FREIGHT TRANSPORT MANAGEMENT IN THE CENTRAL BUSINESS DISTRICT: An Empirical Analysis of the Traffic and Environmental Impacts of the Cooperative Delivery System

by

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Abstract

Movement of goods in the city contributes to the steady increase of traffic congestion and serious deterioration of urban environment. This problem can be mitigated either by supplying necessary infrastructures or by applying policy measures to curve the volume of traffic. These two methods are mostly known as, 1) infrastructure-based measure and 2) TDM-based measure. The first type of measure is normally achieved for a long period of time (e.g. construction of freight terminal may take years) and requires huge financial investment while the second type of measure is adaptable for a short period of time (e.g. reservation of parking space for trucks) and less expensive. This study concerns to the second type of measure. In particular, it investigated the application of cooperative delivery system (CDS) which is one of most powerful TDM measures for freight transport to different types of central business district (CBD).

The CDS can be designed to meet the following objectives, 1) reduce traffic congestion, 2) improve urban environment, 3) used as a tool for urban planning and city protection, 4) reduce transportation cost and 5) enhance companies' social reputation. There are several models of CDS. The one adopted in this study is the "multiple carriers" and "multiple shippers" concept where different carriers and shippers agreed to cooperate and coordinate their operation. Moreover, there are three types of CDS designs namely 1) Horizontal CDS, 2) Vertical CDS, and 3) combination of Horizontal and Vertical CDS. Under the first design, trucks of different sizes and loads have to bring their cargoes to the stock point (SP) or depot for consolidation. Small trucks, normally non-polluting vehicles, will complete the delivery going to the customers. At the (off) loading area of the building, the driver would unload goods and deliver them to the recipients. The second design of CDS on the other hand entails to assigning of staff at high rise buildings with high number of goods attracted. When the delivery trucks arrive, the staff would unload the goods and delivery them to the recipients. The third design of CDS which is the combination of Horizontal and Vertical CDS combined the functions of two systems resulting to comprehensive delivery system that has strong impact both on traffic and environment.

Different designs of CDS under the "multiple carriers" and "multiple shippers" concept are applied to different types of central business district (CBD) to assess their suitability and applicability. From the perspective of application of CDS, CBD can be classified into four categories: 1) low density CBD in developing countries, 2) high density CBD in developing countries, 3) low density CBD in developed countries, and 4) high density CBD in developed countries. Microsimulation analysis is selected as method to evaluate traffic and environmental impact of the CDS due to its high reliability and friendliness when many cases are required to be analyzed. Data of CBD needed for analysis is obtained through survey (i.e. survey in Tokyo was conducted in February 2002 while March 2005 in Metro Manila).

Traffic and environmental impact of CDS to low density CBD which is mostly located in developing countries appears to be limited due to the very high number of private cars (around 50%) and saturated transportation network. Share of trucks on the other hand is considerably low at 1.2% which suggests that even removing all the trucks on the road, the network is still saturated. In the future however, the proportion of vehicle modes might change as the development of the central business district intensifies which would transform the CBD into high density. Share of trucks can be expected to increase that would further aggravate traffic congestion and pollutant emissions. When CDS is applied under this condition, the CDS produced notable positive effect to the road network as well as to the urban environment. In essence, cooperative delivery system becomes more important as the development of the CBD intensify. The limited capacity of infrastructure necessities a management based measure that would limit the number of trucks while serving the same amount of goods.

When the CDS is applied to a low density CBD of developed country (Marunouchi district of Tokyo), the traffic impact of CDS is observed to be high at 12% of the total traffic. Reduction to both NOx and SPM is also substantial at 89% of all those coming from trucks. Aside from the estimation of traffic and environmental impact, the study evaluates the ratio of truck trips to be covered by the CDS in order to avoid queues of trucks at the (un)loading area of each building. It was found out that at least 70% of the truck trips should be covered to meet this objective. Modifications to the CDS however should be made when the proportion of retail space (i.e. shops and restaurants) reached 23% due to tremendous increase of truck trips (presently, share of retail space is 2.7%). These changes can be done in the form of increasing the number of CDS staff and/or increasing the number of freight facilities (i.e. parking space and freight elevator). Regarding the working time (i.e. labor time and delivery time), a 50.4% reduction (from 63,314 min to 31,403 min) can be achieved by the CDS.

It was necessary to identify which of the CDS designs is applied depending on building density and building use in the CBD to realize its full potential. Analysis shows that Horizontal CDS has the lowest distribution time in a low density CBD (15-story) while the two other CDS designs brought increase to the distribution time. Distribution time refers to the time derived from delivery (vehicle's running time), unloading, waiting time for parking, labor time at stock point (SP), and vertical delivery. However, when the building density increases and each building reaches 20-story, all 3 CDS designs brought enormous benefits in the form of time saved (distribution time). The same trend is observed when the buildings reached 30-story and 40-story. These findings would be useful guidelines in selecting which CDS design is adopted and when it is adopted based on the characteristics of the CBD.

It appears that the general trend is that as the building density of CBD increases, the greater it needs of the CDS. It is because the number of trucks followed the same trend and as its numbers increases the more problems it generated. This problem can be in the form of traffic congestion which can cause delay to the goods and other vehicles, truck's queue at the (un) loading area of the buildings, and environmental pollutions.

Acknowledgments

During the course of my studies, I received assistance which was essential to the completion of this dissertation from many talented and knowledgeable people. I am forever indebted to them and I would like to take this opportunity to acknowledge their contribution.

I am blessed to have Prof. Yoji Takahashi as my advisor. Prof. Takahashi who provided considerable insight into the role of cooperative delivery system in managing freight transport in the central business district, who had the difficult task of encouraging me to work and think independently, and introduced me to so many helpful colleagues, has been a major influence to my academic career. His broad range of interests and knowledge makes him and excellent scholar to consult on any research issues. He motivated me to use my imagination in overcoming research difficulty, something I shall appreciate forever. Looking back, I realized how truly fortunate I was to have such an excellent mentor and in the future, I won't see myself complaining if I receive continued advice from him for I always see myself as his student.

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If the dissertation’s contents are consistent, readable and understandable, it is partly because of the help provided by my friends. Michelle Parumog, a doctoral student from Komamoto University and a good friend of mine absorbed the burden of reading almost all the text of the paper while Sahid Kamid, another good friend, edited and provided some very critical suggestions regarding the content of chapter 6 and Chapter 2. I thank both of them for their assistance.

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CHAPTER 1

Introduction

1.1 Background and problem description

There is a strong pressure on the policy-makers to address the mobility needs of urban freight in ways which are economically, socially, and environmentally acceptable. Efficient freight transportation has been the goal of every urban center in view of sustaining the economic competitiveness of the area and maintaining or improving the quality of life it offers. Formulating a policy measure that would embrace the economic, social and environmental elements requires fundamental understanding on the complex nature of urban freight transport. This appears to be a difficult goal and yet, the only option in view of sustainable development.

The substantial efforts poured on managing freight transport at the urban centers such as construction of distribution centers and application of Intelligent Transportation System (ITS) and Information Communication and Technology (ICT), have yielded notable result but still far from desirable. Travel speed of vehicles continues to decline and so do environmental desirability. Moreover, there is a general acknowledgement that moving goods in urban areas is increasingly becoming difficult. Access of trucks to customers in the inner part of the city is seriously hampered by congestion. Trucks delivering goods are often having problems on locating (un) loading areas. Lack of related freight transport facilities such as freight elevators are often limited if not missing, which reduces the efficiency of delivery chain. The ability to expand transport capacity is seriously hampered by the lack of resources. Authorities on the other hand are responding by imposing restrictions that limit the access of trucks out of belief that trucks are main source of the transport problems.

Evidently, there is a need for policy intervention to reduce the negative impacts of trucks without harming its financial viability and service performance. This study is about exploring the potential of cooperative delivery system (CDS) in meeting efficient freight transport.

1.2 Objectives of the study

The goal of the study is twofold, 1) to evaluate the applicability of CDS to different types of CBD and 2) to evaluate quantitatively traffic and environmental impacts of CDS in the CBD using empirical data. For the specific objectives of the study, these are listed below:

- To review the current development and practices of cooperative delivery system and the factors for the implementation of such measure.

- To clarify transportation conditions in urban areas and review the urban freight transport policies in selected developed and developing countries.

- To provide guidelines of which, CDS design is suitable for applications based on the CBD's characteristics and right timing of measure application.

- To assess the roles of CDS as the CBD transform from low density to high-density structure.

- To evaluate the impacts of cooperative delivery system to the traffic flow in CBD road networks and also to the improvement of urban environment.

1.3 Significance of the study

Foremost, the study would advance our understanding to the role of CDS in managing freight transport in the CBD. CDS has been known to have potential to respond to the emerging problem regarding freight distribution in the CBD; however, there is lack of enough evidence if its result can be both socially and economically acceptable. Moreover, there are many types of CDS design, i.e. Horizontal CDS, Vertical CDS and the combination of Horizontal and Vertical CDS, and yet there are few available materials which provide hint on when to apply each design to maximize its potential.

Selecting suitable measure to a given problem is also very important in view that unsuitable measures might deteriorate the problem when applied. There might be some typical characteristics of CBD which could signal to the right circumstances to apply CDS where benefits in terms of economic and social perspective are maximized. In essence, this study aims to be a guideline for the application of CDS in the CBD.

1.4 Scope of the study

The scope of this study is mainly limited to CDS and its application to office-oriented CBD. It has not been tested to other areas such as residential zone where presence of high number of trucks is not desirable. CDS can be an influential tool in achieving this goal and therefore it would be of interest to evaluate its applicability and impact as well.

Moreover, the case studies are limited to the CBD of Tokyo and Metro Manila. The aim is to make the CBD of Metro Manila representative of low density CBD in the developing regions which are characterized by few share of trucks and saturated transportation network while the CBD of Tokyo as representative of developing regions with are characterized by high share of trucks and efficient public transportation network.

1.5 Structure of the study

The study has four parts. Part I sets the framework of the study, i.e. objectives were set, method of analysis is defined and output of the research is partly revealed (Figure 1). Part II reviews the recent developments in urban freight transport and the impact of these changes to both the way freight is manage and to the urban environment. Also given lengthy discussion in this section is the policies taken by different cities as response to the growing challenges of managing city distribution. Policy measures that produces significant benefits such as cooperative delivery system, road pricing, ITS and ICT implementation were also reviewed.

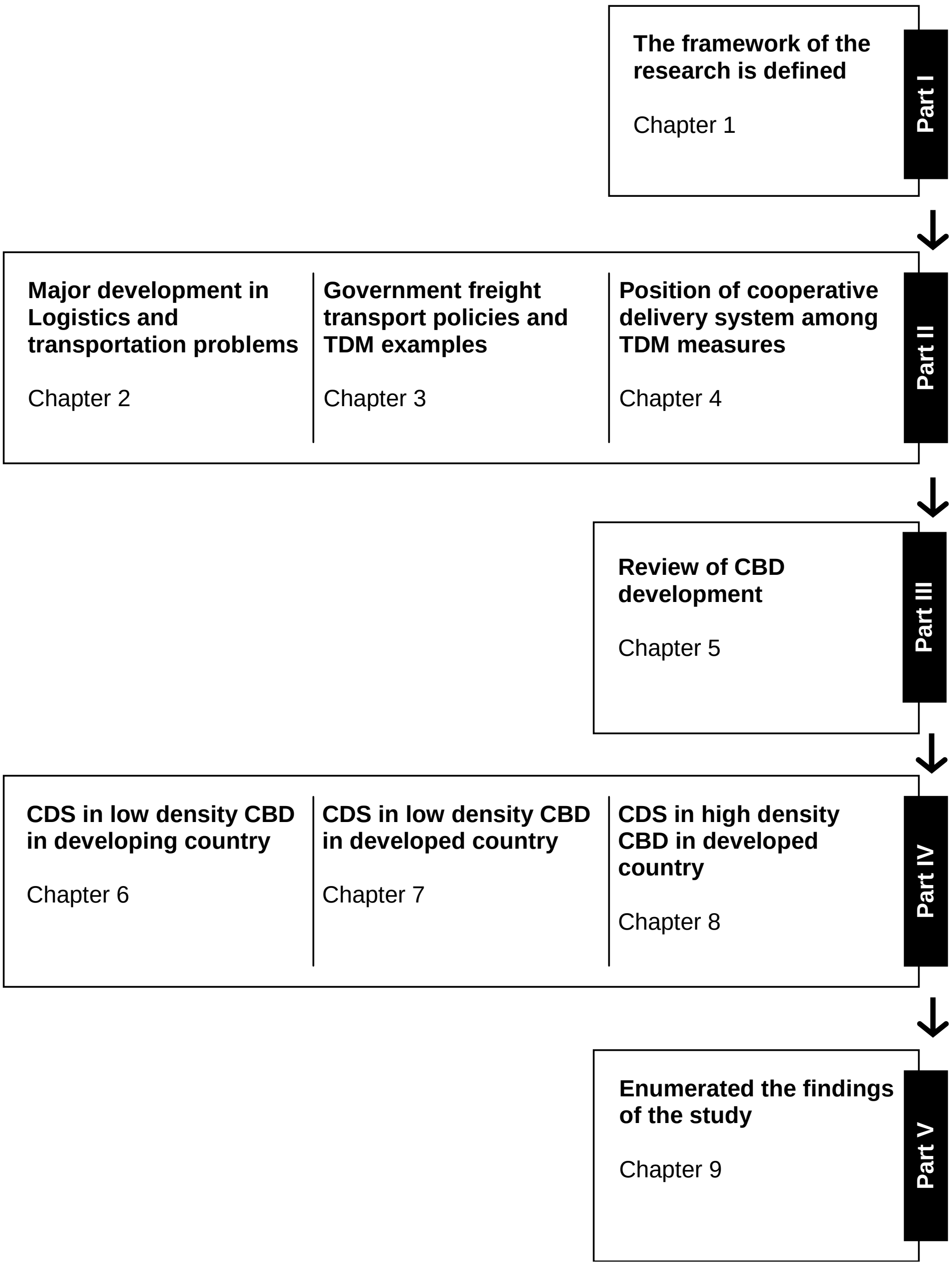


Figure 1-1. Structure of the dissertation

The Part III of the study characterizes central business district in selected cities which lead to identify distinguished features of those CBD in developed countries and those CBD in developing countries. The study area is also defined in this part. The evaluation of the impact of CDS to mitigate the growing problems in the urban center, in particular in the CBD, composes Part IV of the study. CDS's impact was first assessed in a CBD of a developing country. This assessment also takes into account further development in the district which could lead to high number of trucks. After quantifying the impact of CDS to the transport environment of CBD in developing country, the application of this measure is shifted to a CBD in developed country. Comparison of CDS results between CBD of Manila and Tokyo is also presented which highlights the notable traffic and environmental reduction in Tokyo while very limited for the case in Manila. Moreover, the guidelines in selecting which CDS design is adopted and when it is adopted based on the characteristics of the CBD are presented here. Part V of the study contains significant findings of the study.

The flow of the study on the other hand begins at reviewing the problems of urban freight transport (Figure 1-2). After the review, the study visited the policy focus of governments around the world as a response to the growing problems identified before. This review is coupled with some applications of TDM measures to local cities.

Reviews of available measures normally applied to mitigate the problems of urban freight transport are then discussed. This review both discussed hard (infrastructure-based measures) and soft measures (TDM-based measures). The study then identified cooperative delivery system as promising measure to confront the problems of freight transport in the CBD. Different characteristics of CBD which the CDS will be applied are then discussed. Four groups of CBD emerged from this grouping which are: 1) low density CBD in developing countries, 2) high density CBD in developing countries, 3) low density CBD in developed countries, and 4) high density CBD in developed countries. After this grouping, the application of cooperative delivery system of the different groups of CBD is conducted and some comparison of results is made.

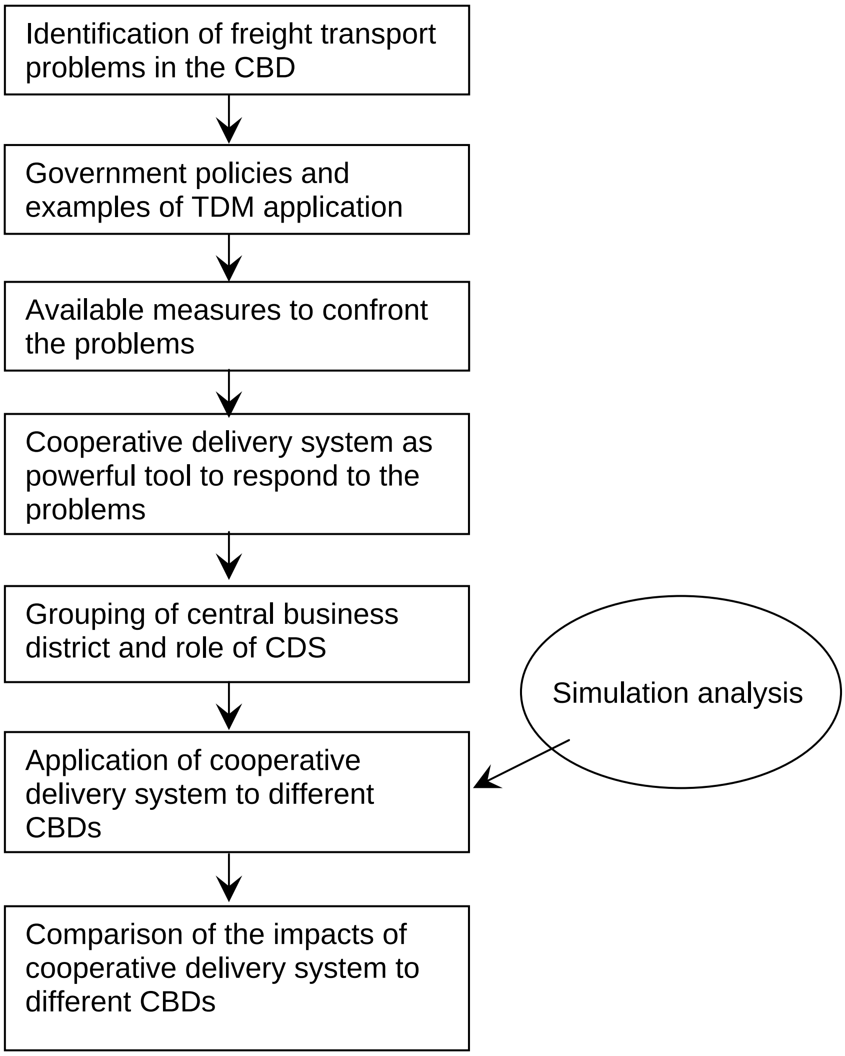


Figure 1-2. Process of the study

CHAPTER **2**

Traffic and Environmental Problems Associated to Freight Transport in the CBD

2.1 Introduction

The quality of urban environment is largely influenced by freight transportation in various ways and means. These factors may be felt in terms of traffic and vehicle emissions and degradation of renewable and non-renewable capital resources. In general, traffic, emission and capital resources are three main actors in shaping the built environment towards sustainable urban system.

The availability of freight transport related facilities such as (off) loading areas, exclusive parking space for trucks, freight elevators coupled with favorable policies toward trucks and its governing environment (*i.e.* exclusive lanes for trucks and protection of reserved spaces for delivery vehicles) are potential elements to ensure the realization of efficient freight transportation.

This chapter describes current trends and developments that shape the freight transport industry. It argues that the current changes to customers' behavior along the expansion of the market and advancement in the field of technology are major factors that overhauled the management of urban freight transport. The contents of this chapter are mainly sourced from existing materials and to some extent from Internet.

There are five (5) sub-sections comprising this chapter. Section 2.2, which has four (4) sub-sections, traces the trends and developments affecting urban freight transportation. Under Section 2.2, Section 2.2.1 articulated the changing customer behaviors that lead to the change of management style of freight transport service providers. Section 2.2.2 explored the advancement in the field of information technology that simplified the connection between suppliers and the customers. Section 2.2.3 discussed the vehicle type shift by the freight distributors to transport goods in urban areas while Section 2.2.4 briefly tackled the current freight transport management principles and approaches. The problems associated to urban freight transport are enumerated in Section 2.3. This section is subdivided into five (5) sub-sections. The continuous growth of road freight transport share is highlighted in Section 2.3.1 while Section 2.3.2 illustrates the speed characteristics of vehicles in the urban areas, as affected by freight transportation. Section 2.3.3 provides critical discussion on the environmental problems, particularly on the different hazardous gases, as well as particulate matters due to transport related activities, where freight transportation has significant share.

This section also discusses transport modal share in terms of emission. Section 2.3.4 traces the continued decline of load factor of trucks while Section 2.3.5 shows the increasing cost in delivering freight transport goods to urban areas. Section 2.4 emphasized the necessity to adopt freight transport management as countermeasure to the pressing problems associated to freight transportation. Finally, Section 2.5 concludes the chapter.

2.2 Trends and Developments shaping urban freight transport

2.2.1 Dynamic society and its impact on freight transport

The massive development of Information and Communication Technology (ICT) industry connects customers to variety of choices in the market. This customers' behavior known as e-shopping (electronic shopping through the internet) has lead to more goods delivery to village homes - attracting substantial amount of truck traffic. Added to this is the dramatic drop of ICT service cost, hence private firms and the general consumers exploited the situation, thereby influenced the urban logistics system (Nemoto *et el*, 2001).

An A.T. Kearney/ELA 'Insight to Impact' (1999) study quoted by City Freight (2002) study identified customer sophistication as a major driver of development in logistics and supply chain systems. The report highlights that customers are demanding greater product variety/assortment, more and tailored value-added services, custom/tailored products, shorter response times and greater accuracy and support throughout the product's life cycle. This service-oriented demand is a potential factor to affect the level of use of freight systems, thereby more stress on the transportation network.

In Germany, for example, the amount of food consumed has not grown so much in the last three decades, but food transport (in tone/km per capita) almost doubled. The reasons include customer preferences for food from other countries, transport policies, and production patterns of the food industry and the policies and location of retailers (FAW, 2000). This trend in one way or another shapes the flow of services across the existing freight transport systems, the built transport network and more importantly, the environment.

2.2.2 Advancement of information technology

The advancement in ICT in both fronts – hardware and software – put firms into position to developed system architectures that have enormous capacity. Real-time positioning of trucks can now be done with the aid of Global Position Systems (GPS) that could enhance urban freight networks and freight operation. Firms are using Internet as a medium to reach more customers and showcase their services. In addition, this technology allows different firms to share real-time data, thereby opening the possibility for partnership through fleet sharing, monitoring support systems (e.g. GPS stations and the like) and infrastructure improvements, among others.

Internet on the other hand gives people variety of choices beyond their geographical borders. There is a growing trend wherein customers demand for quick delivery and high quality of service, which pushes the freight transport sector to improve their traditional freight systems. These phenomena translated into more trips in order to meet the quick time requirement of customers at the expense of low load factor and backhauling. Consequently, reactive service due to real-time demands increased the distance traveled by delivery vehicles.

E-commerce (transaction), e-logistics (cargo), and e-fleet management (vehicle and driver) have taken freight transport and logistics management into another level (Figure 2-1). With the aid of ITS, trucks and cargoes can be traced in real time. Apparent benefits from this system can be manifested in trucks receiving real-time advises to avoid certain congested roads.

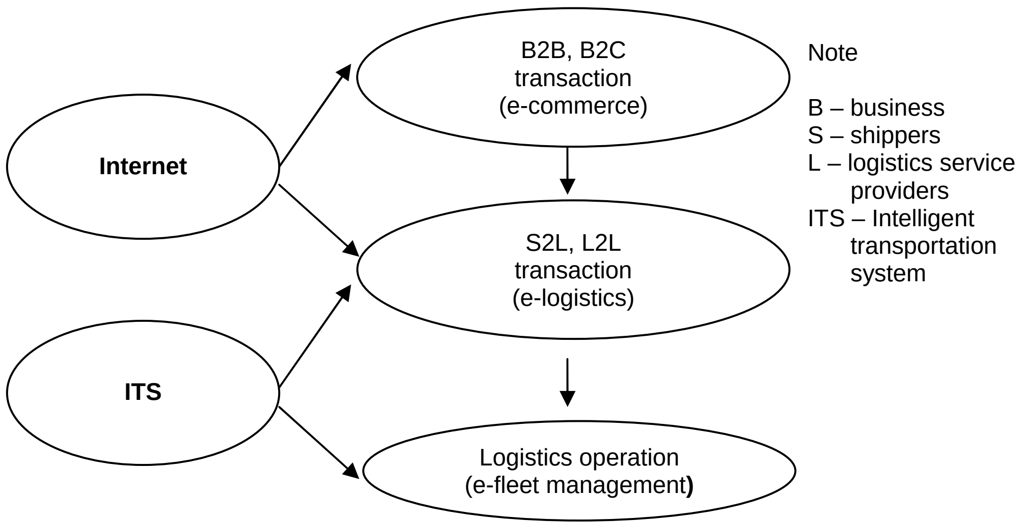


Figure 2-1. ICT and logistics system
Source: Logistics development supported by ICT & ITS in the Asia-Pacific Region, 2003

2.2.3 Shifting of vehicle types and changing structures of commercial transport

Parallel to the above developments in the freight transport industry is the rush on the fleet and cargo management to cater strong customer demands. One of the quick responses being adopted is the use of small trucks in city freight distribution – delivering goods in small quantities or volumes. The rate of proliferation of small trucks in the goods delivery level is caused by several factors, which includes a) changes in the modes of conduct of business and b) government policies.

