road pricing schemes are key issues that should be considered before such schemes are implemented. Little attention has been given to the effects of road pricing schemes on urban freight transport.

Previous traffic network modelling on the effects of road pricing has largely focused on a single vehicle types, assumed to be passenger vehicles. Improved models are required to be developed to determine the impacts of several types of road pricing schemes operating under various conditions (i.e. charge rates for different vehicle classes) on freight carriers, shippers and residents as well as passenger traffic.

Congestion pricing, acting as an economic lever for traffic demand management in urban metropolises, has received substantial interest in recent years both academically and practically (May et al., 2002; Ho et al., 2005). Existing practical implementations of congestion pricing are all cordon-based with entry-based tolls or daily licenses that are not equitable or efficient (Meng et al., 2012).

Three alternative toll charging schemes (time-based, congestion-based and distance-based) have been extended to overcome problems with current pricing schemes (May and Milne, 2000) which can all outperform the flat toll charge scheme in terms of congestion mitigation. However, the first two methods encourage aggressive driving because less time in the pricing cordon means less toll costs. Thus, distance-based schemes are more suitable for practical implementation. With distance-based schemes, tolls are determined as a function of the vehicle's travel distance in the cordon area, which is called the toll charge function. Recently, distance-based tolling schemes have attracted considerable attention (Meng et al, 2012; O'Mahony et al, 2000; Jou et al, 2012; Lawphongpanich and Yin, 2012; Jou and Yeh 2013).

There is a need to develop models for determining the best type of road pricing or charging scheme for reducing the impacts of freight transport in urban areas. However this will require the objectives of the schemes to be clearly articulated. Common objectives for charging road freight vehicles include infrastructure cost recovery, peak avoidance and vehicle capacity utilisation.

Improved models are required to consider both the operational and strategic decisions of carriers, shippers and receivers. The effects of road pricing on route choice and time of day scheduling for carriers need to be predicted. It is necessary to consider changes to the management of suppliers and receiver facilities. Longer term strategic issues for suppliers such as the number, size and location of warehouses as well as the fleet planning of carriers relating to the number and type of vehicles should also be considered.

10. Conclusions

City logistics requires a range of data and information to define problems, develop models and evaluate schemes. Recent developments in ICT allow the performance of urban freight systems to be monitored more extensively and accurately. This provides opportunities for enhancing efficiency and reducing the impacts of goods movement in cities.

Recent developments in alternative fuel vehicles and advanced manufacturing have good potential for reducing the impact of freight in urban areas. However, there are a number of challenges associated with developing improved decision support systems for reducing logistics sprawl as well as the impacts of home deliveries.

References

Anand, N., Duin, J.H.R. van and Tavasszy, L. (2014). Ontology-based multi-agent system for urban freight transportation, *International Journal of Urban Sciences*, 18(2), 133-153.

Awasthi, A. and Chauhan, S.S. (2012). A hybrid approach integrating affinity diagram, AHP and fuzzy TOPSIS for sustainable city logistics planning, *Applied Mathematical Modelling,* 36, 573-584.

Bouhana, A., Zidi, A., Fekih, A. Chabchoub, H. and Abed, M. (2015). An ontology-based CBR approach for personalized itinerary search systems for sustainable urban freight transport. *Expert Systems with Application*s, 42, 3724-3741.

Dablanc, L. and D. Rakotonarivo, (2010). The impacts of logistics sprawl: How does the location of parcel transport terminals affect the energy efficiency of goods' movements in Paris and what can we do about it? Procedia Social and Behavioral Sciences 2 (2010) 6087–6096.

Dablanc, L. (2014). Logistics Sprawl and Urban Freight Planning Issues in a Major Gateway City - The Case of Los Angeles. In J. Gonzalez-Feliu, F. Semet & J.L. Routhier (Eds.), *Sustainable Urban Logistics: Concepts, Methods and Information Systems*, pp. 49-69. Berlin Heidelberg: Springer-Verlag.

Davidsson, P., Henesey, L., Ramstedt, L., Tornquist, J. and Wernstedt, F. (2005). An analysis of agent based approaches to transport logistics. *Transportation Research Part C,* 13(4), 255-271.

Donnelly, R. (2009). A hybrid microsimulation model of freight transport demand, PhD thesis, The University of Melbourne.

Duin, J.H.R. van, Kolck, A. van, Anand, N., Tavasszy, L. and Taniguchi, E. (2012). Towards an agent based modelling approach for the dynamic usage of urban distribution centres. *Procedia-Social and Behavioral Sciences* 39, 333-348.

Duin, J.H.R. van, Tavasszy, L.A. and Taniguchi, E. (2007). Real time simulation of auctioning and re-scheduling processes in hybrid freight markets, *Transportation Research, Part B.* B41(9), 1050-1066.