There is a management philosophy called “Just In Time” (JIT), where in terms of logistics and production, a certain amount of product is shipped in total time precision, which basically requires the type of vehicle with high maneuvering capability in congested urban networks. The system hopes to serve customers with demands for Quick-Response (QR) system to receive product orders. But unfortunately, the same customers are usually found to have lack of parking areas for use by the delivery firms. To address this situation, the freight forwarders/forwarders opted to use small delivery trucks due to its maneuvering capability and less requirement for parking space. This strategy is somehow favored by the present condition of urban centers, which are usually served by small-scale transport networks.

Similarly, government policies also contribute to this scenario. For instance, a truck control measures like truck ban along a congested road would bring changes on how the freight operators would conduct their business. Trucking companies, for instance, in Metro Manila chose to shift from large to small trucks (less than 4 tons) after the implementation of the truck ban in its main thoroughfare (Castro, 2004).

Also, in cities where historic places are treasured, both the engine and weight of the distribution truck has to meet the standards set by the local government as has been seen in some cities in Italy (see freight transport policy report for Italy in Chapter 4 for detail).

2.2.4 Changing form of freight transport management

There is also a big shift from old form of management among the key players in freight transport. New management principles and approaches like JIT, QR, Lead Time Management, Time Compression, Lean Logistics, and Efficient Consumer Response have surfaced in the freight transportation industry, which helps firms maximize their logistics operation.

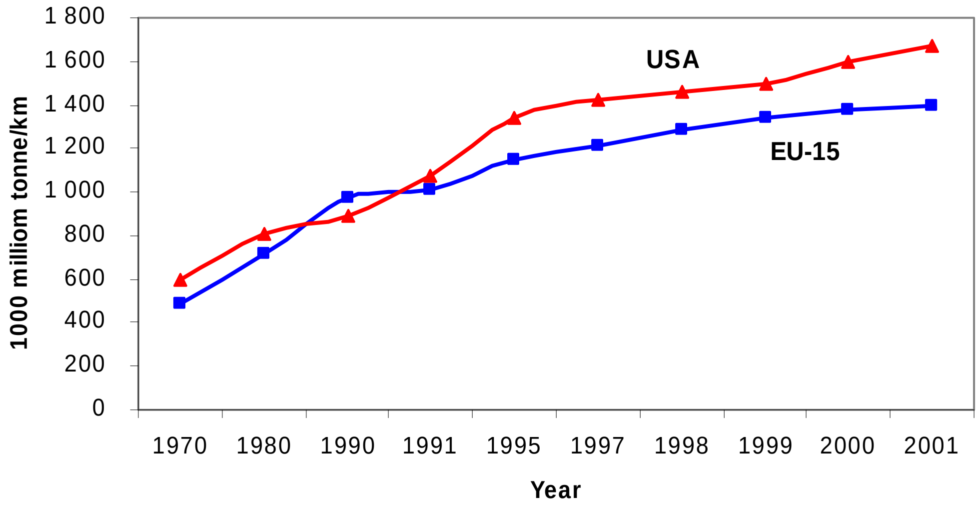


Figure 2-2. Road freight growth in the US and EU-15
Source: EU Statistical Pocketbook, 2000
(http://europa.eu.int/comm/dgs/energy_transport/figures/pocketbook/2004_en.htm)

2.3 Problems associated to urban freight transport

2.3.1 Increasing volume of road freight

The trends and developments shaping freight transport industry have great impact to the flow of freight traffic in urban areas. One trend that can be commonly observed among the developed countries is the continuous rise of road freight that puts tremendous pressure to the urban network (Figure 2-2 and Figure 2-3). Developing countries are believed to be on the same path of freight situation, although the lack of data would make it hard to estimate the pace of the trend over the past years.

Japan faces a situation where road freight's share is increasing, while the share of other two modes' (shipping and rail) is declining (Figure 2-3). Clearly, there is a need to transfer some share of freight transport from road to other modes of transport to reduce reliance on the road-based network, which usually induces further congestion. The Japanese government is trying to rectify this mode ratio by launching modal shift program in 2002 where incentives are given to firms that are considering a plan to utilize other modes except trucks. Also in the interest of this program is to curve greenhouse gases sourced from trucks in line with the government's commitment to the Kyoto protocol.

Ideally, a modal migration from truck transport in shipping is preferable due to factors such as energy efficiency and reduced carbon-dioxide emission per unit of transport. But the capacity of the railroad network for freights in Japan is extremely limited because most of it has been utilized by passengers and there are only very little opportunity for time windows for freights (Takahashi, 2005).

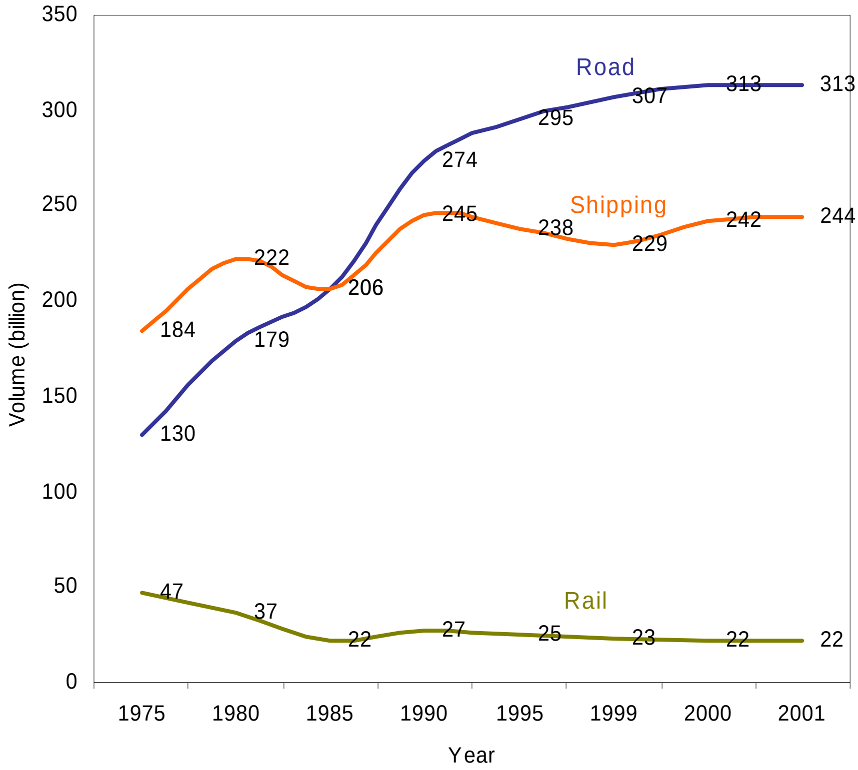
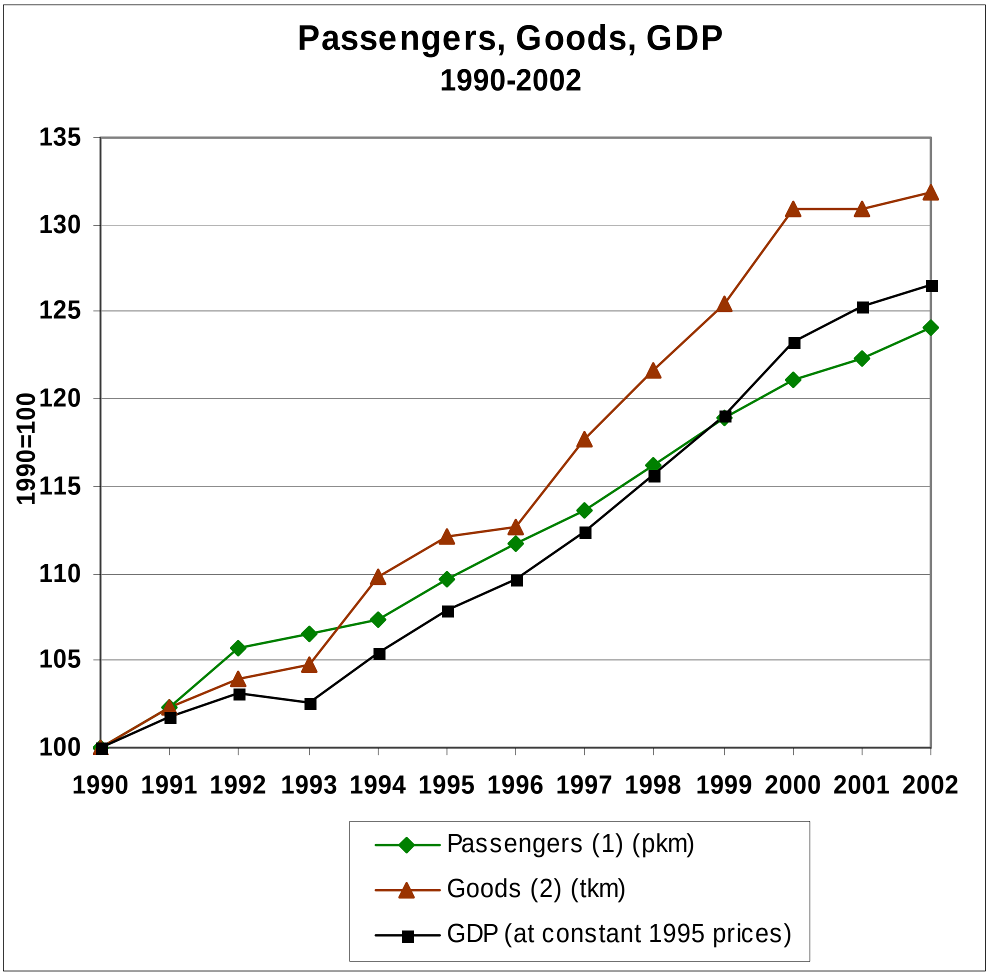


Figure 2-3. Performance by mode in transport of goods in Japan (ton-kilometer)
Source: MLIT data available at www.mlit.go.jp with the filename y1204000.xls

In Europe, the growth of freight transport overtook the growth of EU's GDP (Figure 2-4). This growth is largely due to the creation of single European market supported by globalization and advancement of information and communication technology. The recent expansion of EU to eastern part of Europe would further increase the freight transport. It must be emphasized that amidst this freight growth is the potential increase of road freight share in the overall network traffic.



Notes:
(1): passenger cars, buses & coaches, tram+metro, railways, air
(2): road, rail, inland waterways, pipelines, sea (intra-EU + domestic)

Annual Growth Rates EU-15 (% change per year)

	1980-1990	1991- 2001	2001- 2002
GDP (real growth)	2.3	2.1	1.0
Industrial production	1.8	1.5	-0.8
Passenger transport pkm (5 modes)	3.0	1.8	1.3
Freight transport tkm (5 modes)	1.6	2.5	0.8

Figure 2-4. Growth in freight transport and GDP in EU-15
Source: EU Statistical Pocketbook, 2000
(http://europa.eu.int/comm/dgs/energy_transport/figures/pocketbook/2004_en.htm)

Like in Japan, policy makers in the European community are also trying to address the same form of problem regarding the unbalanced ratio of different modes in freight transportation. The modal shift initiative known as Marco Polo, which aims to maintain the traffic share between the various transport modes for the year 2010 at its 1998 level was launched in July 2003. The key idea of this policy is to eradicate long distance freight transportation by trucks to other less harmful modes of transportation to environment.

2.3.2 Deteriorating travel speed

Serious traffic congestion brings inefficiency to the road network as well as negative impacts to the movement of goods. In Tokyo, like any other large urban areas, indication of worsening traffic condition is manifested by the continuing decline of travel speed (Figure 2-5). The average travel speed in inner Tokyo was 22.5 km/hr in 1980 and declined by 17% in 1997 (see Chapter 5 for the average speed of other urban areas). It is believed that the share of trucks to the total vehicles on the road of Tokyo is quite high at 45% (Takahashi, 2001, Cox, 2001). This indicates that trucks have substantial contribution to the serious traffic congestion.

For the purpose of presenting comparative data regarding congestion problem, we may take a look the average travel of speed in London as shown in Figure 2-6. The trend is identical to that of Tokyo where the travel speed continues to drop down. London's Department for Transport tries to mitigate the serious problem of traffic congestion by implementing congestion charging where vehicles entering the charging zone (inner part of London) are charged for certain price. The idea of the scheme is to reduce the number of vehicles by imposing road-use prices.

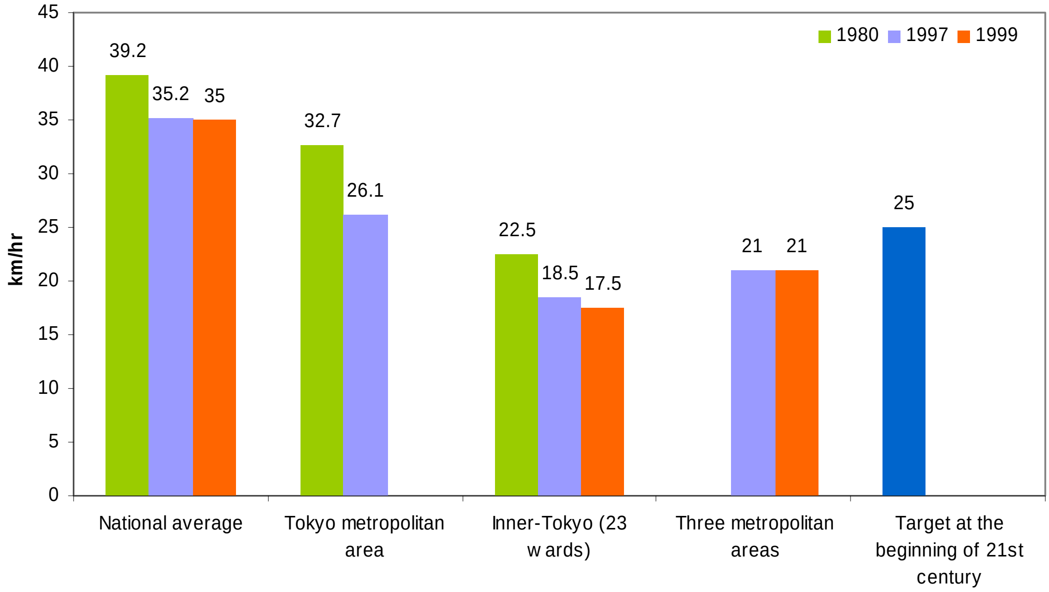


Figure 2-5. Peak-hour traffic speed in Japan
Source: Logistics Developments Supported by ICT & ITS in the Asia-Pacific Region, 2003

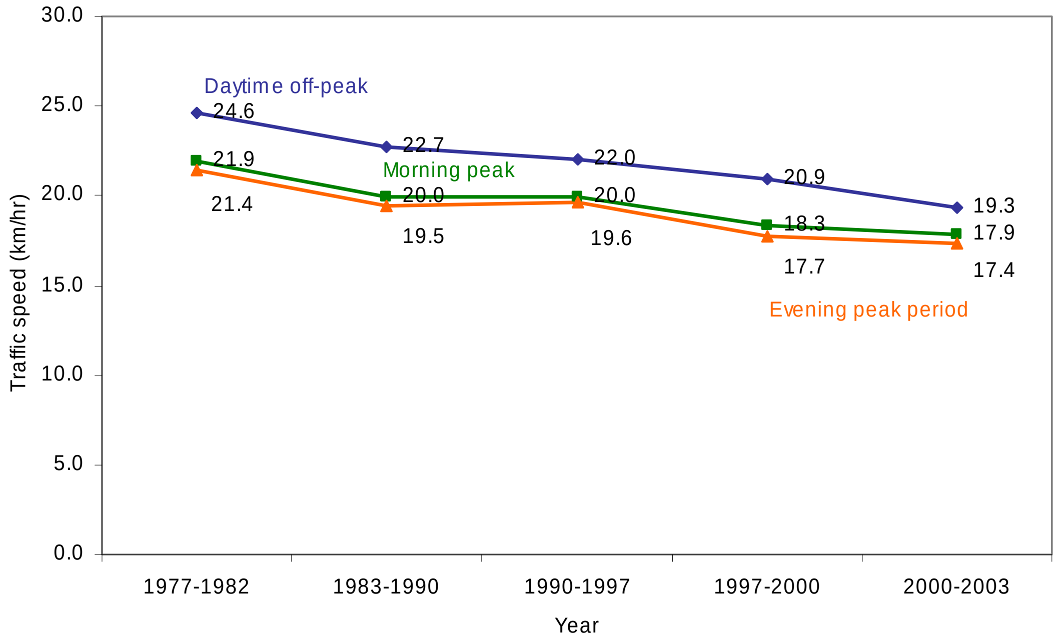


Figure 2-6 Average traffic speeds in Greater London
Source: TfL (http://www.tfl.gov.uk/tfl/ltr2003/road-related-trends-2.shtml)

2.3.3 Environmental problem

Among various urban environmental issues, addressing air pollution is a major challenge for many cities in East Asia. Public concerns over air quality increases with the rising standard of living, as it exhibits direct risks to human health. The major sources of air pollution in large cities are automobiles, although there are other industrial-based sources such as factories. Air pollution caused by traffic is most notable and serious in mega-cities in which the number of vehicles is increasing faster than the pace of population growth (Dhakal, 2003).

As mentioned above, although environmental problem comes from many sources such as factories, commercial establishments, transport sector is believed to have the great share on the said problem. In Japan, for instance, 21% of CO_2 comes from transportation. Furthermore, of all the carbon dioxide coming from transportation, 18% are from trucks (Figure 2-7). In the UK, it was estimated that road traffic is responsible for at least 90%, 20% and 49% of the overall levels of CO, CO2, and NOx gas respectively (Sumalee, 2004).

Dhakal (2003) stated that CO_2 emissions in Tokyo has increased more than two times in the last three decades with 2.5 % annual average growth rate (1970-1998). During the last 20 years, the ratio of diesel vehicles to all cargo vehicles in Tokyo has increased from 22% to 61% wherein it is believed that 70% of CO_2 that came from transportation is sourced from diesel vehicles. In addition, almost all SPM from transportation is believed to come from diesel vehicles. This chemical, SPM, is known to have harmful effects on human health, damages respiratory organs and contributes to lung cancer.

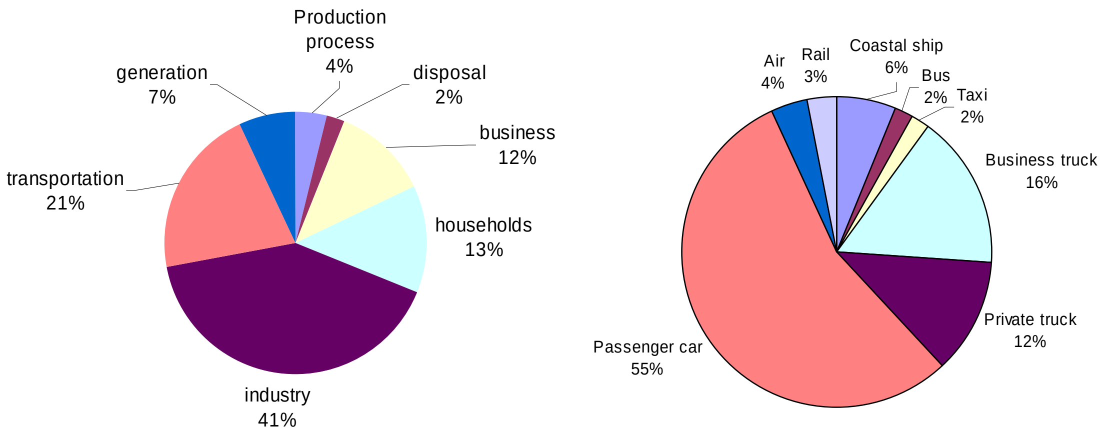


Figure 2-7. CO_2 share of each transportation mode
Source: Takahashi, 2005

2.3.4 Low load factor

As mentioned, the changes in the management of freight transport, as response to the changing customer behavior is remarkable. Freight transport service providers have to deliver small quantity of goods to meet the customers' demand (Figure 2-8). Customers are becoming more demanding to have their goods delivered in short period of time, translating into many delivery vehicles on the road.

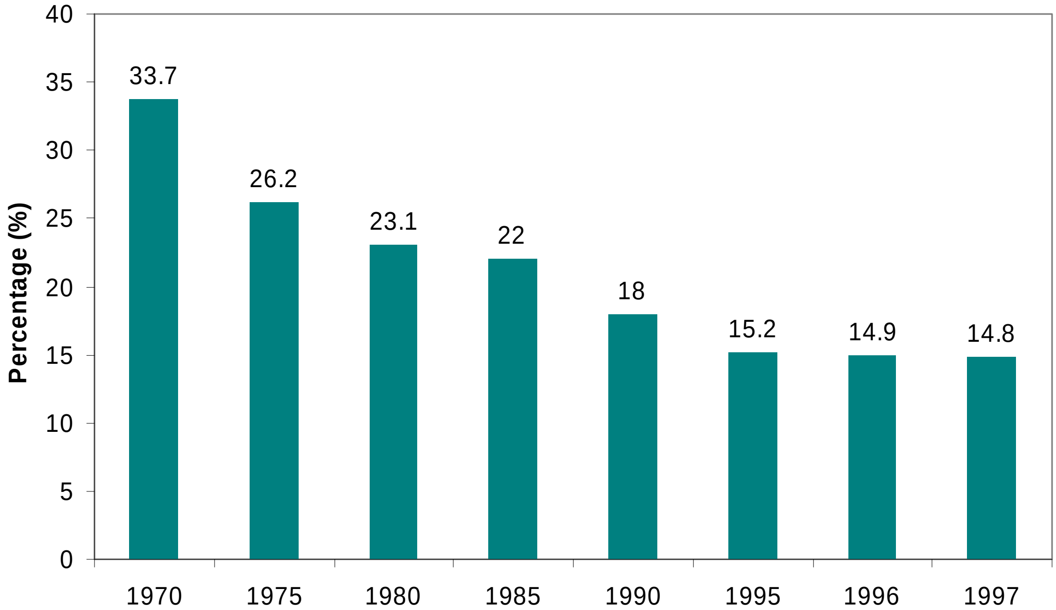


Figure 2-8. Load factor in Japan by weight
Source: Tokyo Metropolitan Government (http://www.kankyo.metro.tokyo.jp/)

2.3.5 Rising of transport cost

The escalating congestion in the road network contributes greatly to the rise of transportation cost. For instance, it was reported that Federal Express claims that it costs 40% more to deliver in New York City (NYC) than in other comparable locations because of the serious traffic congestion. Similarly, United Parcel Service states that it costs them $0.40 more to deliver a package in NYC than in Atlanta, Georgia resulting in an extra $50 per day per driver in NYC (Paaswell and Petretta, 1993).

The rising use of multiple (small-sized) vehicles by the freight companies not only contributes to the increase of goods transportation cost but also traffic congestion, more so on the built environment.

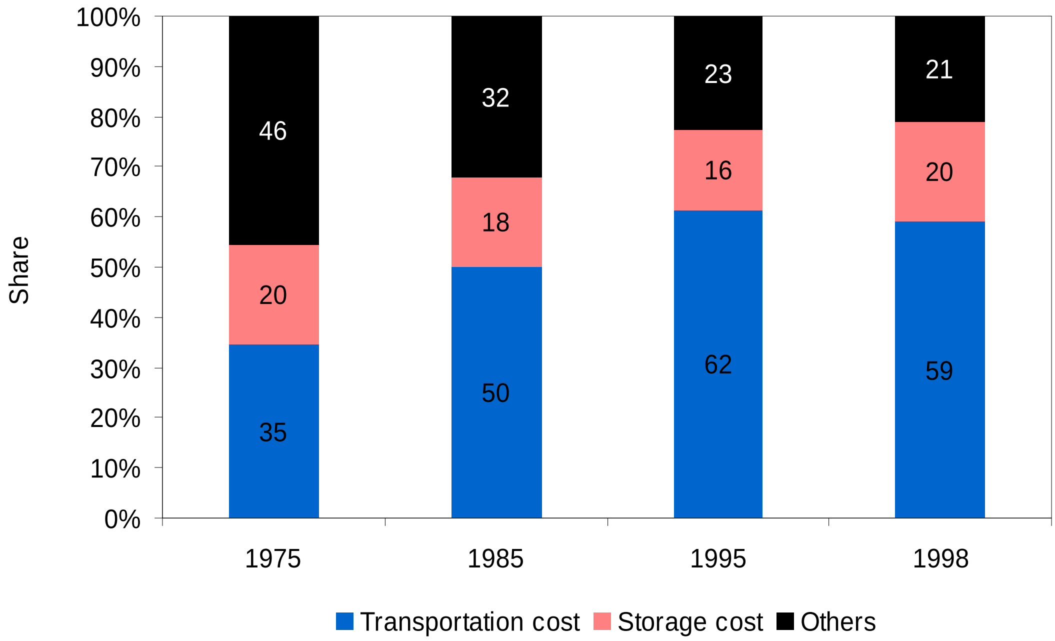


Figure 2-9. Transportation cost in Japan
Source: Tokyo Metropolitan Government (http://www.kankyo.metro.tokyo.jp/)

2.4 The Need for Responsive Policy Intervention for Freight Transport Management in the CBD

It becomes apparent that there is a need to form schemes to manage the distribution of freight in view of several arising problems. Volume of road freight is expected to continue due to the lack of competitiveness of other modes and proactive development in the ICT area to further expand the market for customers. Along this development, traffic congestion and environmental problem will reach new critical level, adversely affecting the lives of the general public. On the other end, transport service providers would face further serious financial challenge as transportation cost continues to rise partly brought by traffic congestion and small delivery activities.

Supplying freight and transport infrastructure, for instance road expansion and provision of freight terminal, is one of the hard measures that can be employed but it always bear the issue on financial investment and term effectiveness. Equally important measure to improve traffic flow and environmental condition is by adopting Transportation Demand Management (TDM) measures that require lesser financial investment. One potential measure is the Cooperative delivery system (CDS), where different carriers coordinate their operations to reduce the number of trucks required in delivering goods, thereby limiting the negative impact of trucks.

Although the above-described problem is rampant in almost every part of urban areas, the peak of this problem can be normally witnessed at the core part of the city, which is the central business district (CBD). CBD attracts large number of freight traffic comprised by goods delivery to commercial establishments and large number of people coming either for work or for shopping as well. The concentration of these establishments in small areas where normally, their location is arranged by functions (i.e. restaurants are located in a single row and retail shops to another row) offers great opportunity to consolidate goods deliveries to the area.

Any attempt to improve the quality of environment and traffic flow will be hard tp realize without policy intervention as has been learned from the current freight transport situations in developed and developing cities. Sustainable freight transport is becoming the new primary objective in the overall development appraisal, as environmental issues have been continually dominating across planning and engineering disciplines. In particular, life in urban areas is becoming very affected by urban accessibility factors like heavy congested roads and the like, so there is an enormous call for innovative transport solutions and concepts to properly handle city distribution of goods.

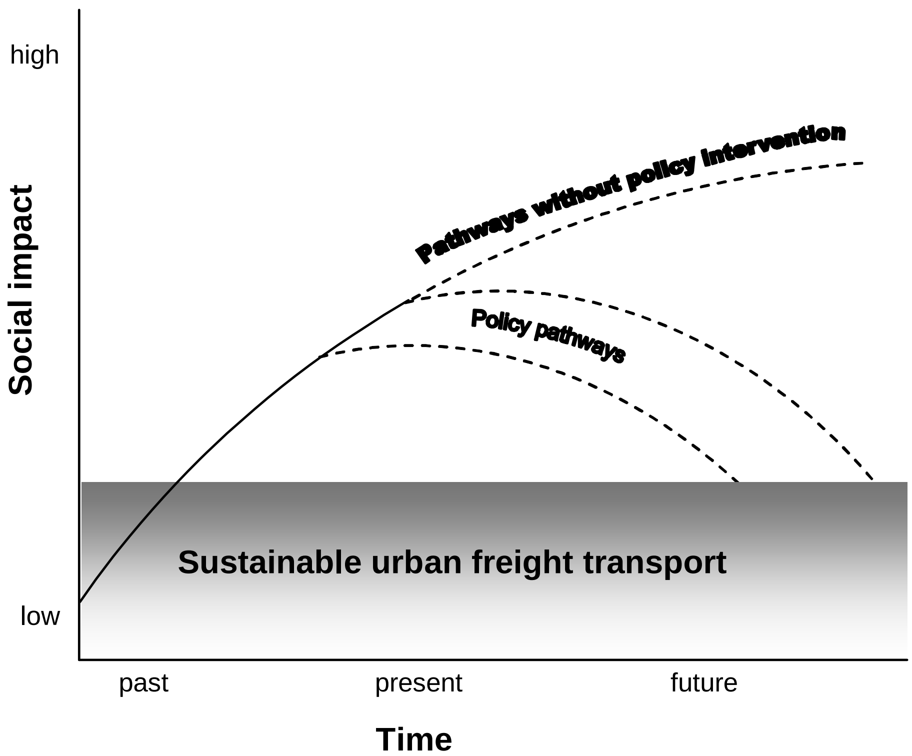


Figure 2-10. Impact of urban freight transport

Figure 2-10, adopted from OECD report (2002) with some modifications, illustrates the direction of freight transport's impact, which rose out of the sustainable urban freight transport area during the past years. The figure shows that without posing policy intervention, the social impact is likely to continue increasing in the future. A policy or a group of measures therefore is essential to counter this growth with the primary aim of pulling back the line to sustainable area.

2.5 Chapter summary

Important changes in technology, expansion of markets, and new concept of freight transport management have led to major changes in the freight transport industry. Through ICT, in particular the Internet, the customers' reach expanded remarkably and within few minutes, they can locate and browse over the menu of their desired products through websites. Customers' appreciation to shorter response time puts great pressure to the freight transport service providers to deliver products in the shortest possible time. This scene greatly contributes to the increase of the number of vehicles in the road network, which often results to exponential level of traffic congestion.

The chapter also highlighted the increase of road freight phenomena common in the US, EU, and Japan. This development has already been recognized by most governments by extending efforts to rectify the unbalance share of freight transport among different modes that are currently in place. Both Europe and Japan for instance have launched modal shift program aims to transfer some freight transport from trucks to other modes such as rail and maritime shipping. Such programs however have limited impact to city distribution of freight since its target is long distance freight. It must be noted that at the core of the city, congestion is extremely serious, which necessitates employment of scheme that aims to enhance the freight distribution efficiency with limited social impact. Under this premise, the cooperative delivery system has enormous potential to meet the said objective through reduced number of trucks while serving the same volume of freight. This scheme is thoroughly discussed in Chapter 4.

In the next chapter, the policies adopted by policy makers for urban centers around the world are reviewed. These policies are thought to be their response to the growing problems occurring in cities with great impacts on the community. Aside from policy reviews, application of TDM measures which basically aims to reduce the social impact of trucks are also tackled.

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CHAPTER 3

Policy Initiatives on Urban Freight Transport

3.1 Introduction

The purpose of this chapter is to review the policies of countries which has been in the forefront of developing innovative strategies dealing with urban freight transport problems. Depending on the availability of source materials in each country, discussions of national policies are presented along with more specific urban center's policy. The review is followed by describing some of city's freight distribution practices initiated by either national or local authorities. In the latter part of this chapter, lessons drawn from public policies presented are summarized.

In the beginning, efforts to improve the quality of environment in the city resulted to the introduction of different transportation demand management (TDM) schemes. Dablanc (1998) after investigating about twenty projects related to freight transport efficiency concluded that - "The unanimous goal is the reduction of environmental impacts in inner cities (energy consumption, noise, air pollution) and the means to achieve that is based on the reduction of trucks movements through consolidation of goods and trips."

In section 3.2, the evolution of policies related to urban freight transport is revisited. This policy recollection is accompanied by clarifying the roles of different groups that have interest to freight transport. Consequent section 3.3 present policies and studies conducted by the European Union (EU) to facilitate uniformity of goal in their urban centers. The goals and policies of some countries within EU are then reviewed along with illustrations of demonstration projects in section 3.4. Further in this chapter, the course of the review led to the discussion of the policies adopted by the USA concerning urban freight transport in Section 3.5. Discussion of freight transport policies of some Asian countries including Japan is presented in Section. 3.6. Japan and Philippines were tackled in detail for the reason that the former has advance and innovative strategies dealing with freight transport while the latter has the well-known truck ban which is typical in some developing country. A comprehensive discussion on the policies of Japan is available in Section 3.6 where several TDM measures by some cities in this country are discussed extensively. A brief review of freight policies in other Asian countries is also available in Section 3.6.3. Comparative analysis regarding the policies and strategies of the countries is presented in Section 3.7. A summary consisting of grouped policies and their merits as well as demerits is finally presented in Section 3.8.

3.2 Urban Freight Policy trends

Policies are made when problems arise and objectives have to be set to avoid the reappearance of the same problems. Early freight transport policy efforts were directed to improve the circulation of traffic. These measures include construction of more roads, provision of (off) loading zones, freight terminal, and improvement of roads to the ports. This can be viewed widely as efforts to equalize supply of infrastructure to meet the growing demand.

However, demand is hardly met and chaos eventually occurs necessitating management. Moreover, intensive use of infrastructure brought negative result such as congestion, air pollutions, and safety.

Figure 3-1 shows that the formulation of policy is getting complicated as time progressed due to complex interest in consideration. Among these interests are private sector's profitability, meeting consumer's demand, minimization of negative social impacts.

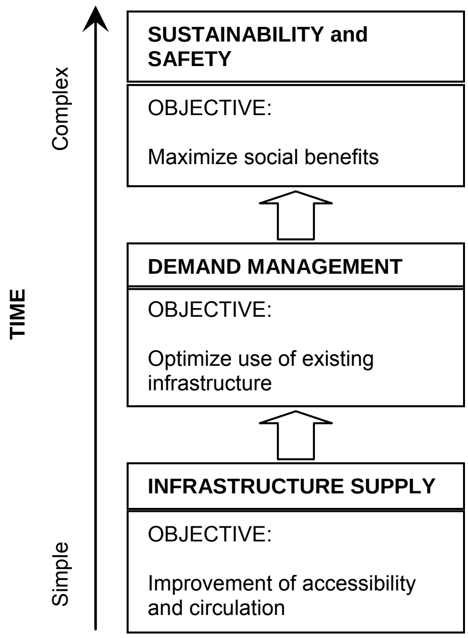


Figure 3-1 Freight transport policy trends

3.2.1 Interest groups

The conflicting interest of stakeholders in freight transport has been observed throughout history. Often, cause of conflict arises from a particular sector pushing its interest into limit leaving few options to the other sector. For instance, customers (shoppers) are demanding quick delivery of service which a transport company has to meet at all cost.

Table 3-1. Main interest group in regard of urban goods transport

Actor	Main interest in regard of urban goods transport
Shipper	Delivery and pick-up at lowest cost while meeting the needs of their customers
Transport company	Low cost but a high quality of transport operation, satisfaction of the interests of the shipper and receiver (shop)
Receiver/ shop owner	Products on time delivered at a short lead-time
Inhabitant	Minimum hindrance caused by goods transport
Visitor / shopping public	Minimum hindrance caused by goods transport and a high variety of the latest products in the shops
Local government	Attractive city for inhabitants and visitors: minimum hindrance but having an effective and efficient transport operation
National government	Minimum external effects by transport, maximum overall economic situation

Source: Handbook of Logistics and Supply-chain Management, 2001

3.3 European freight transport policy and other related studies

The European Commission (EU), a politically independent institution that represents and upholds the interests of the EU as a whole, has authorized and funded several studies tackling the problems related to movement of goods within the Europe. The overall goal of these studies is to provide a ground to harmonize all policies across EU countries related to freight transport. A brief review of these papers would provide useful indication to the differences of policies among the EU countries and to which direction each country's policy would head as they try to hit a common objective as a community (Table 3-6).

3.4 Experiences in Europe

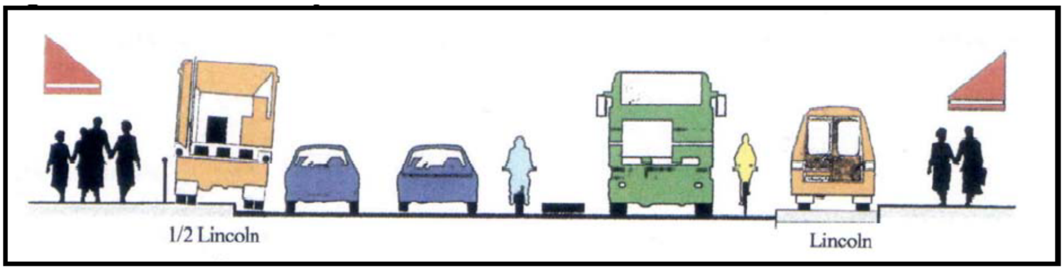
Innovative strategies tackling problems related to the delivery of goods in urban centers have been witnessed in some of the countries in Europe. Such strategies were prompted by wide array of circumstances (e.g. preservation of historic places, decongesting urban centers, etc.) that necessitates careful planning of goods delivery. In the following section, public freight transport policies of a handful number of countries within the EU community were reviewed to get practical knowledge on how each country react to a problem posed by freight transport. A case study that enhances the efficiency of urban goods delivery to each country is also provided.

3.4.1 Freight Transport Policies in France

The development of policies concerning freight transport in France can be traced back from three major laws: 1) The Law of Orientation on Urban Transport (LOTI 1982), 2) The Law of the Air and the Rational Use of the Energy (LAURE 1996) and, 3) The Law of Solidarity and Urban Renewal (SRU 2000). The LOTI has a particular strong endorsement in planning movement of goods to equate in terms of importance as to planning of passengers' movement. Under SRU's Urban Development Plan (PDU), the importance given to goods movement is further clarified. PDU has been instituted compulsory for metropolitan areas with more than 100,000 inhabitants. Government bodies such as the Ministry of Transport and the Agency for the Environment got involved in Urban Goods Movement program as early as 1993. These bodies assist in legal and environmental concerns of projects that enhance the efficiency of city distribution. A major national research program on freight transport was launched in the 1993, the year where the government organizations got involved, which focuses on data collection, modeling and development of pilot projects. In the same year, the regional council of Paris completed an extensive survey on goods' movements in the most urban part of the Paris region.

Practical solutions to urban freight transport problems were also tackled in different ways in the policies. Urban distribution centers (UDC) for instance, which serves as public transshipment depots where goods are dispatched in a coordinated/consolidated way, are being tested in the cities of la Rochelle, Nancy, Besancon, and Monaco. The Plate-forme ELCIDIS of la Rochelle hosts 400 parcels delivery daily to the historic center using electric vans. In total, more than 20 UDC projects were mentioned in the French Urban Mobility Master Plan but most of them were abandoned after thorough feasibility study. One of the reasons of the failure of these projects is financial difficulties where government subsidy is far too high from collections generated from the customers. Despite this large subsidy from the local government, transport companies still find the cost expensive and were reluctant to use the facilities for fear of unequal competition. Aside from UDC, application of IT to aid the delivery of goods was also tested in Toulouse and Rouen. Moreover, in Paris, there is a plan to provide a lane for bus so it can be isolated from general traffic. This plan, which is under the Mobilien project, can also be utilized by other modes such as taxies, bicycles, police and emergency vehicles and trucks (Figure 3-2). Trucks however will be only allowed for a certain time; 9:00-16:30 and 19:30-7:30.

Figure 3-2. Bus lane delivery area under Mobilien program in Paris



Source: BESTFUS

Recently, policy development relating to delivery of goods to the center of Paris is developed. This is a result of several factors (i.e. poor utilization of freight facilities, complexity of guidelines relating to freight transport, etc.) and aims to improve the efficiency of goods movement and reducing its impact on the environment. The new plan guidelines for freight transport are listed below.

Improvement of the delivery bay [1]

The total number of delivery bays is 9,780, which represents 15% of total space allocated for parking. Evaluations show that there has been a low rotation to the use of bays which might be a result of mismatch between the needs of freight operator and

[1] The plan guidelines for Paris is received from Mr. Hervé Levifve of Agence de la Mobilité of Paris

characteristics of the facility. With this regard, a term of reference, which could serve as guide to locate a delivery bay based on one's demand, will be published.

30 minutes rotation on delivery bays

Currently, there is no time limitation to the use of delivery bay and no restriction on the type of vehicles. This lack of guidance made it difficult to distinguish if a freight vehicle is making a delivery or just using the bay as parking area. Starting 2006, a parking disk which would facilitate identification of truck's arrival would be installed and will be manned by police officers. The use of parking bays will also be limited to 30 minutes.

Professionalisation of some delivery bays

Some delivery bays (located in areas with high number of shops) will be reserved to professional carriers or shippers identified by a badge. In effect, this would improve drivers working conditions and facilitate shopping deliveries.

Simplification of regulation

The current regulation is based on the space used, the time of day, and the type of street, which are proven difficult to understand among the concern parties (i.e. drivers and police officers). A simpler regulation is prepared by the City of Paris with the cooperation of the chamber of commerce of Paris, the police department and the federation of carriers.

Improvement of the plan of control

This entails training of police officers on enforcing the guidelines in delivery bays. Upgrading their skills would result to efficient regulation and consequent efficient use of the bays.

Charter of goods uses

The idea of this charter is to solicit cooperation from all stakeholders such as freight shippers, freight carriers, and police department to the City of Paris. The commitment of the professionals from freight industry (i.e. freight shippers and freight carriers) is to adhere to the guidelines which seen as beneficial for the city and citizens of Paris. On the other side, the City of Paris and police department commit on actions points, which facilitate the day to day work of drivers. This Charter is to be singed in 2006.

Introduction of the environmental concept in the regulation

Introduction of this scheme is in recognition to the negative impact of freight transport to the environment. Access restriction based on environmental criteria will be applied to freight vehicles. This policy is another way of encouraging freight shippers and carriers to utilized non-polluting vehicles.

Demonstration Projects

Delivery depots for both shopkeepers and private end-consumer

In Paris, an experiment called 'Magasin de Quartier' serves both private consumers(end) as well as shopkeepers(retail). The project's objective is to reduce the number of deliveries in dense commercial and residential areas using delivery depots. The depot serves as drop-off zones for transport operators delivering parcels received by mail order, telephone, fax, and internet and has the strong support of transport companies, their organizations, and Paris CCI. In fact, it has been proposed in the regional transport plan of 2000. Two to three staffs operate each depot and they inform clients once their product is available. Either they come to pick up their product or the staff will deliver them for extra charge. The size of the depot is no more than a few hundreds square meters.

3.4.2 Germany

Germany is facing the problem of continuing freight traffic growth as a result of the Single European Market and the enlargement of the EU to the east and globalization. Freight traffic is forecasted to grow by 64% before 2015. The German government aims to tackle the problem by creating and efficient transport infrastructure to accommodate the growth in traffic demand, improve the rail freight network, and create fair competition between different modes. Thus, after a long discussion the government in April 2002 approved the introduction of distance-related charges for the use of the motorway system by heavy goods vehicles (HGVs). The act allows the introduction of distance based charging on the motorway networked and some parts of the federal highways and the toll revenues can be used for infrastructure project (Sumalee, 2004).

In parallel with the above policy, some key program to the realization of sustainable freight transport are in place (i.e. Flexible Transport Chain) to reduce road transport by 100 mill truck km/year through the creation of a more efficient transport sector and through the use of intelligent transport systems and technologies. The program has currently 16 large demonstration projects.

The government in particular the Ministry of Transport and the Ministry of Research are financing also some programs that are in line with the national policy. This national policy is a broad framework for transport research based on the interests of the industry. Some of these projects are terminal infrastructure which serve as a hub for intermodal network.

Example of such intermodal terminal is like Bremen Guterverkehrszentren (GVZs) which is one of the leading intermodal freight transfer or distribution centers in Europe, in terms of size and number of companies involved. In many respects, the Bremen facility is a prototype for other GVZs planned for Germany within the next few years. They serve as transfer points where short- and long-distance surface/freight traffic meet. The aim is to promote co-operation between the industries and to create logistic synergy. In essence, these GVZs are industrial areas where various freight transport enterprises are located, all of which remain independent, retaining their legal and economic autonomy.

Demonstration Projects
City Logistics

In Germany, the concept of City-logistik (city logistics), which serves as a platform to conduct cooperative pick up and delivery of goods in urban areas, has been formed in 1990s. Two main objectives of city logistics are: (1) reduction of costs in distributing goods, and (2) reducing the number of Heavy Goods Vehicles (HGV) in the city (Kohler, 2001).

This concept, City-logistics, reduces lorry numbers and improves the urban environment. It is currently in operation in Berlin, Bremen, Ulm, Kassel and Freiburg. The Freiburg example has several pointers to the future shape of freight transport in urban areas. There are currently 12 partners in the scheme. Three of the partners leave city centre deliveries at the premises of a fourth. The latter then delivers all the goods involved in the city centre area. A second group of five partners delivers all its goods to one depot located near the city centre. An independent contractor (City Logistik) delivers them to city centre customers. A third group, this time with only two service providers, specializes in refrigerated fresh products. These partners form an unbroken relay chain, one partner collecting the goods from the source and the other for delivery to the city centre. Effect of such partnership to the movement of trucks is shows in Table 3-2.

The Kassel scheme showed a reduction of vehicle kilometers traveled by 70 % and the number of delivering trucks by 11 %. This has reduced the costs of all the companies involved and increased the amount of work that can be done by each vehicle/driver combination. (Thematic Network on Freight Transfer Points and Terminals , http://www.eutp.org/download/Deliverables4/)

Table 3-2. Effect of city logistics

Variables	Before	After	Difference
Total journey time per month	566 hrs	168 hrs	29%
Montly number of trucks	440 hrs	295 hrs	67%
Time spent by the lorries in the city per month	612 hrs	317 hrs	51%

Source: City Logistics II

3.4.3 Italy

In Italy, issues related to transportation are tackled in the four different administrative levels – the Central government, the Regions, the Provinces, and the Municipalities. Every 5 to10 years, the Central government produces a national transport plan called 'Piano Generale dei Trasporti' (PGT). In it are sets of broad transport policy objectives and principles to be followed and met by the regions when planning their transport infrastructure. In essence, the regions are the one setting up tangible policies within the guiding principles of the PGT.

This devolution of authority to the local levels allows each region to set-up policies based on the characteristics of the cities. Most Italian cities require careful planning with regard to freight transport operation due to their historic centers. This situation is compounded by the presence of narrow streets, which usually populated by tourists that further limits the capacity of the roads. Authorities are approaching these problems by adopting traffic restriction policies like the time windows in the city of Vicenza where delivery vehicle of small size is allowed to enter the city center from 7:00-9:00 in the morning and 14:00-16:00 in the afternoon. Also on the card is the possibility of implementing pricing policies.

Freight transport service providers are responding to this structural change by adopting two strategies – fleet innovation and systems innovation. Specification of freight vehicle - small in dimension and has low environmental impact - is being ordered from the automobile manufacturers. On the same manner, the advantage provided by the Information, Technology and Communication (ITC) is being maximized to rationalize freight vehicle's trip.

Urban freight transport in Italy is mostly done by road and freight is carried by less than 4-ton vehicle. This size of vehicle used to transport freight has something to do with the characteristics of the cities being old and therefore not suitable for heavy vehicles. Another driving force to the proliferation of this small vehicle owes to the practice of 'Just-in-time' (JIT) where small amount of goods is shipped throughout the day.

One of the structural changes to urban freight transport caused by the JIT concept is the relocation of logistics platform from the urban centres to areas where the logistical activities is concentrated. These areas are port, airports, intermodal terminals. This relocation of infrastructure however cause profit decline to some carriers which are quick enough to respond by pulling together their resources proved logistic service providers through consolidation of loads.

Demonstration project
Intermodal centre

A project initiated by Mobility and Parking Directorate, a government organ, has been experimented in the city of Genoa in Italy to deliver goods to city centres using non-polluting vehicles. This type of vehicle is also responsible for collection of goods from the historic city centre going to the exchange center (hub). The hub is where the transfers of freight from one mode (normal truck) to another (electric or natural gas vehicle) occur (Figure 3-3). The project is also evaluating the possibilities to combine the collection of recyclable materials with the distribution of goods.

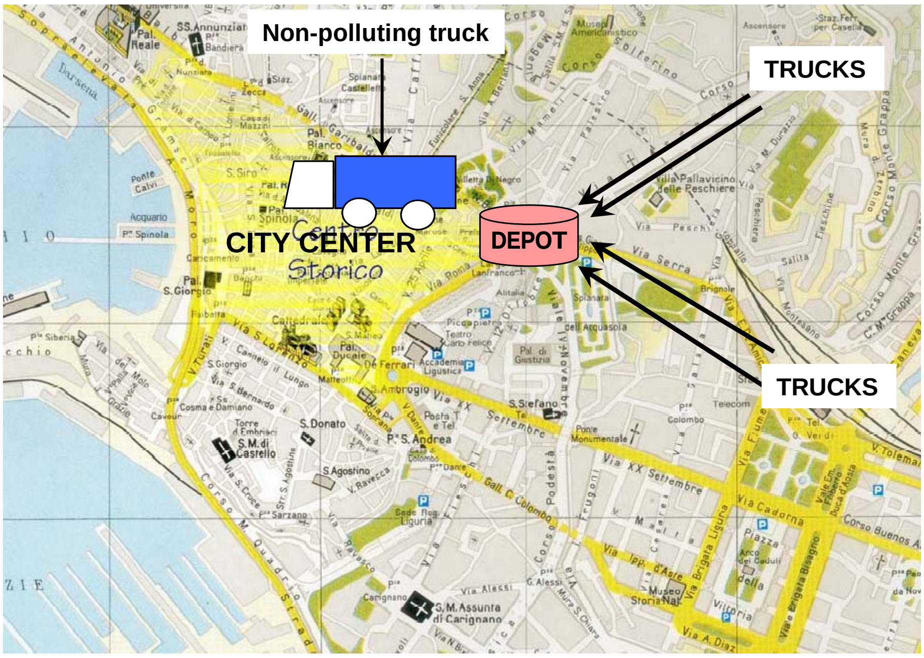


Figure 3-3. Protection to the city centre leads to the introduction of depot where goods are consolidated and delivered by non-polluting vehicles

3.4.4 Netherlands

In 2001, over six million cars, more than half million vans and more than a hundred thousand trucks were registered in the Netherlands. Problem of congestion is particularly heavy in the Randstad, an area that is boarded by the cities of Rotterdam, The Hague, Amsterdam and Utrecht. Because of its strong economic activity, cooperation among neiboring cities on how best to manage the existing infrastructure to support the freight is conceived and called G-4.