Ehmke, J.F. and Campbell A.M. (2014). Customer acceptance mechanisms for home deliveries in metropolitan areas. European Journal of Operational Research, 233, 193-207.

Ehmke, J.F. and Mattfeld, D.C. (2010). Data allocation and application for time-dependent vehicle routing in city logistics. European Transport, 46, 24-35.

Gatta, V. and Marcucci, E. (2014) Urban freight transport and policy changes: Improving decision makers' awareness via and agent-specific approach, Transport Policy, 36, 248-252.

Hajiamiri, S. and M. Wachs (2010). Hybrid electric vehicles and implications for transportation finance, *Public Works Management & Policy*, 15(2), 121-135.

Hensher, D.A., A. T. Collins, J. M. Rose and N. C. Smith (2013). Direct and cross elasticities for freight distribution access charges, ITLS-WP-13-02, Institute of Transport and Logistics Studies, University of Sydney.

Hicks, S. (1977). *Urban Freight*, In: Urban Transport Economics, (D.A. Hensher, Ed.), Cambridge University Press.

Ho, H. W., S. C. Wong, H. Yang, and B. P. Y. Loo (2005). Cordon-based congestion pricing in a continuum traffic equilibrium system. *Transportation Research Part A: Policy and Practice,* 39 (7-9), 813-834.

Holguín-Veras, H. Wang, C. (2011). Behavioral investigation on the factors that determine adoption of an electronic toll collection system: Freight carriers. Transportation Research Part C: Emerging Technologies, 19(4), 593-605.

Holguín-Veras, J. (2011). Urban delivery industry response to cordon pricing, time–distance pricing, and carrier–receiver policies in competitive markets. Transportation Research Part A: Policy and Practice, 45(8), 802-824.

Holguín-Veras, J., C. Wang, N. Xu, K. Ozbay, M. Cetin and J. Polimeni, (2006). The impacts of time of day pricing on the behavior of freight carriers in a congested urban area: Implications to road pricing. Transportation Research Part A: Policy and Practice, 40(9), 744-766.

Holguin-Veras, J., Wang, Q., Xu, N., Ozbay, K., Cetin, M., & Polimeni, J. (2006). The impacts of time of day pricing on the behavior of freight carriers in a congested urban area: Implications to road pricing. *Transportation Research Part A, 40 (9)*, 744-766.

Hong, X., Jingjing, Q. and Xingli, T. (2013). B2C E-commerce vehicle delivery model and simulation, Information Technology Journal, 12(20), 5891-5895.

JFS (2011). Yamato Starts Using Streetcars for Low-Carbon Parcel Transport, Japan for Sustainability, http://www.japanfs.org/en/news/archives/news_id031255.html

Jorgensen, K. (2008). Technologies for electric, hybrid and hydrogen vehicles: electricity from renewable energy sources in transport. *Utilities Policy*, 16, 72-79.

Jou, R.-C., and Y.-C. Yeh (2013). Freeway passenger car drivers' travel choice behaviour in a distance-based toll system. *Transport Policy,* 27, 11-19.

Jou, R.-C., Y.-C. Chiou, K.-H. Chen, and H.-I. Tan (2012). Freeway drivers' willingness-to-pay for a distance-based toll rate. *Transportation Research Part A: Policy and Practice,* 46(3), 549-559.

Kikuta, J., T. Itoa, I. Tomiyama, S. Yamamoto, T. Yamada (2012). New subway-integrated city logistics system, *Procedia - Social and Behavioral Sciences* 39, 476 – 489.

Lawphongpanich, S., and Y. Yin (2012). Nonlinear pricing on transportation networks. *Transportation Research Part C: Emerging Technologies*, 20(1), 218-235.

Leonardi, J., Browne, M., and J. Allen (2012). Before-after assessment of a logistics trial with clean urban freight vehicles: A case study in London. *Procedia - Social and behavioural sciences-*, 39, 146-157.

Lin, C. Choy, K-L., Pang, G. and Ng, T. W. (2013). A data mining and optimization –based real-time mobile intelligent routing system for city logistics. IEEE 8th International Conference on Industrial and Information Systems, 18-20.

Liu, Z., Wang, D., Jia, H., and N. Djilali (2014). Power system operation risk analysis considering charging load self-management of plug-in hybrid electric vehicles. *Applied Energy*, 136, 662-670.

May, A. D., and D. S. Milne (2000). Effects of alternative road pricing systems on network performance. *Transportation Research Part A: Policy and Practice,* 34(6), 407-436.

May, A. D., R. Liu, S. P. Shepherd, and A. Sumalee (2002). The impact of cordon design on the performance of road pricing schemes. *Transport Policy*, 9(3), 209-220.