Goods vehicle share in the road network stands between 6-15% and this increased to 20-22% at the city centers during peak hours. Delivering goods in some cities made difficult not only by the traffic congestion but also by the presence of old infrastructure that are not suited to accommodate vans or trucks. With regard to NOx emission, the government's target of 25 million kilograms in 2010 is too optimistic when in fact, it is expected that NOx reached between 85-110 k/tones.

The Dutch government is strongly concern to balance efficient flow of traffic and quality of life of its residents. This is manifested in its National Traffic and Transport Plan (NVVP) that has an objective of 'to offer an effective, safe and sustainable functioning traffic and transport system, of which the quality for individual users is in balance with the quality of society as a whole'. This national policy, which is the successor of the Second Transport Structure Plan of 1989, is framed from 2002 to 2020 with a perspective on 2030.

Critics pointed out that although this is an important policy initiative, less appreciation to freight transport or in particular urban goods distribution is evident. General freight issues were merely described and urban goods distribution was highlighted as among the topic of concerns. Four main goal of NVVP-freight policy are: 1) accessibility, 2) efficient freight transport, 3) safe freight transport, 4) sustainable freight transport.

The accessibility has something to do with the effective use of the existing infrastructure and giving good network connection to the ports. Some of the spelled policies are: i) pricing policy, and ii) modal shift and traffic management. Efficient freight transport aims at maintaining the current level of transport kilometre while speeding up the economic development. This policy is running against the current trend where both economic and ton-kilometer of trucks are moving up in parallel. The third goal of NVVP - addressing freight policy related issue such as safe freight transport - stresses out the responsibility of both shippers and carriers in maintaining the existing safety level of infrastructure. The last freight related policy is sustainable freight transport, which can be done by maintaining the present quality of life with continued economic growth.

Forum on Urban Goods Distribution

The seriousness of problems brought by freight transport got the attention of the national government who initiate the establishment of Forum on Urban Goods Distribution (PDS). This forum, which composed of the Ministry of Transport, companies and the Association of Dutch City Councils, serves as a platform to these groups to discuss and initiate projects beneficial to city distribution. The Forum enjoys credibility among Dutch cities as it is considered a serious partner in finding solutions to urban freight problems.

Many innovative and successful city freight distribution initiatives have also been tested in the Netherlands. In Amsterdam for instance, distribution centres were established where shippers can deliver their freight and from where shipments are consolidated and transported to the shops and retail facilities. This concept of consolidation is also practices by some food centres to facilitate their goods supply. DHL has tried the use of water in transporting their packages in spite of the already intensive used of canals by round-trip-boats. Another innovative initiative is called 'Packstation' where customers can send and receive packages around the clock using publicly accessible deposit box systems. The central idea of this initiative is to facilitate the gap between carriers and consumers. Oftentimes, parcel recipients are not home during the delivery hours that force the carrier to make a return trip. This project was very successful in some cities of Germany like Maizn, Dortmunt and Frankfurt. Moreover, a possibility of mixing passengers and freight in metro system during the night was studied.

Project Demonstration
Logistic chain and modal shift

Improving efficiency within the entire logistical chain to help reduce CO_2 and NOx is of prime importance to the government. With this view, a lot of project has been supported through subsidies or by organizing the involved parties. One of these projects in line with the principle of reducing transport externalities is called Transactie Modal Shift (TMS). TMS was established in 1999 through the initiative of the Dutch Ministry of Transport, Public Works and Water Management with the participation of some transport organizations. The central theme of the project is to improve road transport efficiency, reduce the number of kilometers, saving fuel consumption, and transferring goods transport to other mode from road-based.

As a result, companies which received subsidy up to 2002 yielded a total reduction of 145 million kilometres. The government is hoping that the acquired knowledge by these companies through participation would be useful to them even without the government's financial aid. With this aim, the government produces a manual in CD-ROM which interprets the project for immediate use.

3.4.5 United Kingdom

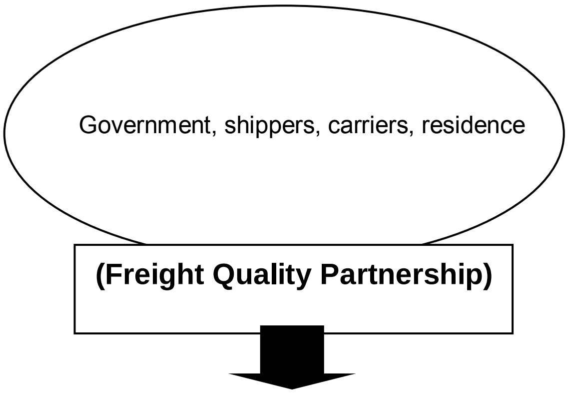
Recently, the UK central government is showing strong interest to improve freight transport through creation of units attached to government bodies and by publishing documents that outlined sustainable distribution of freight especially in urban areas. Agencies such as Freight Distribution and Logistics Unit under the Department of Environment, Transport and the Regions (DETR) have published important document in the freight transport like the 1998 Transport White Paper entitled "Sustainable Distribution". This paper turns out to be the first public policy document of the government demonstrating efforts of understand modern logistics and distribution system. On the same manner, the Department for Transport (DfT) launched programs that aim to engage freight transport stakeholders to work together in addressing problems associated with freight transport. The government is also a signatory of the Kyoto protocol which targets to reduce greenhouse emissions. Under the agreement, the UK government has to reduce 12.5% below 1990 levels by the period 2008 to 2012 which is equivalent to 27 million tones of CO_2. The UK also has a domestic aim of reducing CO2 emissions to 20% below 1990 levels by 2010 and is committed to putting itself on the path to cut CO_2 emissions by 60% by about 2050. This legal obligation is believed to further energize the government's effort to find ways to make the transport of freight more efficient.

As a general trend, although the UK adopted the JIT distribution concept, the government is skeptical of the idea of Urban Distribution Centre or similar concept as a solution to the growing problem of goods distribution in the city. Despite indications that city logistics schemes are both cost-efficient and environmentally friendly has potential of reducing the number of lorries on the road, little progress towards implementing such plans have been made in the UK.

The 1998 Transport White Paper and its daughter document, "Sustainable Distribution: A Strategy", published in March 1999, affirmed the importance of the development of an integrated, sustainable freight transport system, that supports economic growth, whilst simultaneously reducing adverse impacts on society and the environment. The Report confirms that "there may also be scope for reducing the number of lorry and van movements by promoting greater consolidation of loads and drawing on the experience of 'City Logistics' systems where goods destined for city centres are diverted into common transhipment facilities with local distribution being carried out using specialised vehicles which may be smaller, quieter and less polluting. We will learn from the experiences gained in Europe from operating such systems".

In line with this effort of sustainable city freight distribution, the Department for Transport has subsequently published guidelines for initiation and consolidation of projects similar to the German city logistics. The Department for Transport has named such schemes Freight Quality Partnerships (FQP) and published a best practice guide and a case studies guide on the benefits of FQPs and how to establish them. And in order to further accelerate this effort, the Department of Transport, Local Government and the Regions in its Annual Report 2003 restated its commitment to sustainable distribution and the development of Freight Quality Partnerships (FQP).

FQPs aim to tackle issues affecting the supply chain at a local level. They allow more efficient deliveries to town centres, while reducing their effect on the environment. They have produced agreements on routing, load sharing and town centre access, helping to reduce congestion, emissions and the number of vehicles in urban centres. There are currently 31 FQPs in Great Britain, involving local authorities, the freight industry, business communities, residents and environmental groups. The report surveys examples of such initiatives in the UK and describe the successes of The Newton Abbot area, Reading, Hampshire County Council and Winchester, Devon County Council, Merseyside and Halton, North West Freight Advisory Group, and Derbyshire County and Derby City Councils.



Subjects for discussions: efficient deliveries to town centres, reducing their effect on the environment

Solution: agreements on routing, load sharing and town centre access

Figure 3-4. Stakeholders and topics for discussion in the FQP

As for the definition of FQP, the Department for Transport's Good Practice Guide 335 defines FQPs as "a means for local government, businesses, freight operators, environmental groups, the local community and other interested stakeholders to work together to address specific freight transport problems (Figure 3-4). They provide a forum to achieve best practice in environmentally sensitive, economic, safe and efficient freight transport. We need to achieve more sustainable distribution that holds the needs of the economy, the environment and society in balance. Freight Quality Partnerships can help to achieve these sustainable distribution objectives through developing constructive solutions that reconcile the access to goods and services with local environmental and social concerns".

Access restriction is a common approach in UK like in the city of Preston and London. London is charging every vehicle of all form (5 GBP) that enters the city centre. The purpose of this approach is two fold – one is to decongest the urban centre and the second one is to upgrade the transportation infrastructure by using the generated money from the scheme.

Demonstration Project
Cyclone Courier

Cyclone courier is a private company with contracts with circa 40 parcel carriers (Figure 3-5). Cyclone couriers fills a commercial gap as York is a congested medieval city with a vehicle ban from 11 a.m. to 4 a.m. Cyclone couriers operate a next day delivery service on behalf of their contracted parcel carrier customers.

They transship from carrier's vehicles or collect. They consolidate and deliver the next day. This is only possible for a cycle due to the vehicle bands and even before the ban the cycles are faster, use bike lanes and are cheaper. The cycles are similar to cycle rickshaws but built for freight. The tricycles feature 42 speed transmission, hydraulic disc brakes and aircraft grade steel and accommodate loads up to 250 kg. Cargo boxes and passenger seats can be swapped in minutes.

Cyclone couriers also run collect and deliver courier services both within York and from carriers to York. With this, they use normal bikes, thus avoiding loading/unloading restrictions as well as using bikes lanes, being faster in congested traffic and cheaper.

Cyclone couriers is financed by the clients (parcel carriers and others) paying for the service. And since a bike and rider costs 60 GBP a day as opposed to 250 a day for a van and driver, it is cheaper to use bikes to achieve multiple delivery slots than equivalent number of vans.

Figure 3-5. Cyclone courier
Source: BESTUF

Freight Consolidation Scheme in Broadmead, Bristol [2]

Background
As part of the VIVALDI European Commission supported project (www.vivaldiproject.org) Bristol City Council have established a freight consolidation centre serving city centre retailers (Figure 3-6 and Figure 3-7). This scheme aims to combine individual loads destined for retailers in the Broadmead shopping centre for onwards consolidated delivery. The target area for the consolidation centre is part of Bristol's Local Air Quality Management Area where levels of pollution are forecast to exceed standards. The scheme also forms a key component of the Council's Clear Zone Strategy, aimed at promoting more sustainable access to the city centre, which was submitted to UK Government in July 2003.

[2] Note: This section is mainly taken from e-mail received from Mr. Pete Davis of Bristol City Council

Innovative Aspects
The Broadmead consolidation scheme is the first serving an urban centre in the UK. Being so innovative in the UK context, of necessity the specification and development of the scheme initially evolved, and has been subsequently refined, through discussions with the key stakeholders. These include the manager of the Galleries shopping centre, the Broadmead Board who represent the interests of retailers, members of the Freight Quality Partnership, Business West (formerly the Bristol Chamber of Commerce) and UK Department for Transport.

Clearly the views of the retailers themselves were also important and an extensive survey in summer 2003 gauged their interest in the scheme, ascertained current delivery patterns and therefore suitability for consolidation, and identified delivery problems which the scheme could potentially overcome. This survey illustrated the scope and impact of the scheme if consolidated deliveries were rolled out across the entire Broadmead area - with potential savings of over 59,000 freight delivery trips per year based upon pilot phase levels of consolidation. The planned expansion of the Broadmead shopping centre, increasing retail space by 40% over the next 5 years, has also heightened awareness of the importance of managing urban freight movements.

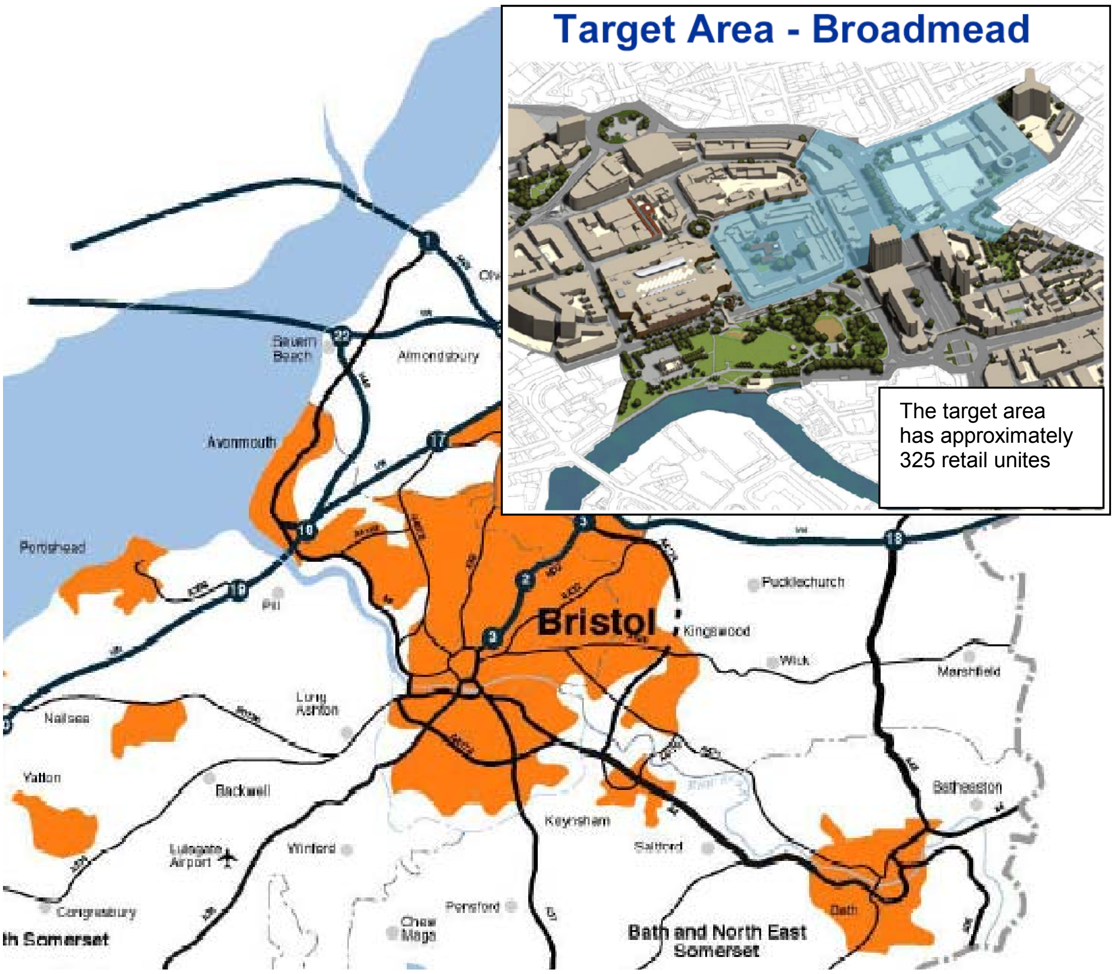


Figure 3-6. Map of Bristol city

Developing the Scheme
The freight consolidation scheme seeks to reduce the number of delivery vehicles operating in the target area with resultant transport and air quality benefits, and also to provide an improved delivery service supporting city centre economic vitality.

To ensure the technical and operational robustness of this novel scheme the Council, through public procurement, engaged supply chain experts Exel to run the consolidation centre. Exel were able to draw on their experience of operating the two other UK retail consolidation schemes serving Heathrow Airport and an out-of-town shopping centre. In addition they also had existing relationships with a number of retailers participating in these schemes some of whom became the all important early adopters in Bristol. The scheme operates from a warehouse of some 5,000 ft^2 on the northern edge of the city close to the strategic road network approximately 7 miles from the city centre target area.

To encourage retailers to participate the service had to be free of charge during the pilot phase – with the value of the service being the reason for their involvement rather than coercion imposed through access restrictions or landlords.

Figure 3-7. Delivery vehicle and key personnel of the scheme

Progress to Date
The 6-month pilot consolidation scheme commenced operation in May 2004 with an initial target of involving 20 retailers. This has subsequently been extended and to date 51 retailers have joined the scheme ranging from major high street brands (such as Tie Rack and Monsoon) to small independent stores (such as Kathies Comics), with a reduction of 67% in the number of delivery trips amongst the retailers involved. Through consolidation the centre has to date saved over 29,300 lorry kilometres otherwise made into and around the city centre removing over three and a half tonnes of Carbon Dioxide.

In addition a survey of retailers in November 2004 has illustrated the positive benefits that the scheme is bringing in terms of improved reliability of delivery times, time saving when receiving deliveries and a consequent increase in time spent with customers.

The Future
The Council and operator Exel are currently working to develop a sustainable business model for the scheme including the allocation of costs across beneficiaries. An important element of this process will be developing value added services such as

remote stock rooms, peak/seasonal storage, pre-retailing services and waste/packing collection and recycling.

3.5 Freight Transport Policies in the US

US policy focuses on improving transport efficiency and reducing the transport share of GDP. However, there is no overarching freight logistics policy. The policies are separate by mode: surface, air, sea. There is still a significant infrastructure approach. The main exception to this is an emphasis on ITS (Comparative Public Policy on Freight Logistics, 2001).

Although it appears that the US policy is still on infrastructure approach, there is an emerging sign to integrated approach to the different modes. This has its root in 1991 with the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA-91). For the first time, urban freight was specifically mentioned as one of the 15 planning factors that required attention in the planning process (Czerniak et el, 200). This legislation made Intermodal facilities eligible for funding as part of the National Highway System from the government. In essence, it gives Intermodal project equal opportunity to secure a fund from the government just like any other project of the National Highway System. This policy has this pronouncement: "It is the policy of the United States to develop a National Intermodal Transportation System that is economically efficient and environmentally sound, provides the foundation for the Nation to compete in the global economy, and will move people and goods in an energy efficient manner" (Intermodal Surface Transportation Efficiency Act of 1991, Section 2 found on http://ntl.bts.gov/DOCS/istea.html).

The ISTEA-91 stressed out the necessity to provide access to the freight systems and the use of intelligent vehicles and other technologies to improve cost effectiveness. The fund of US$155 billion over 6 years between 1992 and 1997 is largely spend to infrastructure projects, intermodal loading units, reimbursement of operating deficits for certain non-profit routes and transport studies. State/local authorities in conjunction with private parties selected projects.

The second policy appeared after the ISTEA was the Transportation Equity Act for the 21st Century (TEA-21) which has an authorized funding of US217.5 billion between 1998 to 2003. The fund will be linked to monitoring freight flows at regional and international levels, establishing public-private partnerships and re-organizing government functions, financing missing links in transport infrastructure networks.

3.6 Experiences in Japan and some Asian countries

3.6.1 Japan

The evolution of Japanese logistics policy has its origin in 1950's when the economy start showing a healthy growth. This growth has reshaped the balance of population distribution between urban and rural areas as thousands of people sought to find economic related-activities in major urban centers like Tokyo, Osaka and Nagoya. From the late 1950's to the early 1970's, 400 to 600 thousand people migrated yearly to these three metropolitan areas which constituted only 10.4% of the total land area of Japan (Takahashi, 2003). This phenomenon unlocked two parallel streams of development; first, the concentrated labor force further propelled the economy and second, the centralization of population brought serious problems like traffic congestions, housing shortage and environmental degradation.

While trying to improve the situation in these major urban centers by constructing infrastructures, the government also launches series of program to encourage people to return to rural areas. The idea is to have parallel growth between these two regions to attain balance growth of Japan.

The report entitled “Basic policies on the re-development plan of Tokyo and Osaka” which was the result of the Forum on the Problems of Large Cities in 1963 lied down the foundation to the idea of relocating factories from urban centers to suburb and the formation of a multi-core urban structure against urban sprawl. The major policies put forward to achieve these objectives were the formation of sub-centers, and the formation of distribution centers (Castro, 2002).

In 1966, a law that spelled-out the realization of distribution centre was endorsed. The central idea of the distribution business centers is to facilitate the merging in operation of small companies which lack funds to upgrade their logistics facilities and relocate them outside the city. In 1969, the master plan that identified location of distribution business centers for Tokyo Metropolitan Areas was released. Four areas located 30 km away from the center of Tokyo was identified as ideal location which would also serve as sub-city cores. These areas are Omiya, Chiba, Tachikawa and Yokohama. A highway network would connect these four areas and four to five distribution centers would be established to re-organize the flow of freight in the Tokyo Metropolitan area (Figure 3-8)(Takahashi et el, 1995).

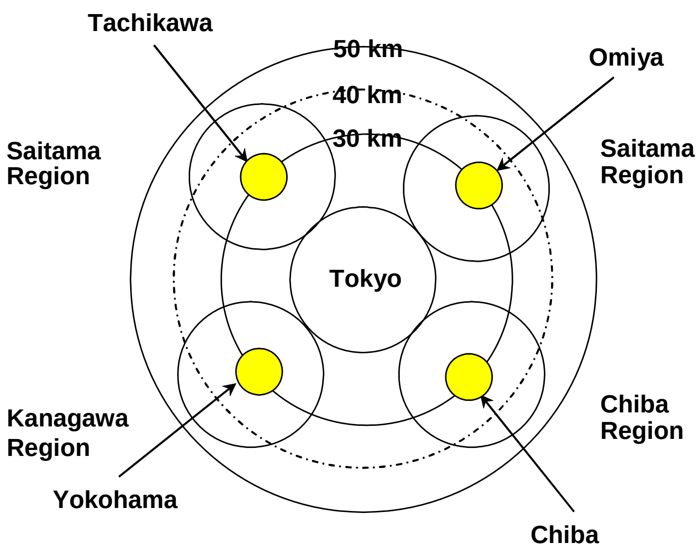


Figure 3-8. Plan of distribution business centers for Tokyo Metropolitan Area

The Comprehensive Program of Logistics Policies (CLPL)

The government in 1997 introduced the Comprehensive Program of Logistics Policies (CLPL). The threefold general objectives of CLPL are:

- To provide one of the most convenient and attractive logistics services in the Asia-Pacific region.
- To provide logistics services at a reasonable cost by strengthening international competitiveness of Japanese businesses.
- To address negative externalities related to logistics such as environmental, energy and congestion and safety issues.

Among the specific aim of CLPL are:

- In urban logistics, increase load factor of trucks to 50% and increase urban truck travel speed to 25 kilometres per hours.
- In regional logistics, encourage multi-modal transport in order to cover 90% of the population in a half day.
- In international logistics, by 2001, reduce waiting time of ships form the present 4-5 days to 2 days through container shipping and reduce land transport cost by 30%.
- Standardization by year 2001, increase palletization rate of existing palletizable cargo from 70% to 90%.

The program is being by implemented by the Ministry of Land, Infrastructure and Transport (MLIT) and the Ministry of International Trade and Industry (MITI) with support by other ministerial offices and agencies.

The 1997 Annual Report of Transport Economy charts the areas where necessary action is needed to construct an efficient logistics system. These are:

- Improvement of the social infrastructure,
- Promotion of deregulation, and
- Development of a more sophisticated logistics system.

In 2001, a new version of the CLPL was approved and released by the government in July of the same year. The new objectives are:

- To establish logistics market that can compete internationally in terms of cost.
- To establish logistics systems that reduces environmental road and social problems.

The announced strategies to achieve the above objectives are:

- By appropriate partnership between actors, such as public-private setors, and central-local governments.
- By establishing fair and competitive logistics service market.
- By efficient development of logistics infrastructure and effective use of existing infrastructure.

The policy measures indicated by the new CLPL are:

- Establishment of efficient logistics system (i.e. simplified procedures, uni-loading, intermodal transport, utilization of EDI and ITS, and TDM measures, etc.).
- Establishment of logistics system responsive to social problems (i.e. intensify emission control in line with the Kyoto Protocol, fuel efficient vehicles, reverse logistics, improve safety through utilization of ITS).
- Establishment of logistics system to support people's life (i.e. deregulation on tariff system, logistics infrastructure during emergencies).

Although the CLPL has a tone of social oriented logistics, the government has also recognized the importance of providing sufficient infrastructure to facilitate efficient logistics services. For instances, it was announced that the government would promote the redevelopment of international ports and airports coupled with the construction of linkages among roads and railways, ports and harbours, airports and logistics centers to facilitate the fluidity of goods.

In line with the Kyoto Protocol, modal shift was also promoted by the government through subsidizing projects deemed to help reduce greenhouse gases. Along with the idea of encouraging enterprise to shift their freight operation from truck-base to rail-based or ship-based, the projects want also to rectify the imbalance of cargo share among the different modes.

It appears that the government policy is tacking both the social and physical infrastructure of logistics to provide what they termed as 'most convenient and attractive' logistics services in the region.

Demonstration projects

i) Tenjin Joint Delivery System

Perhaps the oldest cooperative system of freight delivery in Japan was started in Tenjin district of Fukuoka city in 1978. The district has an area of 370,000 m_2 and at that time experiencing serious traffic congestion which resulted to the deterioration of the environment. Particular problem of the district is the limitation of (off) loading spaces on and off street which generates illegal parking and compounded the congestion.

At the beginning, twenty-nine (29) freight carriers joined the joint delivery systems supervised by the Regional Transport Office of Ministry of Transport. In 1994, thirty-six (36) companies have established the Tenjin District Joint Distribution Company Ltd. for promoting the systems.

Freight carriers bring their goods to Hakozaki distribution centre of the Joint Distribution Company that is located in the suburb of Fukuoka city, close to interchange of urban expressways. Then the Joint Distribution Company will deliver goods from member carriers to each receiver at Tenjin district after sorting goods to each building. The Joint Distribution Company also collects goods from costumers in Tenjin district and unloads them at the distribution centre of the Joint Distribution Company where the freight carriers take them over individually. The Joint

Distribution Company delivers about 90,000 parcels and collects about 10,000 parcels per month at Tenjin district.

Each freight carrier pays 160 yen per parcel below 50 kg. No subsidies are provided by the public agencies. The Regional Transport supports the joint distribution systems in Tenjin district in institutional ways. The Regional Transport Office provides a platform for discussing related things and coordinating many stakeholders including shippers, freight carriers, residents and administration who are involved in the systems.

This system benefited freight carriers, shippers, road users and residents alike. Ieda et al (1992) based on modeling estimated the following as benefits of the system:

- decrease of number of trucks in the served area by 65%
- decrease of total distance traveled (km/day) by 28%
- decrease of total distance traveled within Tenjin district (km/day) by 87%
- decrease of total frequency of parking by 72%
- decrease of total parking time (h/day) by 17%

ii) Shinjuku Matenro Cooperative

The Materno Cooperative system is designed primarily to conduct join delivery and pick-up of parcels to and from high-rise buildings in Shinjuku, Tokyo. It has been in operation since April 1992 until now. A staff is waiting for the arrival of truck at a docking area of the building, unloads the goods put in a small container from the truck and release the truck. The goods are then brought to the freight elevator and distributed by the staff from the top to the down floors. Each parcel is limited up to 20 kg in weight, and 120 cm in height, width, and depth. The delivery truck runs on a fixed route three times a day on a regular schedule – 10:00 and 11:30 in the morning and 1:50 in the afternoon.

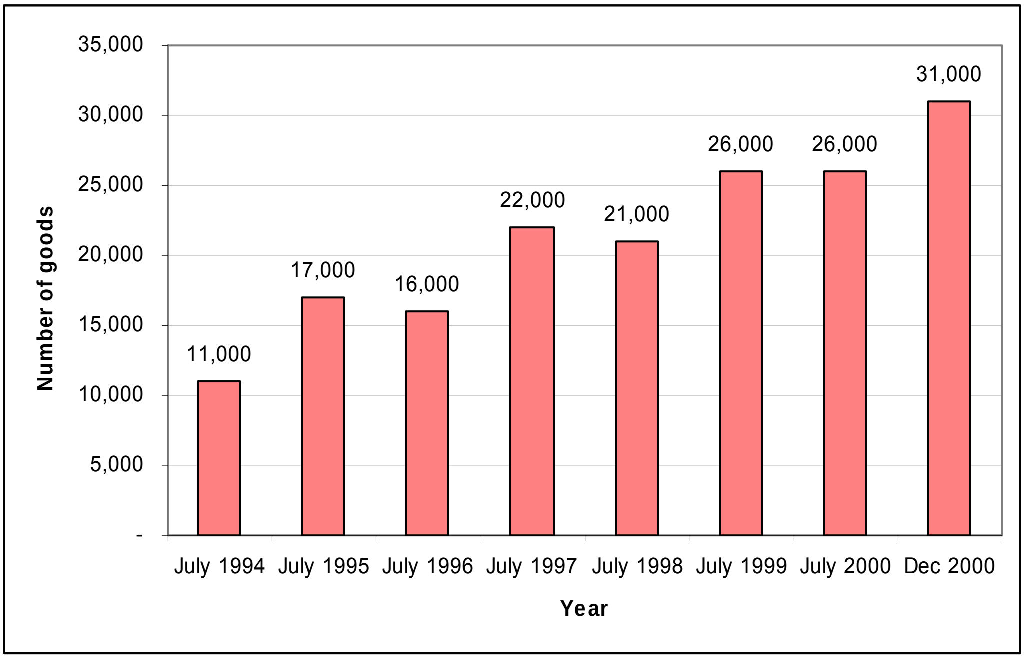


Figure 3-9. Number of goods handled by Matenro cooperative from 1994-2000

The cooperation involved 21-high rise buildings and 3-underground shopping malls. As shown in Figure 3-9, the volume of parcels delivered to these buildings increases to 6,000 after one year in operation. Without the system, accommodating such huge shipment is difficult given the limited number of parking slots in the area. The timeline of the project is found below:

- April 1992, the Shinjuku Ground Transportation Cooperative launched delivery services for skyscrapers as “Matenro Staff”.
- 1993, “The Committee for Promotion of Joint Distribution Systems for Skyscrapers” was established to consider how best to promote the services.
- March 1996, “The Matenro Center” is established as distribution base facility.

iii) Cooperative Delivery in Horidome, Nihonbashi, Tokyo

Horidome is home to 600 companies engaged in textile business that are sourced from all over the country. These wholesalers are concentrated to a small area with radius of 500m. They are thought to be the distributors of textile fabrics of the entire *Higashi Nihon*, which covers Chiba, Tokyo, Ibaraki, Saitama, Gunma, Tochigi, Kanagawa, Yamanashi, Nagano and Niigata. Congestion is felt in Haridome due to large volume of truck trips. This incident prompted the shop owners to realize efficient form of transporting their product that would require small number of trucks.

In March 1972, “The Groups of 10 Textile Wholesalers” was inaugurated and launched integrated cargo collection and distribution services in July. This group was then renamed in 1982 to “Tokyo Textile Collection and Distribution Organization” to highlight the cooperation among the shop members in collection and distribution of their products. Twenty-one year (21) later and in April 1993, the organization was renamed to “Japan Joint Collection and Distribution” and distributors were grouped into two to encourage competition.

The length of years the organization has been in operation is an indication of its success in addressing several problems that are common to the delivery of goods into urban centers. It has been reported that the efficiency of trucks has improved remarkably that locating an (un)loading area becomes less concern. In a congested business district, approaching an available area to park temporarily the truck is one of the hardest parts of delivering goods. Since both collection and distribution have been jointly operated among the textiles shops, significant reduction of the number of trucks was also noted. This reduction to the number of trucks handling their products has also positive effect to the transport cost by observing cost reduction.

Although several benefits were derived from the system, concern to the loss of transport company providers is also reported. In addition, the loss of each shop’s liberty to handle its own operation was seen as another setback of the system.

iv) Textile Wholesalers Street, Chojamachi, Nagoya

In 1993, a survey was conducted for working out guidelines to facilitate distribution in the region where commercial businesses concentrated.

In June 1994, “G-Net Cooperative” was established for promotion of information networks for textile wholesalers.

In November 1994, implementation of online system for shipping and collection.

v) Akihabara TDM pilot project

Akihabara, located in Chou-ku which is at the heart of Tokyo, is famous to its electronic products and known to be the place to visit for latest product in the market. The area commands large number of customers being the largest area displaying electronic products.

The face of famous old Tokyo is very much visible in Akihabara where the streets are narrow and stores are rowed and have very limited space. Number of stores in the area could reach hundreds and shop managers are making up to the limited space by displaying their products outside the store. This practice often consume portion of space intended for pedestrians thus obstruct the fluidity of pedestrians.

The limited number of off-street parking space by these shops generates traffic congestion and compounded by the fact that customers are observed to come by car since this gives them convenience to carry their purchased product home. Trucks distributing the shops product are so huge that it was observed that there was an average of 15.5 vehicles per 100 meter. Travel speed in the area is at low of 14.3 km/ hour.

From October 10 to November 11 2004, a social experiment designed to create smooth traffic flows by reducing the number of trucks on the road was conducted in Akihabara. This was realized by establishing consortium which consists of local authorities, retailers, manufacturers, carriers, academe and the Ministry of Land, Infrastructure and Transport (MLIT). The central theme of the experiment is the utilization of Radio frequency identification (RFID) to manage the transport of goods. Wikipedia, an online encyclopedia, define RFID as a method of remotely storing and retrieving data using devices called RFID tags/transponders. It is a small object, such as an adhesive sticker, that can be attached to or incorporated into a product. RFID tags contain antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver.

To utilize RFID, two distribution centers were temporarily built that would house the electronic products for Akihabara. One is located in Chiyoda-ku, which is close to Chou-ku, and the other center is in Urayasu city in Chiba prefecture, beside Tokyo. The center in Chiyoda-ku used for storing products such as PC, DVD, printer while the center in Urayasu stored item such as TV, Refrigerator and other house appliances.

A maximum of 5-minutes on-street parking was allowed while vehicles wishing to park longer were directed to reserve parking spaces. A shuttle bus was also provided that would take customers to Marunouchi area near the Tokyo station. The idea is to have the customers’ cars park in Marunouchi and the bus will service them from there.

Aside from the previously mentioned groups, 8 unions of shopping stores and 15 companies were involved in this project.

vi) Poppo Machida

Machida City is located in the southwestern part of Tokyo and about 30 km from the center of the metropolis. Above the underground Machida train station is scores of shopping stores dotted to the streets of town. Train station in Japan is normally surrounded by high-density urban development.

Trucks distributing goods to these shops are mixing up with customer’s cars making the area heavily congested. To improve the flow of the traffic, vacant spaces near the shops were designated as parking space for delivery trucks. Instead of using portion of road as parking space, these trucks would instead park their trucks to the reserved parking space, unload their goods and carry them going to the recipients. An 82% of the number of trucks that are passing the area was observed.

vii) Kashiwa city

Kashiwa City is located in Chiba-ken and it is 30 kilometers away from Tokyo. The city has been experiencing rapid growth and becoming ideal residential suburb of people working in Tokyo due to its proximity. The city is accessible both by train and by car for one hour or so.

Two stages of urban development was conducted in the city to facilitate smooth movement of traffic around the city’s main train station. The capacity of these roads is very limited which prompts concern authorities to adopt TDM measures in 2000. Some of the measures undertaken are summarized below.

1. Improvement of physical layout in front of the station
   - Extension of sidewalk
   - Organization of bicycle parking
2. Provision of parking information
   - Reduction of the waiting for trucks at the parking lot.
   - Reduction of the number of vehicles and their parking time.
   - Reduction of the environmental impact by reduction of obstruction and idling stop.
3. Cooperative delivery of goods
   - (Off) loading space was installed.
4. Park and ride area was prepared

Owing much to the success of the first adopted TDM measures, in 2003, further improvement were made such as marking of the designated (off) loading area to avoid confusion on which side of the street to park trucks (Figure 3-10). This measure improved fluidity of the traffic and is believed to reduce traffic impact on the environment.

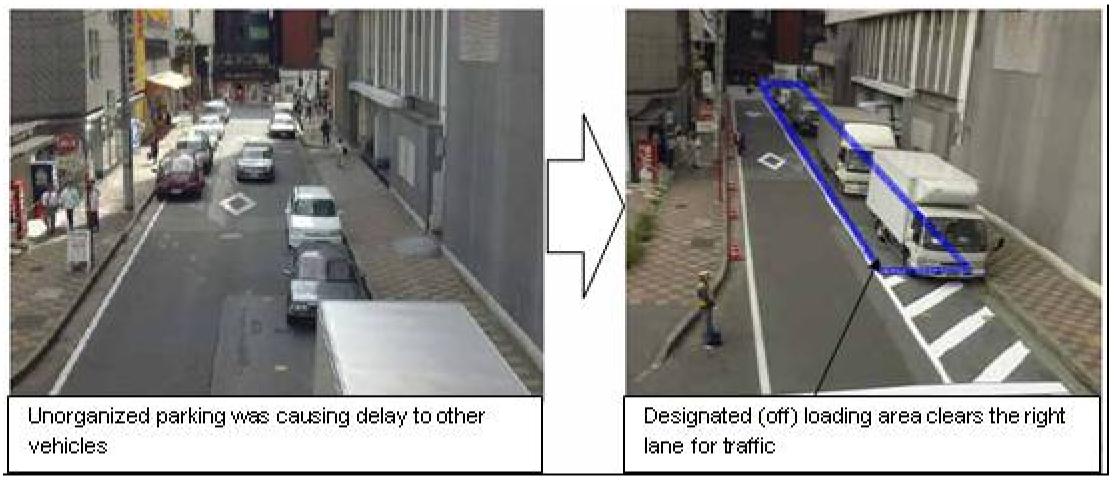


Figure 3-10. Provision of (off) loading area near Kashiwa station

viii) Sapporo City distribution experiment

Sapporo is located in Hokkaido, the northernmost island of the Japanese archipelago. The city is not only the prefectural capitol but also the center of administration, economy and culture in northern Japan. It is the fifth biggest city of Japan.

What looks to be a very simple experiment taken in Sapporo city in 2000 yelled drastic improvement to the traffic flow in its major thoroughfare (Figure 3-11). The strategy was to provide the right lane as (off) loading area for delivery vehicles. Freight vehicles , however, are not allowed to utilize the right lane of the road. Time which frieght vehicles allowed to deliver are 9:30 to 11:30 in the morning and 14:30 to 16:30 in the afternoon.

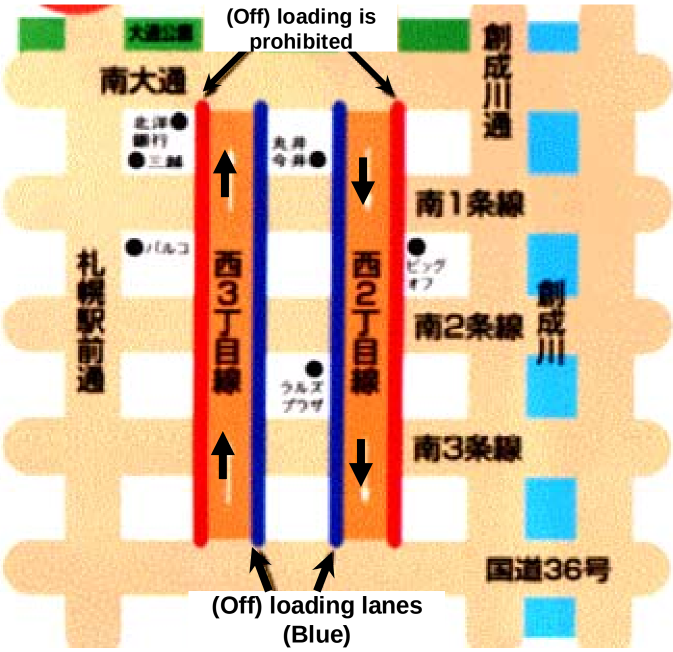


Figure 3-11. The thoroughfares where the improved delivery of goods schem are implemented

Initial findings suggest there was an improvement of the bus's travel speed. Dwelling time of freight vehicles menwhile was shortened. It appears that the key to the expirement's outcome was the removal of of time spend by freight drivers locating an available space to park.

ix) Nihonbashi track time plan

Nihonbashi, literally meaning "Bridge of Japan" is a city district of Tokyo, located just north of Ginza. The bridge, in the middle of which, is the marker from which mileage throughout Japan is measured. Since the district's development came ahead of modern's planning time,

In 1995, a plan to divide the hours for different types of vehicles was enforced to decongest the small street. The early morning provides access to delivery vehicles who are rushing to have their goods to the shops. Shoppers and alike who visit the district by car could park their car free of charge from 10:00 to 16:00. In the afternoon, freight vehicles are given access again for delivery and pick-up activity (Table 3-3). This arrangement gives higher utilization rate to the parking area and all sectors were served (Figure 3-12).

Table 3-3. Time zone for each type of vehicle

7:00 – 10:00 (parking time for freight vehicles)	**(10:00 – 16:00)** parking time for private cars	**(16:00 – 19:00)** parking time for freight vehicles
Freight vehicles can use the space without parking meter which correspond to some amount of money. Other type of vehicles uses the parking meter at this time span.	Freight vehicle still can use the space however has to be charged by the parking meter.	Freight vehicles can use the space without parking meter which correspond to some amount of money. Other type of vehicles uses the parking meter at this time span.

Before segregating the parking time (1993) After segregating the parking time (1995)

Figure 3-12. Photo of the district before and after the scheme

x) Saitama new urban core area

Saitama Prefecture is part of the Tokyo Metropolitan area and currently promoting a new urban development project called the Saitama New Urban Centre. The project aims to create a bustling, integrated city with easy access and mobility for people, goods and information alike.

In 2000, a vendor campus (like distribution center) was installed in the suburban section to serve as consolidation of goods (Figure 3-13). Non-polluting vehicles transport goods from the consolidation center to the city. Collection and delivery are done on fix schedule. Shops who received customer orders can deliver the goods to the center and call the center for pick up. The idea of the scheme is to limit the impact of delivery vehicles to the environment by reducing its number.

Reported benefits of the system are the following: 1) improved delivery service, 2) reduction of number of delivery vehicles, 3) reduction of environmental impact, and 4) reduction of transport cost.

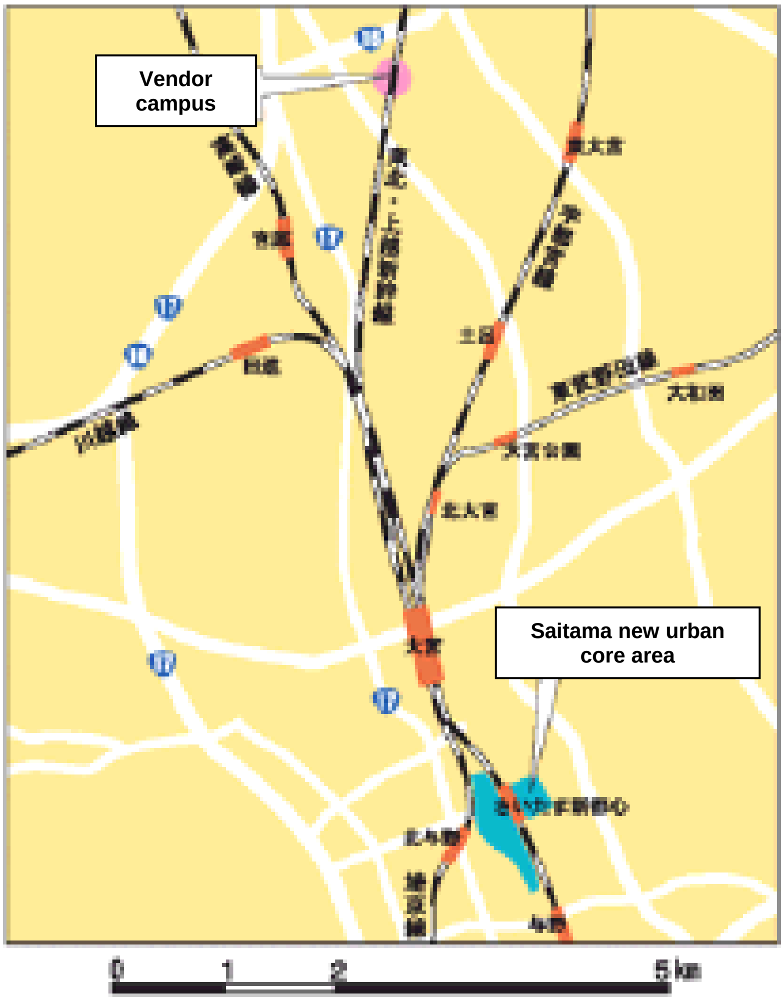


Figure 3-13. Location of vendor campus which serves as distribution center

xi) Motomachi shopping street in Yokohama

The Motomachi district attracts big crowds everyday being home to shopping shops in Yokohama. Yokohama is located on the western coast of Tokyo Bay directly south of Tokyo, and is the second largest city in Japan.

A social experiment of cooperative delivery system was carried out between October 20 to November 2 in 2000. This was in line to the desire of all parties concern to the problems of congestion particularly blames from delivery truck. An access restriction was enforced that would not allow delivery trucks to deliver between 12:00 to 16:00 otherwise parking meter would be applied.

Some of the TDM measures enforced in the area are: 1) cooperative delivery, 2) promotion of utilization of public transport for staffs, 3) regulation of delivery time, 4) control of illegal parking, and 5) control of idling stop. The cooperative delivery system able to control the number of trucks operating in the district from 100 to 29. The 29 trucks serve as common delivery vehicles among the 11 transport operators. Regarding the utilization of public transport, out of 17 shopping centers, five responded by facilitation means for the staff to utilize public transport. After the imposition of time restriction from 12:00 to 16:00, the rate of vehicles delivering this period was reduced to 33% of total trucks from 37%. The social experiment has also tremendous impact to the parking behavior of vehicles. Before the experiment, and average of 959 vehicle a day was recorded which was reduced to 708 during the experiment and even lower down to 628 after the experiment.

xii) Kichijouji in Tokyo

The kind of measure employed in Kichijouji district is unique in a way that parking lots of temples and shrines were utilized along with the area of some banks. Kichijouji is located outside of Tokyo's 23 wards and attracting significant visitors during the weekend for people wanting to get a break from Tokyo’s crowded area.

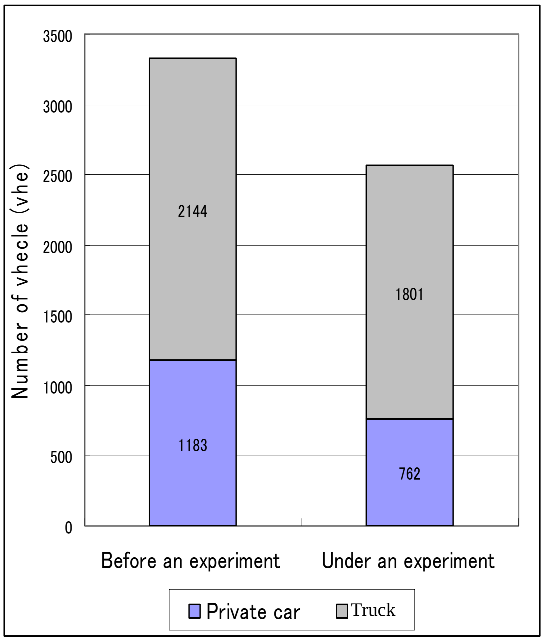


Figure 3-14. Change of number of cars parked in the street

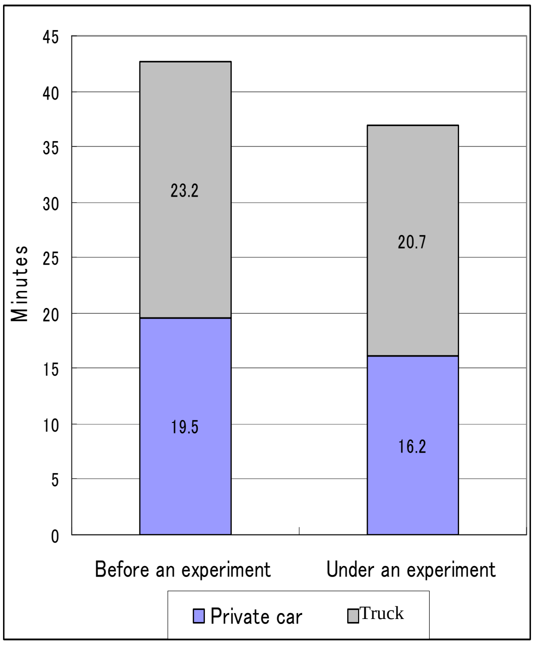


Figure 3-15. Change of parking time

Its main station is suffering from traffic congestion which caused by several factor such as shortage of parking facilities, unorganized delivery of goods, and high proportion of pedestrians. It was thought that if the delivery trucks could be organized by proving facilities where they can perform their operation, perhaps the traffic situation would improve. This idea came to realization after considering the number of spaces available to some temples and shrines in the area. The method employed reduces the number of trucks parked on the street to 16% while its reduction rate to private cars is 35.6% (Figure 3-14). Regarding the parking time, the truck's parking time was shortened by 2.5 minutes and 3.3 minutes for private cars (Figure 3-15).

Policies has always been perceived leaning towards the side of passenger transport. This can be best attested to the enforcement of the truck ban along the major road of Metro Manila. While policies concerning trucks tended to focus on controlling and restricting their activities rather than addressing issues about how to assist them and make them more efficient, the trend regarding passenger transport is more of a way of accommodating them.

3.6.2 Philippines

Philippines has adopted truck ban as early as 1978 to the major thoroughfares of Metro Manila as a means to decongest the serious traffic congestion brought by limited road space and high number of vehicles. This ordinance was issued by then Metro Manila Authority (MMA). The obvious parties receiving the benefits of this policy are commuters (improved travel time), buses (less competition for space), and private cars (more freedom to drive). On one hand, this policy brought some negative impacts to the business of shippers and truck operators who are affected by the route restriction. Freight terminal was once an issue among the freight actors however, realization of this scheme never comes to reality due to problems related to land acquisition, lack of funding, and to some extent opposition from the trucking industry.

The recent Medium-Term Philippine Development Plan (1999-2004 MTPDP) has four broad objectives regarding the transport policies of the country. These are : 1) provision of more intermodal transport system to create efficient flow of traffic particularly at major urban terminals and transshipment points, 2) establishment of a Geographic Information System (GIS)-based urban transport infrastructure network, 3) application of non-engineering measures such as stricter traffic enforcement, demand management, prioritisation of high-occupancy vehicles, and land use regulations, and 4) improvement of rail, water and air transport facilities.