McKinnon, A. C. (2006). A review of European truck tolling schemes and assessment of their possible impact on logistics systems. *International Journal of Logistics Research and Applications*, 9 (3), 191-205.

Meng, Q., Z. Liu, and S. Wang (2012). Optimal distance tolls under congestion pricing and continuously distributed value of time. *Transportation Research Part E: Logistics and Transportation Review,* 48(5), 937-957.

Minghong, P., Lian, L., and J. Chuanwen (2012). A review on the economic dispatch and risk management of the large-scale plug-in electric vehicles (PHEVs)-penetrated power systems. *Renewable and Sustainable Energy Reviews*, 16, 1508-1515.

O'Mahony, M., D. Geraghty, and I. Humphreys (2000). Distance and time based road pricing trial in

Rao, C., Goh, M., Zhao, Y. and Zheng, J. (2015). Location selection of city logistics centers under sustainability, Transportation Research Part D, 36, 29-44.

Reaidy, P.J., Gunasekaran, A. and Spalanzani, A. (2015). Bottom-up approach based on Internet of Things for order fulfillment in a collaborative warehousing environment, *International Journal of Production Economics*, 159, 29-40.

Roorda, M.,Cavalcante, R., McCabe, S. Kwan, H. (2010) A conceptual framework for agent-based modelling of logistics services, Transportation Research Part E, 46, 18-31.

Stathopoulos, A., Valeri, E. and Marcucci, E. (2012) Stakeholder reactions to urban freight policy innovation, *Journal of Transport Geography*, 22, 34-45.

Tadic, S., Zecevic, S. and Krstic M. (2014) A novel hybrid MCDM model based on fuzzy DEMATEL, fuzzy ANP and fuzzy VIKOR for city logistics concept selection, *Expert Systems with Application*s, 41, 8112-8128.

Tamagawa, D., Taniguchi, E. and Yamada, T. (2010). Evaluating city logistics measures using a multi-agent model, *Procedia-Social and Behavioral Sciences*, 2(3), 6002-6012.

Taniguchi, E. and Kakimoto, Y. (2004) Modelling effects of e-commerce on urban freight transport, *In: Logistics Systems for Sustainable* Cities (Eds. E. Taniguchi and R.G. Thompson), Elsevier, Oxford, pp.135-146.

Taniguchi, E., Yamada, T. and Okamoto, M. (2007) Multi-agent modelling for evaluating dynamic vehicle routing and scheduling systems, *Journal of the Easter Asia Society for Transportation Studies,* 7, 933-948.

Taniguchi, E. and R.G. Thompson, (2014). *City Logistics: Mapping the Future*, CRC Press, Taylor & Francis, Boca Raton.

Thompson, R.G. and E. Taniguchi, (2014). Future Directions, Chapter 13, In *City Logistics: Mapping the Future*, (E. Taniguchi and R.G. Thompson, Eds.), CRC Press, Taylor & Francis, Boca Raton, 201-210.

Teo, J.S.E., Taniguchi, E. and Qureshi, A.G. (2012). Evaluation of distance-based and cordon-based urban freight road pricing on e-commerce environment with multi-agent model, *Transportation Research Record: Journal of the Transportation Research Board*, 2269, 127-134.

Teo, J.S.E., Taniguchi, E. and Qureshi, A.G. (2014). Multi-agent systems modelling approach to evaluate urban motorways for city logistics, *International Journal of Urban Sciences*, 18(2), 154-165.

Teo, J.S.E., Taniguchi, E., Qureshi, A.G., Mai, V.P. and Uchiyama, N. (2015). Towards a safer and healthier urbanization by improving land use footprint of last-mile freight delivery, 93rd Annual Meeting of Transportation Research Board.

van Duin, J. H. R., Tavasszy, L. A., and H. J. Quak (2013). Towards E(lectric)-urban freight: First promising steps in the electric vehicle revolution. *European Transport*, 54, Paper no.9.

von Rosenstiel, D. P., Heuermann, D. F., and S. Hüsig (2015). Why has the introduction of natural gas vehicles failed in Germany? - Lessons on the role of market failure in markets for alternative fuel vehicles. *Energy Policy*, 78, 91-101.

Wangapisit, O., Taniguchi, E., Teo, J.S.E. and Qureshi, A.G. (2014) Multi-agent systems modelling for evaluating joint delivery systems, *Procedia-Social and Behavioral Sciences*, 125, 472-483.

Xu, F. Q., Ding, N., Lu, H.F. and Liu, J.G. (2014). The data study and analyzing of city logistics system based on cloud platform, *Journal of Chemical and Pharmaceutical research*, 6(8), 449-455.