It appears that provision of major infrastructure is of prime importance to the MTPD. In line with this, the 2002 JICA report identifies major projects which include: Davao International Airport Development Project, Laguindingan Airport Development Project, MIAA – NAIA Terminal 3, MIAA – New Manila General Aviation Airport, NAIA International Cargo Terminal, New Iloilo Airport Development Project, Selected airports trunkline development project (Bacolod and Tacloban), and Third airports development project. In addition, JICA identifies nationally funded development projects at Dumaguete, Kalibo, Laoag Interational, Legaspi, Roxas, San Jose, Surigao, Tagbilaran, Tuguegarao and Zamboanga International airports (JICA, Master Plan Study on the Strategic Policy of the Air Transport Sector in Indonesia. Draft Final Report. 2002.).

In the following sections, the truck ban ordinance is presented while its effect to shippers and carriers is discussed.

3.6.2.1 Truck Ban

The present truck ban is covered by Ordinance No. 5, series of 1994. This ordinance is categorized into two types, the peak hour and the "all-day" truck ban. The "all-day" truck ban covers the lone stretch of EDSA from Bonifacio Monumento to Taft Avenue.

The peak hour truck ban on the other hand prohibits trucks from using 10 major thoroughfares from 6 AM to 9 AM and from 5 PM to 9 PM except Saturdays, Sundays and holidays (Figure 3-16) . The 10 major thoroughfares covered by the truck ban are the following:

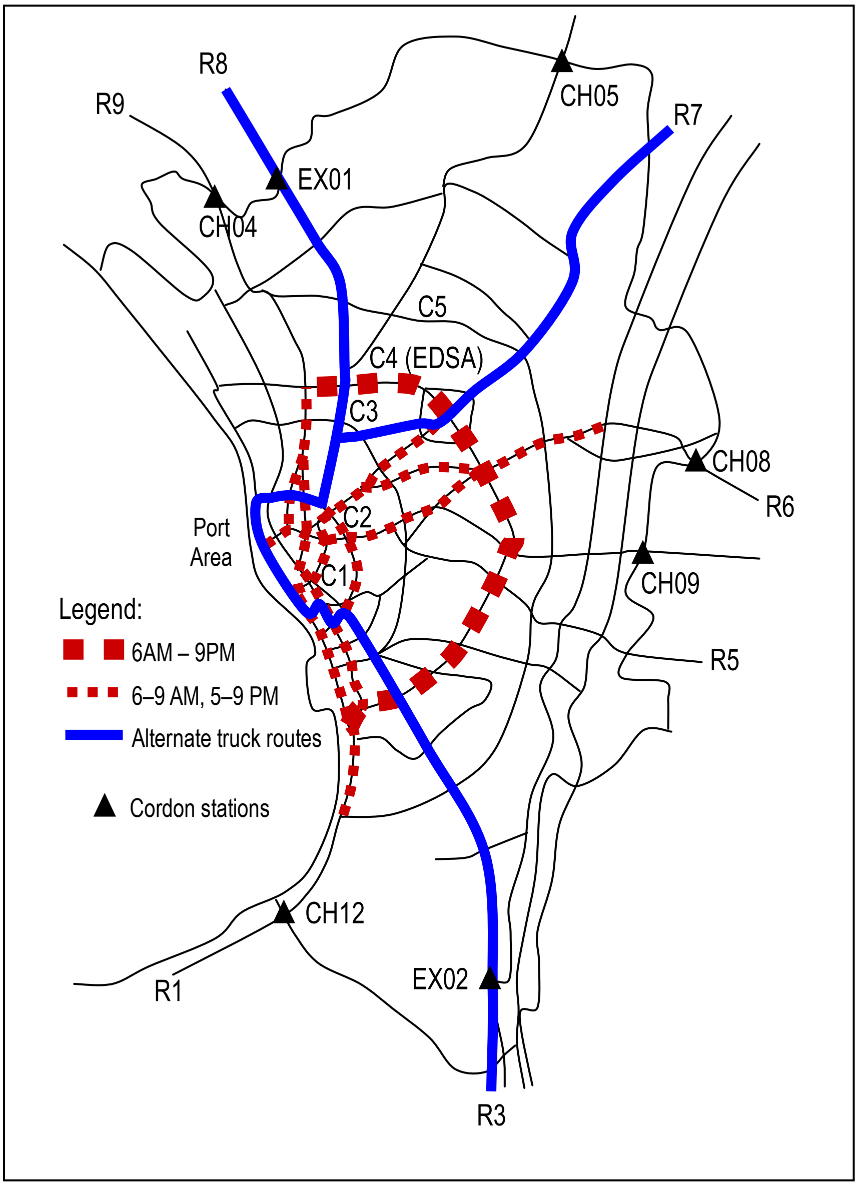


Figure 3-16. Truck ban routes of Metro Manila
Source: Castro, 2005

1. Espana Street through Quezon Avenue from Echague Street to the intersection of West and South Avenues.
2. Claro M. Recto Avenue from Legarda Street to Del Pan Street.
3. President Querino Avenue from South Superhighway to Roxas Boulevard.
4. Padre Burgos Street through Ayala Boulevard, Legarda Street, Magsaysay Boulevard from Roxas Boulevard to Boston Street.
5. E. Rodriguez Avenue throught Bonifacio Avenue from Welcome Rotunda to Shoe Avenue.

6. Sooth Superhighway through Nagtahan Bridge, and Alfonso Mendoza Street from EDSA to Dimasalang Street
7. Taft Avenue through Quirino Avenue from Redemptorist Street to Plaza Lawton, to include McArthur, Quezon and Jones Bridges.
8. Bonifacio Drive through Roxas Boulevard and MIA Road from Aduana Street to the Manila Intenatoional Airport.
9. Rizal Avenue Extension form Carriedo Street to the Bonifacion Monument.
10. Reina Regente Street through Abad Santos Street from Reina Regente Bridge to Rizal Avenue Extension.

The ordinance also provided alternate routes to be used by the trucks while the ban is in effect. The said routes radiating to and from the port of Manila are the north bound, south bound and east bound.

Northern Truck Route

From Port Area to North Diversion Road
From Port Area, traveling northward along R-10, turns right to Capulong towards Tayuman, straight ahead towards Gov. Forbes, left Maria Clara, turns left to Dimasalang, right Blementritt, left A. Bonifcaio.

From North Diversion Road to Port Area
From the north traveling southward along A. Bonifacio Avenue, turns right to Blumentritt, turns left to Aurora Boulevard, turn right to Dimasalang St., turn right to Aragon St., turns right to Gov. Forbes towards Tayuman St. and Capulong St. and finally, turn left to R-10 to the Pier Zone.

Southern Truck Route

From Port Area to South Superhighway
Bonifacio Drive (Roxas Boulevard) and then diverts to P. Burgos Street towards Ayala Boulevard, turns right to San Marcelino St. and turns left at Pres. Quirino Avenue and turns right to South Superhighway.

From South Superhighway to Port Area
From the South Superhighway, turns right to President Quirino Avenue, turns left to United Nations Avenue, turns right to Romualdez Street, turns left to Ayala Boulevard towards P. Burgos St., turns right to Bonifacio Drive towards the Port Area.

Eastern Truck Route

From Port Area to Marcos Highway
The eastern truck route passes along R-10 (Marcos Road), turns right to Capulong towards Tayuman, straight ahead to Gov. Forbes, turns left to Maria Clara, cross Dimasalang, straight ahead towards Constancia, turns left at Laonglaan, straight ahead towards D. Tuazon, turn left at Quezon Boulevard Extension, straight ahead Elliptical Road to Don Mariano Marcos Avenue (Commonwealth Avenue), turns left to Aurora Boulevard, straight ahead towards Marcos Highway.

From Marcos Highway to Port Area
From Marcos Highway, straight towards Aurora Boulevard, turns right at Katipunan, straight towards Tandang Sora, turns left to Don Mariano Marcos Avenue, straight towards Elliptical Road, take Quezon Boulevard Extension, straight towards West Avenue, turns right West Avenue, turn left Del Monte Avenue, straight towards Bonifacio, turns left to Bonifacio Drive, turn right to Blementritt, turn left to Aurora Boulevard, turns right to Dimasalang, turns right to Gov. Forbes towards Capulong and Tayuman, turns left to the Pier Zone.

Shift to small trucks

The implementation of truck ban along EDSA resulted to the proliferation of small trucks that are not covered by the ban (Figure 3-17). Small trucks having gross weight of less than 4,000 kg do the pick-up and delivery. Increase of this type of vehicles is remarkable few years after the implementation of the truck ban in 1978. For the last decade, an increase of 14% in the registration of small freight vehicles has been observed in Metro Manila.

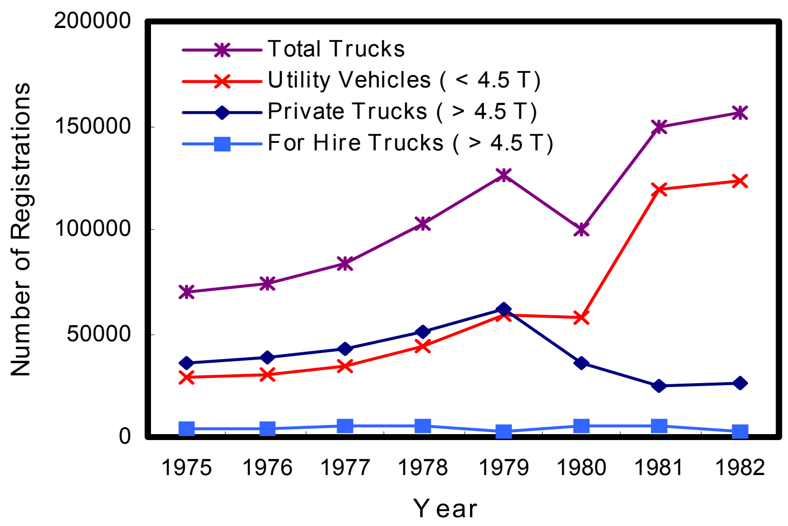


Figure 3-17. Truck registration after the truck ban implementation
Source: Castro, 2002

A survey conducted in 2000 to 29 medium sized freight forwarders with average employment of about 52 workers and 12 large-sized freight shipping companies with average employment of about 1,100 workers in Metro Manila reveals that around one-third (32 to 36.6 percent) of the total truck fleet used for distribution belongs to four-wheel trucks (Table 3-4). This type of trucks is not covered by the ban having gross weight of less than 4.5 tons.

It appears that companies into freight transport put their priority on acquiring trucks that are ban-exempt so they can continue their operation without changing their route or operation time due to the ban. In essence, the truck ban distort the size distribution of the fleet towards small trucks and the it also serves as driver that accelerate the sudden surge of the number of small trucks.

Table 3-4. Distribution of truck fleet

Truck type	Freight forwarders (%)	Freight shippers (%)
4-wheel truck (<4.5T)	36.6	32.0
2-axle 6-wheel truck (8-16T)	14.0	24.0
3-axle 10-wheel truck (25T)	8.0	24.0
3-axle semi-trailer truck (20T)	19.1	3.0
4-axle semi-trailer truck (20T)	2.0	3.0
5-axle semi-trailer truck (27T)	16.8	6.0
Truck-trailer (34T)	3.5	9.0
Total	100	100

3.6.3 Freight Transport Policies elsewhere in Asia

Most of the countries in Asia incorporate their policy concerning freight transport to their national transport plan. There is no such plan that crosses among the transport modes which could serve like a funnel to the flow of goods. Instead, there is a separate policy to each mode of transport (air, rail, road, and water) that is updated every few years to reflect the actual situation on the ground. Thus, in the following sections, two freight transport measures that are active in the region are discussed.

3.6.3.1 Truck Ban in Indonesia, Korea and Thailand

Truck ban is enforced where traffic congestion is serious. The central idea is to push-out trucks from major thoroughfares during the peak hours. Trucks are believed to be slow moving and consumes large portion of the road thus its contribution to traffic congestion is believed to be higher. Authority in major city of Indonesia, Korea, Philippines and Thailand used truck ban measure to counter deteriorating travel speed of vehicles caused by lack of road space and other related factors (i.e. high number of vehicles, poor maintenance and utilization of road, etc.). The characteristics of truck ban to each city is described below:

- In Indonesia, trucks whose gross vehicle weight is heavier than 3.5 tons are not allowed to enter the downtown area of Jakarta between 7-9 AM and between 3-5 PM on weekdays, and between 7-9 AM and between 1-3 PM on Saturdays.

- In Korea, all trucks over 2.5 tons are banned from circulating within central Seoul during working hours to help relieve congestion and to push truck arrivals and departures into the night.
- In Thailand, four and six-wheeled trucks are restricted in the Greater Bangkok Area during peak hours (6-9 AM and 4-8 PM) while ten wheelers and larger trucks are restricted in the morning between 6-10 AM and in the afternoon between 3-9 PM everyday except official holidays.
- In Philippines, as mentioned, the ban prohibits movement of cargo trucks over 4.5 tons along 12 specific routes during the peak periods from 6 to 9 AM and from 5 to 9 PM during the weekdays to the major thoroughfares of Metro Manila.

Both Bangkok and Manila registered high annual growth of registration of small freight vehicles exempted from the ban. Bangkok has 10% while Manila, as mentioned, has 14% increases in the registration of small freight vehicles during the last decade. In 1997, vans and pick-up trucks in Bangkok already correspond to 20 percent of all registered vehicles, which is more than four times that of trucks. This is significant as the share of freight vehicles in 1990 was only about 16 percent. In Manila, a sudden increase in utility vehicle registration was observed after the imposition of the truck ban in 1978. Thus, it may be that the effect of the truck ban is to worsen congestion in peak hours.

Apart from developing countries in Asia, imposing truck ban and other restrictions on access are also popular in European cities. For instance, in Vicenza, Italy, only vehicles with a length of less than 2.5 meter and a capacity of less than 7.5 ton are allowed access without restrictions to the historical old town during the permitted hours. In Amsterdam, the Netherlands, access to the city were classified based on the weight of freight vehicles. Those freight vehicles with weight between 3.5 to 7 tons have wider access as compared to those trucks with weight of higher than 7 tons. In particular, freight vehicles whose weight is over 7.5 tons may only use the main transport route in the city centre. This resulted to 43% increase in the number of deliveries by vehicles lighter than 7.5 tons and 9% decrease of vehicles heavier than 7.5 tons from 1997 to 1999 after its adoption (BESTUFT, 2002).

Imposition of access restriction appears to be done in different objectives between mentioned cities in Asia and cities in Europe. While it is obvious that the drivers behind the adoption of truck ban to Asian cities are factors such as congestion and lack of road space, European cities appears to be more on protection to the environment as well as preservation to the old towns. Their effects to the size distribution of trucks however are the same which heads to small trucks.

3.6.3.2 Freight terminals

Freight terminal has potential to sort out the problems of traffic congestion caused by trucks in major urban centers. The facility could serve as storage for different truck operators and could serve as an area where they can organize their routes and cargoes before bringing them into the city. This measure has been widely used in Europe and Japan to solve physical distribution problems.

In developing countries, however, although past studies on the development of such facilities were done in Jakarta, and Manila, their implementation were never realized due to problems in funding, land acquisition, and some opposition from the trucking industry. In Manila, truckers opposed the idea of developing public freight terminals as they wanted to keep full control over all aspects of their operations. They are more favorable to the further expansion of roads, provision of (off) loading areas, and strict enforcement of traffic laws.

In Bangkok however, three public freight terminals has been serving the freight industry since 1999. These facilities are located in the north, west, and east of the Bangkok Metropolitan Region. Its long distance location from the city center however has raised issues on its suitability.

3.7 Comparative Review of Policies

There seems to be general recognition to the importance of producing efficient logistics system along with a policy that responds to the environment (Table 3-5). Except Germany and the US, all countries have explicit public policy that aims to tackle negative effect on the environment imposed by trucks. The drivers of these objectives are however quite different like the case of Japan where economic objective is highly preferential. Countries that have old town centers like Italy and France were obviously prepared a policy that would safeguard their historic towns.

Controlling the access of trucks is present in all countries though its form may differ from one country to another. In addition, within a country, form of implementation may vary from one urban center to another. For instance, London is charging all vehicles type that enter the city center while other cities in UK like Preston is implementing route restriction to its city center. Some cities adopted access restriction based on vehicle characteristics like in New York for instance; freight vehicle longer than 33 feet cannot enter the Financial District and Midtown core of Manhattan. With the exception of London in the UK, restricting truck's access in these countries appears to have link to urban management than say decongesting the area. Also noted in the table is the eco-zoning measure where only vehicles with low emission are given access permit to certain area. In essence, access restriction can be categorized to 1) time of delivery, 2) delivery efficiently, and 3) vehicles characteristics.

Although the UK has shown great interest to freight platform, there has no facilities constructed and prefer instead the approach of providing a forum where different stakeholders could exchange knowledge on how to best solve the problems confronting the sector. Since rail in the US has substantial share to freight transport and yet has limited access to the urban centers, intermodal facilities are highly important that could facilitate smooth transfer of goods from rail to truck. Other countries in Europe including Japan and Thailand have been utilizing freight terminals as a means to organize their freight traffic.

Although freight routes exist to some countries, its primary objective has not been to make the flow of freight more efficient but rather to avoid some sensitive places to truck or to decongest some routes by deviating freight vehicles.

Most city administrators are becoming more concern to the damage to environment by freight transport thus; access restriction is becoming a common urban management tool. This reaction from the authorities' pushes shippers, transport carriers, and shop owners to explore cooperation schemes that reduce the number of vehicles operating. City logistics where stakeholders across the freight transport are cooperating have been proven successful in Germany and Japan.

All the countries have shown their commitment to reduce the emission level by experimenting freight vehicles that are compatible to the environment. The Japanese government has been long involved to activity and even supplying the technology to the firms that have shown their concern to produce a logistics system that are less harmful to the environment and to the society in general. In the US, the 32,000 fleet of the Department of Interior (DOI) includes more than 300 alternative fuel vehicles (AFVs) of which 15% use either natural gas or propane. Some trash packers in Washington D.C. are CNG trucks that have been in operation since 1997.

3.8 Chapter summary

There has been transition in urban freight transport policy objectives overtime. In the beginning, provision of infrastructure through road expansion, construction of freight terminals and parking facilities is of high importance. These physical infrastructures were designed to relieve traffic congestion in major urban centers which attract great number of people and goods due to centralized economic activities. After having the infrastructure, the policy objective is shifted to institutional measures for proper utilization of the facilities. Access restriction of trucks by different means (e.g. night deliveries, total truck ban, time window, etc.) is imposed and utilization of IT is promoted. The policy objective is then bended toward sustainability and safety which tries to achieve environmental and social benefits. Access restriction measure for different purpose aside from eliminating congestion such as preservation of historic sites is gaining fame while partnership between public and private sector and among companies is endorsed.

Most countries in Europe and Japan have been experimenting schemes that aim to strike a balance between economic and social benefits. The key issue is on how to deliver the same amount of goods in less number of freight vehicles. In addition, the vehicles used for operation met detailed specifications so as not to disturb the physical environment. Issues such as consumption of urban space, emission and noise pollution, and physical hindrance to people are something that is unlikely to become prime movers for policy direction in the early years of policy evolution. However, recent urban management approach changed remarkably as has been seen to the demonstration projects, which tends to put higher weight to these concerns.

Moving the policy review from developed countries to developing countries provides an opportunity to get a wider look to the current freight transport system. The gap between these two groups ranges from infrastructure to institutional measures. Majority of the developed countries attain sufficient infrastructure, which support the movement of freight. Moreover, these countries have dedicated government organ supervising the plan and implementation of logistics facilities. The US for instance has two government bodies, i.e. Office of Intermodalism and Office of Freight

Management under its Department of Transport, that looks for freight issues and freight productivity. The absent among developing countries of these two vital elements of freight transport, i.e. freight facilities and freight institutions, is an indication to the lack of concerted effort to fully understand the underlying freight issues. In addition, this could also be interpreted as a sign that freight issues are not among the immediate issues in transportation. In the next chapter, the focus of discussions will be cooperative delivery system along with other TDM measures that are potential candidate for freight transport management.

Table 3-5. Differences in polices among countries

	France	Germany	Italy	The Netherlands	United Kingdom	Japan	USA
Two main policy objectives	▪ Reduction of freight traffic and shopping trips ▪ Reduction of local emissions	▪ Efficiency improvement ▪ Reduction of hindrance	▪ Efficiency improvement ▪ Reduction of environmental impact	▪ Reduction of local emissions ▪ Accessibility improvement	▪ Efficiency improvement by engaging stakeholders ▪ Reduction of environmental impact	▪ Efficiency improvement ▪ Reduction of energy consumption and emissions	▪ Improving transport efficiency ▪ Reducing the transport share of GDP
Underlying problems	▪ Urban structural enforcement ▪ Congestion ▪ Environmental problems	▪ Transport inefficiency ▪ Heavy duty trucks in urban areas	▪ Protection of historic centers ▪ Transport inefficiency dominated by road transport	▪ Environmental problems ▪ Accessibility problems	▪ Congestion ▪ Environmental problems	▪ High transport cost ▪ Congestion	▪ Congestion ▪ Rising of freight traffic
Licensing and regulations	▪ Implementation of time windows, weight and volume restrictions ▪ Experimenting with temporary closing when emission limits are exceeded	▪ Implementation of time windows and weight restrictions ▪ Experiment with low emission zones	▪ Implementation of time windows and weight restrictions ▪ Experiment with low emission zones	▪ Implementation of time windows, weight and size restrictions ▪ Experiment with permits (green sticker)	▪ Access control to some urban centers ▪ Road pricing	▪ Implementation of weight restrictions ▪ Implementation of permits to enter shopping malls	▪ Access control to some urban centers ▪ Truck lane restrictions ▪ Vehicle length restriction
Freight centers	▪ Implementation of freight villages	▪ Implementation of freight centers (GHZ)	▪ Implementation of freight village	▪ Experiments with consolidation terminals	▪ FQP calls for dialogue among stakeholders	▪ Implementation of different types of freight terminals	▪ Implementation of intermodal facilities
Freight routes	▪ No special routes	▪ Experiment with freight routes ▪ Intercity freight trains	▪ No special routes	▪ Attempt to use bus routes ▪ Experiments with freight routes near industrial areas	▪ Some routes specified for HGV	▪ Truck ban in outer lanes of some routes at night	▪ Handful of US cities with truck routes
City logistics	▪ No city logistics experience	▪ Implementation of cooperation in city logistics but ending	▪ Small freight depots in some cities	▪ Attempt but failed ▪ No experiments	▪ Skeptical to the idea	▪ A few cases of implementation ▪ Government promotion	▪ No reported case
Low-emission vehicles	▪ Experiments with electric trucks	▪ Experiments with electric and CNG trucks	▪ Experiments with non-pollution trucks	▪ Experiments with electric/hybrid trucks	▪ Experimented to some cities	▪ Subsidizing of electric vehicles	▪ Experimented with CNG trucks to some cities
Consultation	Local consultation platforms	Local consultation platforms	Local consultation platforms	National consultation platform	Local consultation platform	National consultation platform	Local consultation platform
Policy level	National	National	National	National	National	National	National

Source: Visser, et al, 1999
Note: Italy, UK and USA are work of the author

Table 3-6. Urban Freight Transport Project Research authorized by European Commission

Name of project	Background and Objectives
LEAN - Integration of LEAN LOGISTICS in urban multimodal transport management to reduce space demand and optimise use of transport mode	The project aims at developing and demonstrating new concepts to distribute and collect goods in urban areas. The scope include five different levels: 1. Logistics concepts to improve the productivity in transport organisation; 2. City-Terminal operation to improve forwarding processes in view of the whole logistics chain, even with additional goods transfer points and handling costs; 3. Telematics applications, to improve control of goods distribution process; 4. Tools for administrations to influence transport without radical disruption of economic activities; 5. Alternative transport modes recommendations to support significant modal shift to rail. After a review of the actual and current European city-logistic schemes, the feasibility of new concepts will be analysed for the following: 1. The logistic operational level will address the problem of building an efficient organisation of transport chains with the support of new software applications, also to manage the highly automated transport information chain on a 'real-time' basis and provide required information availability to the respective staff. 2. The City-Terminal operation concept will organise the distribution and recollection of goods on a sustainable basis for traffic and environment at an acceptable price level. It will make use of telematics application to offer new concepts for highly automated data interchange between different types of data, especially considering the mobile data communication requirements and their costs. 3. The City Administration level will implement new ways of access control and regulation procedures, and space ressource management for urban goods transport without major risk of low acceptance, neither by the economy nor by the inhabitants. In particular, innovative dynamic loading management systems will be tested.
BESTUFS – Thematic Network "Harmonisation of strategies and highlighting best practice to determine optimum URBAN FREIGHT SOLUTIONS"	BESTUFS is a co-ordination activity to encourage the co-operation between domain experts, re-search institutions, urban transport operators and city administrations in order to identify and to disseminate innovative urban freight transport solutions which are considered as best practices within Europe. BESTUFS is establishing and maintaining an open European network between urban freight transport experts, user groups/associations, ongoing projects, interested cities, the relevant European Commission Directorates and representatives of national transport administrations in order to identify, describe and disseminate best practices, success criteria and bottlenecks with respect to the movement of goods in urban areas. The network is collecting, comparing and summarising available experiences and results of projects and initiatives mainly in Europe, is organising thematic workshops, clustering meetings and conferences and is further disseminating its results via the Internet, via newsletters and via other dissemination channels. BESTUFS is contributing to the integration of urban collection and delivery services into door-to-door transport and logistics chains and to the improvement of the quality of life in urban areas
IDIOMA –	The IDIOMA project aims to demonstrate the possibilities to improve

Innovative distribution with intermodal freight operation in metropolitan areas	the distribution of goods within metropolitan areas and between intermodal transport terminals/ freight centres and metropolitan areas. The IDIOMA project consists of five Demonstration Projects which, during the project, will be prepared, implemented, validated and evaluated. Before that, an over-view of all relevant European projects related to intermodal transport and city logistics has been provided.
COST 321 – Urban goods transport	COST 321 is a research project studying the design and operation of innovative measures to improve the environmental performance of freight transport in urban areas. Analysing how the air pollution, noise and energy consumption are reduced by optimising the use of trucks in city traffic through the application of modern logistical devices and appropriate administrative measures.
SOFTICE – Survey on Freight Transport including a cost-comparison for Europe	The project consortium is composed of 7 partners coming from different countries within EU and Switzerland. The aim of SOFTICE is to demonstrate the interactions between production costs, transport costs and transport demand for freight, and to demonstrate the benefits of harmonized freight transport costs. The project will also provide a framework for discussions at the European level and facilitate the dissemination of national results and findings. It will assist the development of comprehensive policies on freight transport at the Community level, as well as informing national and regional governments.
FV-2000 – quality of freight villages structure and operations	Freight Village is structured by its objectives: Objective 1 : analysis and evaluation of the impacts of FV lay-outs and operations on the improvement of intermodal transport market share, i.e., determination whether the proximity of different transport and logistic activities is a key factor for improving the use of intermodal transport (integrated vs. non-integrated FVs); Objective 2 : establishment of the merits and limits of the development of Freight Villages for the enhancement of intermodal transport competitiveness; this will be based on benchmarking and analysis of the best practices and case studies; Objective 3 : establishment of the environmental impact of FVs and intermodal terminals; Objective 4 : definition of guidelines and management tools for the improvement of risk and environment management, working conditions and safety in FVs; Objective 5 : increasing the awareness of FV operators (FV personnel, private transport companies personnel, etc.) with regard to the environment, work safety, quality, risk prevention and assessment. The project will consolidate extensive knowledge based on the actual structure and operations of FVs, taking into account the transport environment in which they operate. For this purpose, specific data

	will be collected at the test sites, as well as a validation and verification of the management tools with reference to the participating freight villages. The project activities will take place in 7 countries in the European Union, with the participation of one or more freight villages. The countries are: · Denmark, Finland, France, Germany, Italy, Spain and Sweden.
FREYA – Towards the networking of European freight villages	The FREIA Project has these three main gols: ▪ To improve the accessibility of European intermodal freight villages and their related transport networks for small and medium sized freight operators ▪ To stimulate the commercial options of transport SME's and thereby improving the market share of intermodal transport. ▪ To develop models and concepts for a virtual freight village information system through the use of Internet or VAN-networks.
INFREDAT – Methodology for collecting intermodal freight transport data	The INFREDAT project aims at developing a consistent methodology for collecting intermodal freight transport data. The proposed INFREDAT methodology will be achieved by the following major operational objectives: - to identify and to monitor the actual transport (door-to-door) flows of goods in complete chains of different transport modes; - to study the composition of intermodal transport chains concurrently with the development of different logistic services by making the distinction of the so-called logistic families; - to identify market segments for intermodal freight transport considering all different transport modes; - to clearly define the intermodal freight transport data to be collected as well as the methodologies for data collection and processing; - to investigate existing information sources and methodologies and to derive approaches for best practice; - to elaborate a data model for data collection and data processing including rules to avoid double counting; - methodologies for the forecasting/estimation of missing data; - modal split estimations; - to identify appropriate sources of information and new methodologies considering automatic data collection in a most efficient and profitable way to both data providers and data users; - to set-up a mechanism for gathering in a consistent way the basic data on transport chains, with prominence to maritime and/or air stage; - to demonstrate the feasibility of the proposed methodology and to evaluate the results under the three pilot cases; - to evaluate the cost-benefit aspects of the intermodal data base in general and of the data collection methodology proposed; - to design a detailed implementation plan for the realisation of the project methodology on a European level considering aspects of commercial exploitation and further research needs. %
REFORM – Research on	The REFORM project has two fold objectives:

freight platforms and freight organization	**Primary** Analyse and evaluate the effects of freight platforms regarding the urban traffic. 2. Provide guidelines and criteria for designing, locating and organising freight platforms in urban areas with the view of optimising the benefits of these platforms and to reduce their negative effects. **Secondary** 1. Empirical investigation as a basic requirement for modelling and simulating the effects of freight platforms. 2. Develop a methodology to calculate or estimate the different effects of freight platforms. 3. Practical application and evaluation of freight platforms by a detailed analysis of test sites in Berlin, Brussels, Madrid and Rome. The focus of the practical application is set on: · coordination of big interports (long distance traffic) with city terminals (urban and regional traffic); · organisational and operational requirements for the development of successful freight platforms; · multimodality of freight platforms (road, rail, waterborne traffic); · operational improvements to be expected from co-operation schemes. 4. Derivate recommendations and guidelines.
City Freight	City Freight is a research project on inter- and intra-urban freight distribution networks. It will carry out an analysis of selected freight transport systems already functioning in Europe and evaluate their socio-economic and environmental impacts in an urban context, with a common assessment methodology. CITY FREIGHT will focus on innovative and promising logistic schemes in the seven countries represented in the project consortium. The objective is to provide guidance to interested stakeholders (government, regional or local authorities, network operators, shippers and consignees) on the advantages and drawbacks of some recent innovations in the field of inter- and intra-urban freight distribution systems. In the City Freight project seven innovative city logistic projects and/or policy plans in seven different countries, will be analysed, evaluated and compared. Afterwards, a Best Practices Handbook will be compiled. In this handbook best practices for the different kinds of actors (logistic services providers, shippers and retail companies, public authorities) will be de-scribed categorised by the effects they have on f.i. environment, economy, land use etc. For the various cities involved also recommendations and an implementation plan will be derived.

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CHAPTER **4**

Cooperative Delivery System and other Transportation Demand Management measures

4.1 Introduction

In the previous chapter, it was shown that cooperative system has been widely used in many cities in different parts of the world as an instrument to reduce the number of trucks on the road. Some are adopting the system to counter the decline of profits because of the structural re-organization of the sector as it has been seen in Italy while others opt to adopt the system to fit-in to the requirements of the city which are not suitable for large number of trucks. Many literatures pointed out that the reduced number of trucks because of the enforcement of cooperative system is benefiting the environment in great deal.

Obviously, there is a need to produce a package of measures to minimize if not eliminate the problems induced by freight transport to the environment and to the society as a whole. These problems can be seen in the form of congestion, environmental pollution, accidents, and consumption of urban space. The cause of these problems is very dynamic in nature although there are two clear trends that are not positive in urban freight sector: 1) unbalance share of modes in freight transport and 2) increasing ton-km of trucks.

This chapter rationalizes cooperative system as one of the most powerful transportation demand management measures (TDM) to confront the growing problems associated with trucks in the urban environment. Section 4.2 charts some goals and general objectives of freight transport policies. As policies are driven by a variety of factors, Section 4.3 identified the key drivers of policy implementation and noted the trend of policy direction between developed and developed countries. The following section presents a summary of strategies for managing freight movement and all kinds of policy usually adopted by both private and public sector to restrain problems born out of urban freight distribution. Section 4.5 then illustrates how they can be classified into infrastructure-based and transportation demand-based strategies. The concept of TDM and its examples, including CDS, are shortly discussed in Section 4.6. Section 4.7 thoroughly discussed CDS and the concept of freight centers, which has been in used to many countries in Europe as well as in Japan. This section clarifies their differences in terms of function, organization and objective. The chapter concluded in Section 4.8 where the issues related to urban freight distribution is summarized.

4.2 Freight transport policy goals

Any policy is driven by a certain goal. And goals can be categorized to short and long term. Generally, short term goal involve regulatory measure; for instance, reserving portion of the road as (off) loading area for trucks to allow the fluidity of the traffic. On the other hand, long term goals are deemed to be achieved in a long period of time since drastic changes are usually involved. An example is the new measure in the draft city master plan of Paris (expected to come into effect on 2006) requiring new commercial and industrial buildings (to be constructed) above 500 m^2 and within the "Zone urbaine générale" (General urban zone) to provide delivery and access facilities in the city.

Ogden (1992) provides a clear direction in which policies can be aimed by classifying objectives into economic, efficiency, environmental, safety, infrastructure, and urban structure. This classification shows just how broad the objectives are and how drafting solution to serve one or two of these objectives can be challenging. The broadness of this policy objective could also be a source of conflict when applying measures. For instance, measure like encouraging night delivery of goods to reduce congestion during the day suits economic and efficiency objectives but might not fit with safety (previous study shows that driver's awareness is decreasing and becomes prone to accident [Castro, 2003]) environmental objectives (noise emission is the biggest problem with night deliveries that affects the quality of life of inhabitants). The complicated issues of producing a measure or bundles of measures that would serve every end of the policy objectives will be discussed as the chapter progresses.

The importance and controversy of deciding measures for urban freight transport assured to generate attention among the concerned parties. Another influential study conducted concluded that policy actions generally centre on three main goals which are listed below (City Freight, 2002).

Improvement of accessibility and circulation: These policies are aimed at achieving infrastructure that complies with certain quality demands. Measures can consist of building infrastructure, using infrastructure more efficiently and/or imposing regulation on infrastructure use. What is positive for one traffic sector, however, can work out negatively for other sectors within or outside the traffic and transport world.

Improvement of environment and safety: Reduction of emissions and enhancing the safety of the traffic systems are the goals of these policies. Sustainability definition issues, the trade-offs between optimal and maximal safety, and the impacts of environmental questions on the transport and logistics sector will be among the task expected to be discussed.

Strengthening of competitive position: This entails creation of right conditions to maximize competition of the sector as a whole, and enhancement of the competitiveness of transport companies and logistics service providers. Employment in the logistics sector and its contribution to the GDP and tax returns are dependent on its competitive position. Further, an efficient logistic sector helps to increase the productivity and competitiveness of the whole economy.

4.3 Diversity of key drivers for implementing urban transport policy

Congestion is often the key driver for issuing a new set of policies relating to freight transport as the case of truck ban in most developing countries (see Chapter 3 for truck ban discussion). For a developed country, this might be just one of the forces that pull the policy formulation as many other issues such noise, vibration have significant influence to the birth of the new policy. A European comparative study (Lewis, 1997) concluded that congestion, air pollution, noise, safety and intrusion are considered as the most important negative impact of freight traffic within urban areas and are seen as key factor in implementing policy measures (Table 4-1). It appears that developed region has broader basis for policy formulation while developing region is singling out congestion as sole springboard for policy intervention.

Table 4-1. Key-factors in the implementation of measures regarding urban freight transport

Key Factors in implementation	Monaco	Kassel	Zurich	Chester/ London	Winchester	Barcelona	Bologna	Total score
Congestion				■		■	■	3
Environment	■				■		■	3
Noise					■			1
Safety					■			1
Intrusion	■				■			2
Political considerations	■			■				2
Cost								0
Lack of loading facilities						■		1
High percentage of in-house transport		■	■				■	3
Poor utilization of vehicles		■	■				■	3
High proportion of commercial traffic							■	1
Retail balance between retail and transport practices				■			■	2

Source: Lewis, 1997

The above discussions on key factors in implementing policy measures between developing and developed countries exposed just how much approach to freight transport issues differ. Apparently, the difference in approach has a probable link to factors such as economic performance, digital infrastructure (ITS and ICT) and other factors. For instance, e-shopping (shopping through internet) is quite popular in European cities and other cities in developed countries which would aggravate the already poor state of vehicles utilization (i.e. low load factor). If this practice becomes common among freight carriers, this would deteriorate the traffic flow and might become a source for implementing a measure such as access restriction based on load factor. E-commerce is only successful when digital infrastructure is efficient which is hardly found in developing country.

4.4 Freight Movement Management

There are number of strategies that can be pursued to advance freight transportation management. Meyer (1997) list down some of the measures that when taken bring enormous improvement to the movement of goods.

Traffic Management – Transportation System Management (TMS) measures to improve the flow of freight include such things as truck-only lanes or roads, providing region-wide traffic information to freight movers, and preferential moments at toll or access points.

Improvements at shipping/receiving points – On-street loading and unloading can be facilitated by designing additional curb space for loading zones and enforcing time restrictions. In addition, intermodal transfer facilities can be developed or enhanced to facilitate truck-rail cargo transfer.

Reducing operational and physical constrains – Traffic signal timing can be changed, or demand-actuated signals can be used at intersections with large volumes of trucks to compensate for the acceleration, deceleration and turning characteristics of trucks. Intersections can be widened and horizontal and vertical obstacles (e.g. islands, lamps and utility poles) can be removed or relocated.

Changes in business operating practices – Business-operating practices to reduce the time required for pick-up and delivery reduce the transport costs of shippers and receivers, and improve the performance of the transportation system. In addition, changes in time of delivery, e.g., at off-peak hours, will provide positive benefits to peak hour travels.

Changes in public policy – The commonly considered technique for relief of truck-induced congestion is the separation of trucks from other traffic. Land use planning, zoning and industrial location policies and building regulations requiring off-street loading and unloading facilitates can be used to separate freight-oriented. Another policy action is to charge tolls during peak hours to encourage truck movements to shift to no-peak hours, less congested routes, etc.

Investment in rail – Improvements in rail transport could alleviate heavy truck use of highways leading to ports and freight terminals.

Goods movement management during peak period traffic can effectively reduce overall congestion. The development of the off-peak hour system for urban goods movement through various incentives (tax and otherwise) assist in the congestion.

A more detailed measure that is being applied to improve freight transportation is available in Table 4-2. Although the contents were arrived through analyzing freight distribution problems in European cities, nonetheless, most of the measures are quite general in form and therefore can be adopted by any city. Problems like traffic congestion and negative impact of freight transport to the environment are two most common problems associated to the industry and measures to curve these problems are also quite the same – for instance, provision of (off) loading facilities, time windows, etc.

Table 4-2. Problems and developments in the freight transport sector

Problems and developments	Initiatives (implemented, planned or suggested)
Congestion in town center	▪ Consolidation of deliveries, Urban distribution centers ▪ Off peak and night deliveries ▪ Access and parking restrictions (based on the time of the day, vehicle weight, length, capacity usage, destination) ▪ Dedicated routes for freight traffic in the cities ▪ Usage of bus lanes for freight traffic ▪ Dedicated lanes for freight traffic on highways ▪ Development of bypass roads and ring roads ▪ Increased capacity in traffic bottlenecks ▪ Underground delivery ▪ Usage of alternative transport modes (rive boats, trains, trams, metro, pipelines, bicycles) ▪ Reduction of passenger traffic (public transports, home deliveries and deliveries to collect points) ▪ Intelligent traffic management system
Scarcity of space in town centers (especially in historic ones)	▪ Usage of vans or bicycles in deliveries ▪ Underground distribution
Reduced accessibility to towns or premises	▪ Flexible and widened time windows ▪ Harmonization of regulations (at city/region/country/int'l level) ▪ Long term stability of regulations in order to allow time for developing new technologies to cope with the regulations ▪ Integration of regulations with information policies and investments
Environmental impacts Emission	▪ Awareness programs and codes of behavior ▪ Restricting access of codes vehicles above certain tonnage, age or emission level ▪ Reverse logistics ▪ Usage of environmentally friendly fuels ▪ Promotion of alternatives transport modes (rail, waterway, bicycles) ▪ Promotion of intermodal transport (facilities, documentations)
Noise	▪ Restricting night deliveries and access to residential areas ▪ Rerouting of freight traffic ▪ Relocation of logistics and industrial activities ▪ Underground deliveries
Safety risks	▪ Routing of dangerous goods traffic ▪ Development of vehicle designs ▪ Collision warning system
Lack of on-street or off-street unloading places for delivery vehicles	▪ Designated unloading places for delivery vehicles ▪ Taking delivery requirements into account in town planning and building permit processes ▪ Guidance for studying and planning unloading space needs ▪ Intelligent Parking Management System ▪ Van and truck design allowing fast unloading/loading (lateral doors, low floor) ▪ Unloading and loading equipment

Problems and developments	Initiatives (implemented, planned or suggested)
Lack of parking places for good vehicles	▪ Designated parking areas ▪ Intelligent Parking Management System
Violation of parking and access restrictions	▪ Simplification and (city/regional/country level) harmonization of regulations ▪ Support of restrictions by positive initiatives such as information and investment ▪ Checking the consistency of regulations with other relevant factors influencing urban traffic (other public measures) and market driven development ▪ Entry poles, access cards and certificates ▪ Improved law enforcement and surveillance (cameras) ▪ Adequate and clear signaling and guidance
Fragmented and frequent deliveries	▪ Consolidation of shipments ▪ Urban distribution centers ▪ Nominated day and time deliveries ▪ Restricted access of vehicles with low loading percentage ▪ Usage of ICT applications in logistics planning and operations
Poor unloading conditions	▪ Freight traffic needs to be taken into account in planning and granting building permits
Urban freight traffic neglected in town and traffic planning	▪ Urban freight policies and strategies ▪ Planning guideline manuals ▪ Research on the topics
Lack of cooperation and exchange of information between public and private actors	▪ Cooperative forums ▪ Urban transport policies and programs ▪ Urban transport studies
Distribution of e-trade purchases	▪ Collection points and boxes (both for private and public customers) ▪ Allowing deliveries in the evening
Variety in traffic regulations	▪ Harmonization in regulations (access restrictions based on time and vehicle characteristics, standards)
Lack of information concerning urban freight traffic	▪ Studies, surveys, workshops ▪ Development of databases and statistics ▪ Best practice dissemination
Market demands (customer tailoring, low price level, speed)	▪ ICT applications in production and logistics planning and operations (warehousing, transportation) ▪ Standardization of loading units ▪ Cooperation of companies ▪ Infrastructure development ▪ Company subsidies to improve transport efficiency ▪ Van and truck design (lowered floors)

Source: City freight, 2002

4.5 Policy options

Policies measures can be grouped into two, infrastructure-based measures and TDM-based measures. Measures under the first category are those measures that involve transportation facilities and infrastructure development (e.g. freight terminals development, road network improvement, truck parking and loading facilities) which are characterized by huge amount of capital investment. On the other hand, measures under the second category are those measures that involve policy and regulatory which do not require large capital investment.

Although it was emphasized earlier that the focus of the thesis is on the TDM measures rather that the infrastructure-based measures, it is rather appropriate to supply information regarding freight centers due to its familiarity as freight transport measures both to European and Asian cities (e.g. UDC of Tokyo and public distribution centers of Thailand). Freight centers serve as central facilities where it is possible to process and store goods before bringing in to the city center. These facilities also provide the platform where different carriers could perform cooperative delivery taking advantage to the common location where their logistic activities are.

4.6 Concept of Transportation Demand Management (TDM)

Transportation Demand Management (TDM) refers to a wide range of actions and measures taken to improve the traffic flow and enhance the transport environment without substantial capital investment. The key to this strategy is the efficient use of transport resources. TDM operates through legislative, traffic engineering, and operational measures to attain the goal of better traffic environment.

TDM becomes increasingly important alternative measure as significant improvement of road transport becomes difficult in urban areas. Since this measure does not require substantial capital investment to implement, it becomes the focus of attention of many policy makers both in developed and in developing countries. The objectives of TDM are very broad that it may pose enormous impact on the social, economical, and environmental condition of the society. These objectives are:

- To enhance the efficiency of the transportation system by reducing demand while increasing supply;
- To promote balanced modal split among different modes of transport;
- To improve environmental conditions by reducing transport congestion; and
- To promote sound and balanced development of a society through efficient transportation system.

These objectives can be better understood by looking at Figure 4-1. The figure illustrates the striking difference in method of addressing the growth of traffic between traditional method and TDM method. In most cases, there is an imbalance between traffic volume and the capacity of transportation infrastructure. Traditional method opts to meet the volume of traffic by expanding the capacity of the transportation infrastructures. Traffic volume however is hardly meet thus sooner of later, traffic congestion and other related problems occurs. Further, allowing the traffic to increase at its natural pace would be hard to meet through upgrading the infrastructures without harming the environment. There are certain limits where the infrastructure could be expanded without posing damage to the environment. On the contrary, the TDM approach intervenes the growth of traffic to ensure that such growth is within the capacity of the infrastructure. Construction of additional infrastructures to meet future demand under the TDM measure is also done with great consideration to the capacity limit of the environment.

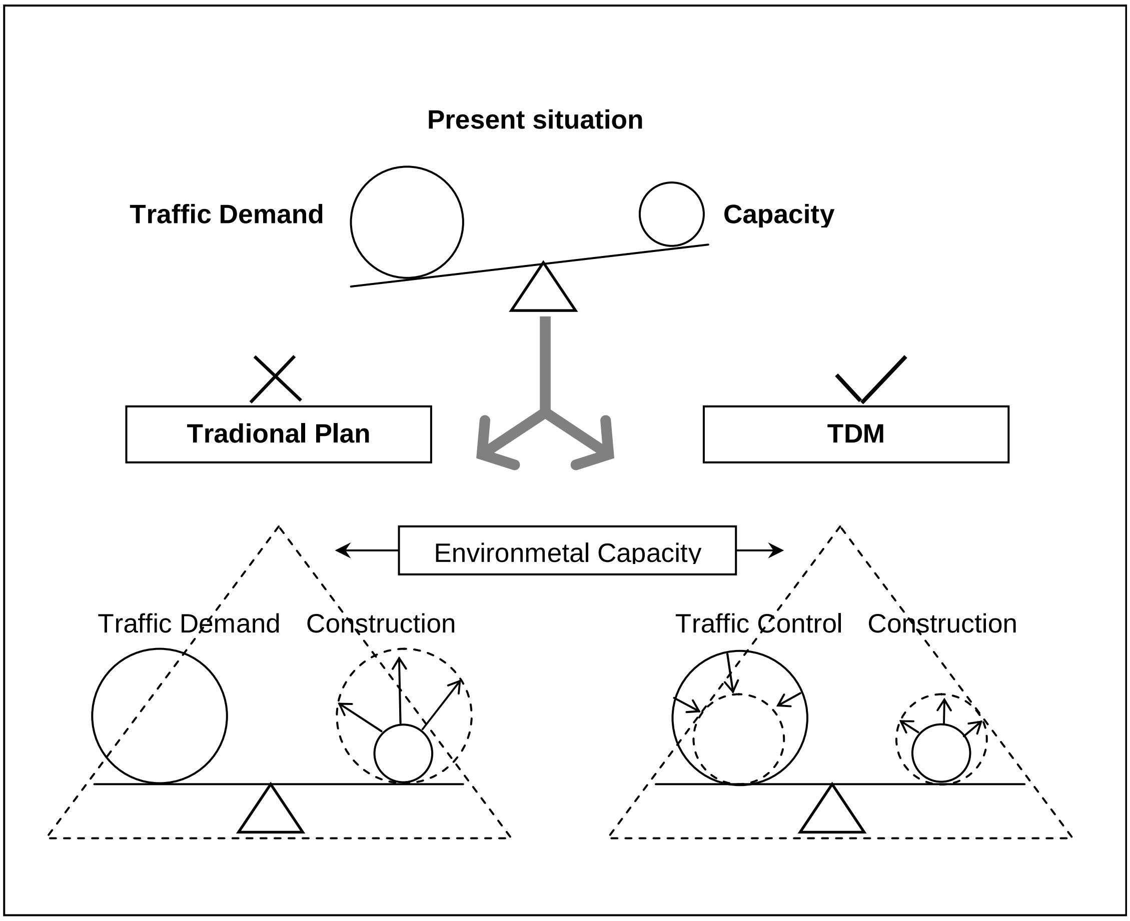


Figure 4-1.Concept of TDM

Note: This TDM interpretation is of Prof. Yoji Takahashi. There are lots of TDM interpretation such as this one available from the website of Tokyo Metropolitan Government (http://www2.kankyo.metro.tokyo.jp/jidousya/roadpricing/1siryo4.htm)

4.6.1 Objectives of some TDM measures for freight transport improvement

The objectives of TDM measures that are mainly aim to improve freight distribution are presented in Table 4-3. In the preceding chapters and in the early part of this chapter, there were lots of discussions regarding the importance of formulating a bundle of measures that is capable of meeting social and economic benefits as precondition to its success. Castro et. al. (2002) states that most efficient measures are likely those that meet social and economic benefits simultaneously.

By looking at the same table, it can be realized that CDS is ahead of other TDM measures in meeting all possible objectives for implementing policy measure. Further, present urban freight transport condition favor cooperative delivery system as many urban centers banning trucks to minimize its social impact (Best Practice Handbook, 2001). There is also the difficulty of supplying freight and transportation infrastructures in view of difficulty of finding financial resources.

Table 4-3. TDM measures for freight transport and their objectives

TDM list	Objectives			
	Traffic	Cost	Environment	Safety
Freight terminal	✓	✓		
Cooperative delivery system	✓	✓	✓	✓
Road link improvement	✓			✓
Truck parking and loading facilities	✓			✓
Guidance and information system for goods	✓	✓		
Freight regulation	✓		✓	
Road pricing and parking charges	✓	✓		✓

4.6.2 Review of the application of most common TDM measures

Although CDS appears to be the most powerful measure to improve freight distribution in the city, it is still of interest to review the application of other TDM measures to note their strength and limitation. Further, this review covers the most common TDM measures that both impacting freight and passenger transport. These measures, i.e. road pricing, modal shift, cooperative delivery, access restriction, utilization of ITS and ICT, and land use zoning, are defined below. The list appears to be quite large and each measure’s ultimate goal may vary from one to another. The different goals of these measures will be discussed to have an idea on which among the measures has the strongest impact to improve city freight distribution.

Road pricing

A handful of countries have been benefiting from the development of road pricing. Singapore, Norway, and the UK have enjoyed financial revenues derived from this scheme which they intelligently invest to the improvement of transportation infrastructure. Critics argue however that there are still many issues to be resolved in this scheme which includes the public and political impact (politicians might have a second opinion to the scheme due to the fear of public opposition), equity impact (i.e. fairness of the right of access to transport infrastructure for different groups of people and the distribution of benefits associated with reduced congestion), and economic impact (those businesses lost customers due to the scheme). Moreover, road pricing is perceived as a measure more to do with passenger transport although it does have an impact to freight transport.

Modal shift

Modal shift strategy can help balance the overall modal share of transport and also plays significant role to reduce the green house gases sources from the transportation. This measure calls for the modal shift from road freight transport to rail, waterway and, short sea shipping. The idea is take away long distance freight transportation from trucks to other less harmful modes of transportation to environment. Europe has launched on July 2003 the Marco Polo which aims to maintain the traffic share between the various transport modes for the year 2010 at its 1998 level. The Japanese government in line with its commitment to Kyoto Protocol also adopted modal shift strategy to reduce environmental problem sources from road freight transportation. It appears that modal shift is a strategy aimed to balance the distribution of freight traffic among the transport modes which when done is expected to contribute to the improvement of environment through reduced traffic congestion. However, this strategy's impact to city distribution where the congestion is serious is very limited due to the limited access of other modes in the city centers. At the end of the distribution chains, trucks would still be called to service the freight coming from other transport modes.

Cooperative delivery

The idea of cooperative delivery system which is to improve the freight distribution thorough consolidation of loads is very compelling. Success stories of this scheme can be witnessed in some cities of Germany and Japan with several discussions regarding the idea taking place across Europe. The TDM examples mentioned in Chapter 3 reveals that as early as 1970s, there already exist cooperative delivery systems in Japan (in Nihonbashi, Tokyo in 1972 and in Tenjin, Fokouka in 1978). The key issues to this scheme centered on the financial difficulty of carriers and their reluctant to participate for various reasons. Although the existence of successful operation of this scheme might serve as evidence to remove cloud of doubts from private sector, these two concerns deserves further research that would give them total confidence to idea.

Access restriction

Access restriction is wide-spread in Europe and appears to be sourced from two reasons: protection of historic sites and protection of the environment. Current applied regulations can be formed into five groups which are: 1) regulations related to the type of transport means especially to vehicles emissions, weights, and sizes; 2) regulations related to the access time in predetermined areas; 3) regulations related to preferred truck routes; 4) regulations related to loading and unloading zones; 5) regulations based on licenses. Among the regulations on the first group, weight restrictions are the most common regulations and they tended in the past to be more and more restrictive in urban areas, which has enhance the use and number of small delivery vehicles. On the second group, night delivery scheme appears to be the most controversial like the case in cities in France where some cities consider the idea as a good strategy to decrease the number of trucks in the city during the day. Other cities however, argue that truck and delivery noise impacts are too high and night deliveries should be banned. The third group of regulations has something to do with assigning a particular route for trucks to avoid congested thoroughfares like the case of truck routes alternatives in Metro Manila. Providing dedicated loading zones falls under the fourth group of access restriction. In Copenhagen, the access to freight handling facilities is based on a license. In Paris, utilization of their loading bays is good for 30 minutes for every truck which they modeled from the experience of Barcelona.

Intelligent Transport Systems and Information Communication and Telecommunication

Intelligent Transport Systems (ITS) and Information Communication and Telecommunication (ICT) can enhance the delivery of freight in several ways. New and automated enforcement technique formed from ITS and ICT make it easier for police to implement access restriction measures. One sector that is benefiting from the application of ICT is the police forces who is tasked for instance to enforce access restriction of trucks to city center. Enforcement is traditionally a labor intensive task and is therefore costly. However new applications of ICT may improve the "enforcement efficiency" and enlarge the scope of enforcement. This type of application has been applies in Barcelona, Spain where the monitoring of vehicles entrance to (off) loading bays is monitored by camera that fed the data to control center. The system wants to make sure that freight vehicles were following the 30 minute maximum stay to the bay and if they are delivering within the allowable time frame. On the part of transport operators, these technologies could facilitate them to integrate their operation or even could facilitate them for cross-company management of loads and fleets. The result would be improved scheduling and routing which would reduce freight vehicle mileage and increase load factors (e.g., avoiding empty backhauls). This can be accomplished through increased computerization and coordination among distributors. However, application of ITS and ICT relies heavily to digital infrastructure (e.g. internet connection) which could be a reason for limited application in developing countries which do not possess abundantly of such technology.

Land use zoning

Land use zoning has enormous impact to the settlement and thereby the flow of traffic. For instance, sitting manufacturing and assembly processes closer to their destination markets reduces the amount of travel required for goods distribution. Requiring new establishments to provide logistics facilities (i.e. parking area, loading zone) would have positive influence to the traffic. Freight vehicles would no longer use the road space while (off) loading their load should these facilities are available and with good access location.

As a case of example, Paris is divided into three zones in which each establishment has to provide logistics facilities depending on its location. The "Zone de grands services urbains" requires establishment to offer 25 m^2 dedicated for logistics facilities. The "Zone urbaine générale" directed commercial and industrial buildings larger than 2500 m^2 and office buildings larger than 500 to provide delivery and access facilities. And lastly, the "Zone urbaine verte" ordered the preservation of parks and areas of architectural interest. Under this zone, logistic activity is allowed only on a time-sharing basis and using non-polluting delivery vehicles. Obviously, this zoning ordinance has effect to the flow of freight traffic as many transport operators would be pushed and encouraged to form a partnership with other companies in order to deliver their goods to the customers located the third zone (zone urbaine verte).

4.6.3 CDS and its potential to respond to the problem in the CBD

The issue at hand now is how to improve the current city distribution of freight with reference to sustainable urban freight transport. Throughout the discussion of the development of measures, it appears that the city administrators are aggressively pursuing access restriction measure to safeguard the city's physical environment and to minimize the contact between freight transport activities and the city's citizens.

Obviously, the congestion level is extremely high at the inner part of the city (or central business district) and it decreases remarkably as the distance is getting bigger away from the city center (Figure 4-2). Congestion is borne out of the idea that too many vehicles are operating in too small area. This problem, congestion, then becomes the source of several problems in urban areas such as environmental pollution, safety risk among others. It appears therefore that reduction of the volume of vehicles granted access to the city is the most promising solution.

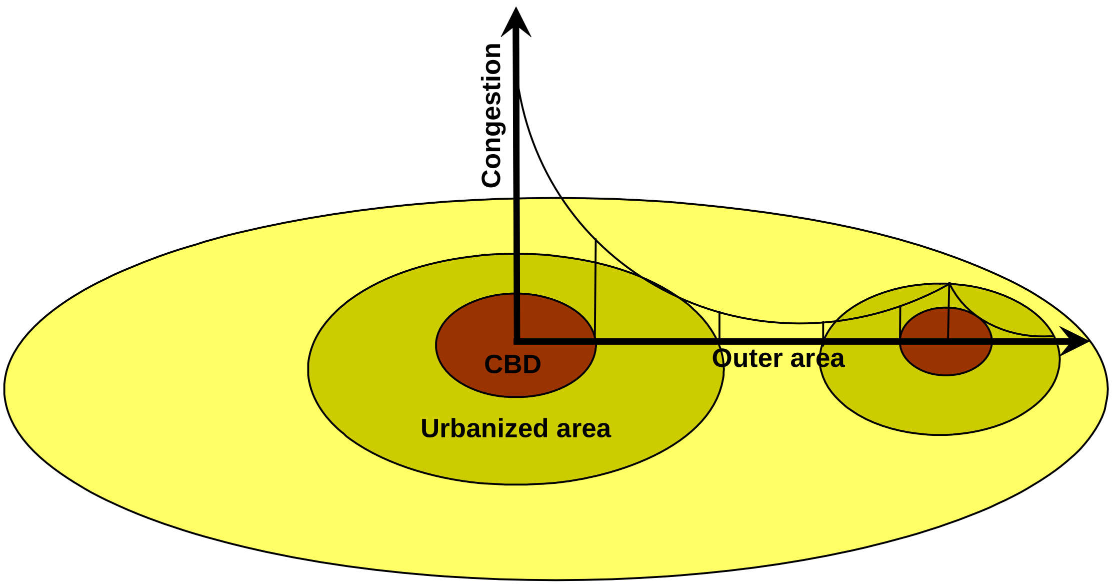


Figure 4-2. Congestion level at the CBD

4.7 Concept and Components of Cooperative Delivery System (CDS)

The idea behind conceptualization of CDS is to improve the freight distribution thorough consolidation of loads. This means that the aim is to reduce the negative externalities of trucks (air pollution, vibration, noise pollution, etc) to the residents and physical environment of the city. Goods destined for city centres are diverted into common transshipment facilities (depot) with local distribution being carried out using specialized vehicles which may be smaller, quieter and less polluting (Figure 4-3). This delivery method could result to the reduction of vehicle kilometers, reduction of delivery time, reduction of the number of trucks, reduction of environmental emissions, and reduction of transportation cost.

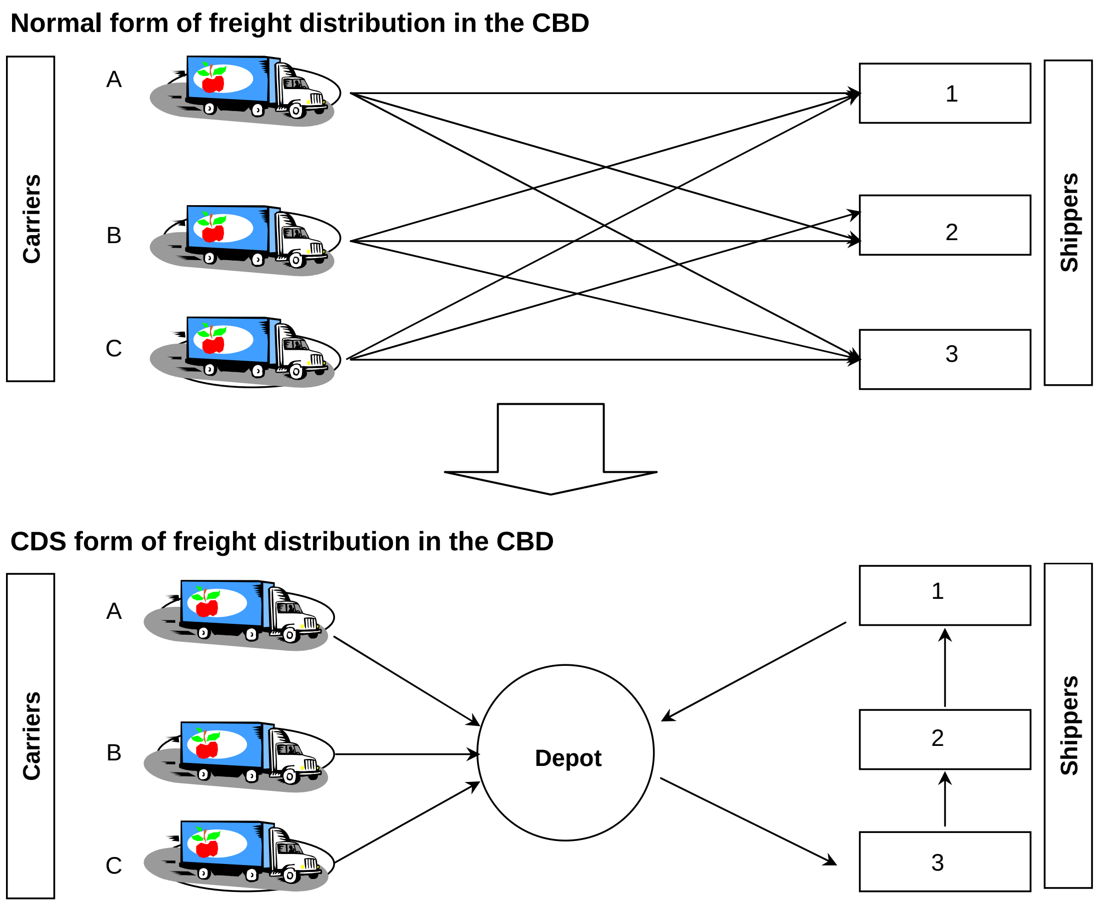


Figure 4-3. Freight distribution in the CBD with and without CDS

As mentioned, the current trend in urban management highlights the significance of cooperative delivery system as a measure that could serve the goods to the urban centers with less harm both to the physical structure of the city and environment. The key element of this trend is the desire of city authorities to reduce number of freight traffic to the city especially in areas with large number of pedestrians and/or with historical significance.

The fact that bulk of freight that enter urban areas are usually concentrated in small highly dense places offers great opportunity to organize the goods traffic through cooperative scheme. City Freight (2002) confirms that the distribution of urban goods is not organized efficiently and that there is considerable scope for reducing urban goods traffic (vehicle-km) through coordination and consolidation of transport. This is because restaurants, shops, offices and other commercial functions are normally located in one small area that are served by different carriers.

The effect of cooperative scheme is the consolidation of goods to be distributed and/or collected by different transport operators or supplies. Consolidation reduces the number of vehicles needed for delivering the same amount of goods and thus improves cost-efficiency of transport companies and reduces environmental impact. The consolidation of goods may be organized in a number of ways. Among these are transport companies reach a mutual agreement on the consolidation arrangements, or a third party operator carries out collection of goods from different suppliers and later takes care of consolidation in its own distribution centre for distribution.

Another appeal of cooperative delivery system aside from those mentioned above is that it can be virtually applied to every city. Although sophisticated ICT could enhance the management of the operation, it is not a pre-requisite to its implementation. This element of cooperative system allows cities with limited ICT hardware (e.g. cities in developing countries) to adopt the system.

i) Urban distribution center (UDC) and depot as consolidation center

UDC and depot as mentioned are essential component of a CDS since it is at this facility where the consolidation of goods is made. Figure 4-4 illustrates the freight distribution system and the location of UDC for city goods. Normally, the distribution center is located outside the city (see distribution center of Tokyo in Chapter 3) in view of limiting the number of trucks in the city. This location of the facility however should have good access road leading to the main road to the city. Goods are organized at the distribution center where packages for the same destination are bundled together.

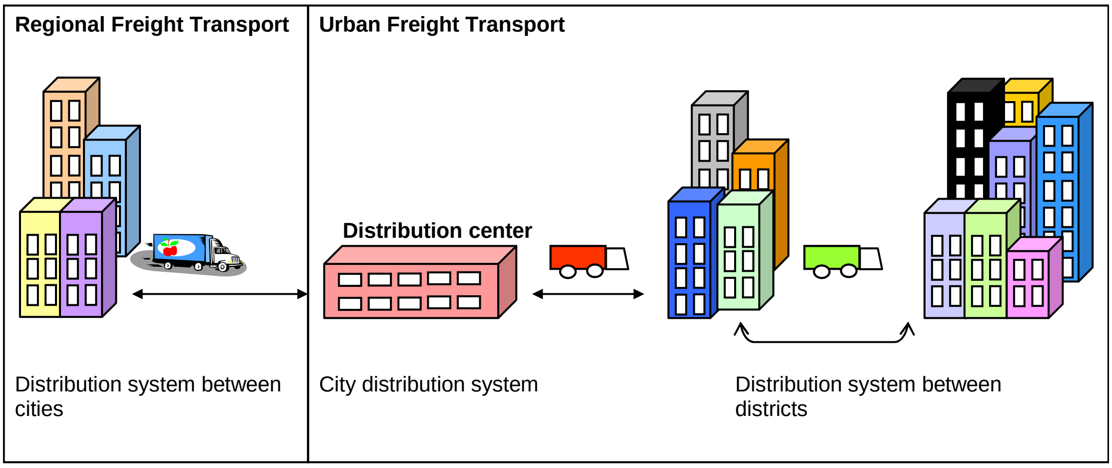


Figure 4-4. Freight distribution system and location of the depot

Regarding the goods for district distribution, the depot should be located at the border of the district (Figure 4-5). The objective is still to limit the number and movement of trucks in the district to minimize its negative impact. A single depot might serve part of the CBD and another depot to other parts of the CBD. Suitable location and number of depot per CBD depends on many factors such as the size of the CBD, its building density and building use.

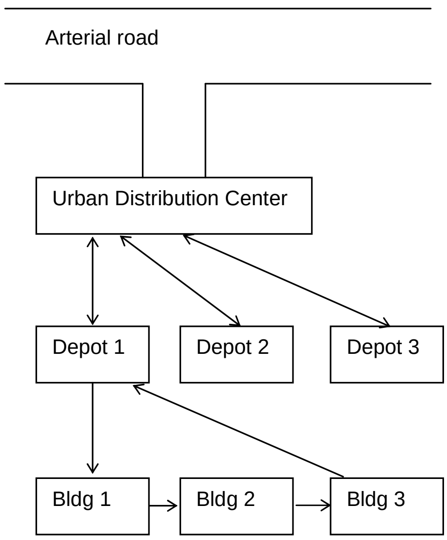


Figure 4-5. UDC and depot

4.7.1 Cooperative delivery system (CDS) as transport instrument

ii) Objectives of CDS

At the beginning of the development of cooperative system, public sector appears to be the initiator for such undertaking as a means to improve city's traffic flow and protect the quality of life of residents. For instances, the Tenjin Cooperative System in Fukouka was originally promoted by the Local Office of the Japanese Ministry of Transport to rationalize movement of trucks and reduce the traffic and environmental impacts in the city (Ieda et al, 2001). Recent trends, however, suggest that companies are becoming more sensitive to the protection of environment as market advantage (also called "social reputation"). They try to enhance their standing as responsible companies regarded as mature and reliable. The following objectives (i.e. reduce traffic congestion, environmental improvement, urban planning and city protection, cost reduction, and improved social reputation) thus might serve as key driver for the implementation of cooperative system.

Reduce traffic congestion

Cooperative system is capable of satisfying both the interest of private and public sector as shown by the study conducted by Taniguchi *et. al.* (1995). The study uses a questionnaire survey which identified that the main benefits of co-operative systems were the cost reduction for shippers and freight carriers. Many companies have enjoyed both cost reduction and the provision of better services to customers after implementing co-operative systems. In addition, a reduced number of trucks will be used and the total travel time of trucks will also be reduced in co-operative systems.

Environmental improvement

Both traffic congestion and environmental impacts are strongly influenced by travel times and speed, which depend on traffic flow (Taniguchi et al, 1999). Taniguchi et al. (1999) analyzed the effect of co-operative systems on CO_2 emissions within small road network using dynamic traffic simulation. They found that co-operative systems substantially contributed toward ensuring that CO_2 emissions remained at the same level as the base case for pick up/ delivery trucks when the demand for goods doubles.

Urban planning and city protection

Although originally, the target of setting up cooperative systems is to reduce the number of freight vehicle operating in the area as a means to decrease traffic congestion, recently there has been a growing recognition of the benefit of cooperative systems as urban management tool. Reduction of the consumption of urban space for transport infrastructures and delivery points can be achieved through this system. This system's effect would increase the accessibility of the city making it attractive for business.

For some cases, cooperative system can play a role to preserve a historic part of the city by deliberately avoiding the sensitive place during the planning process. This would enhance the image of the companies involved among the residents as responsible and sensitive to the negative externalities caused by freight transport.

Cost reduction

Taniguchi et al (1995) using survey questionnaire survey identified that the main benefits of cooperative systems were the cost reduction for shippers and freight carriers. Most companies enjoyed both cost reduction and provision of better services to customers after implementing cooperative systems.

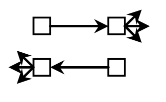
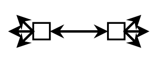
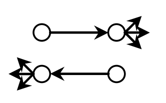
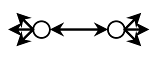
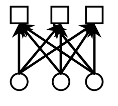
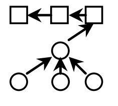
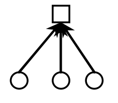
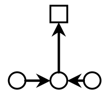
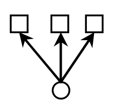
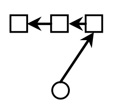
Enhance social reputation

Reductions in environmental impacts generate double dividend. Companies benefit from reduce costs and an improved competitive position. They will be more attractive to customers eager to buy “green” products and services (Good practice in freight transport, 2000).

iii) Different models of cooperative delivery system and its application

There are many terminologies used to describe cooperative system; among them are cooperative freight transport system (CFTS) and voluntary cooperation. Yamada *et al* (1999) gives a clear definition of CFTS as systems in which a number of shippers or carriers jointly operate freight vehicles to reduce their costs for collecting and delivering goods and provide higher levels of service to their customers. Castro (2002) on one hand stated that cooperative delivery is concerned with the promotion of change in the form of urban delivery, from independent private transport to consolidated transport using public carriers.

In essence, cooperative system is attained when two or more companies (either shippers or carriers) pool their resources and start coordinating their operation. Kuse (1999) provided what appears to be extensive list of cooperation delivery system models among the stakeholders in freight transport (Figure 4-6).

Type	Before Application	After Application	Remarks
Consolidated transport between shippers (Multiple shippers)			Mutual cooperation among shippers resulting to consolidated transport
Consolidated transport between carriers (Multiple carriers)			Mutual cooperation among carriers resulting to consolidated transport
Cooperative delivery (Multiple shippers, multiple carrier)			Shipments are consolidated at a distribution center, then delivered cooperatively to several outlets by routing
Cooperative delivery (Single shippers, multiple carrier)			Individual shipments are delivered to a designated carrier, which then performs consolidated delivery
Cooperative delivery (Multiple shippers, single carrier)			Carrier performs cooperative delivery to several outlets by routing

□ **Shippers**
○ **Carrier**

FIGURE 4-6. Different models of cooperative system

iv) Different types of design of cooperative delivery system

There are three ways to design a cooperative delivery system namely; horizontal cooperative delivery system, vertical cooperative system, and combination of vertical and cooperative delivery system. Under the first design, trucks of different sizes and loads have to bring their cargoes to the stock point (SP) or depot for consolidation (Figure 4-7). Small trucks, normally non-polluting vehicles, will complete the delivery going to the customers. At the (off) loading area of the building, the driver would unload goods and deliver them to the recipients. Usual practices of cooperative delivery system follow certain time interval for delivery and assigned regular route. For instance, the Shinjuku Matenro cooperative has two delivery time in the morning (10:00 and 11:30) and one (13:50) in the afternoon and the route has been prepared to easily trace the delivery vehicles.

Vertical cooperative delivery system on the hand entails to assigning of staff at high rise buildings or establishment with high number of goods attracted. When the delivery trucks arrived, the staff would unload the goods and delivery them to the recipients. Under this system, trucks arrived without fix frequency and the goods are not consolidate due to the absent of Stock point where the consolidation can take place (Figure 4-8).

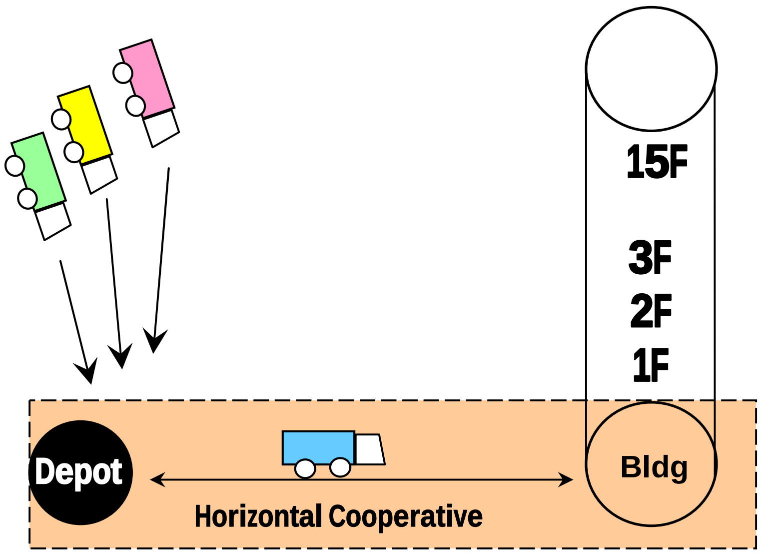


Figure 4-7. Design of Horizontal CDS

The third design of cooperative delivery system which is the combination of horizontal and vertical cooperative system combined the functions of two systems resulting to comprehensive delivery system that has strong impact both on traffic and environment. Under this system, staff are usually stationed at each building covered by the joint delivery (Figure 4-9). The task of the staff is to free the driver from the difficulty of delivering goods going to the recipients. Instead, the staff would replace this role from the driver. After the truck docked-in at the (off) loading area of the building, the staff would unload the goods and the driver could move immediately to the next delivery destination. This procedure allows limited parking time of the truck and the delivery is faster. The familiarity of the staff to the layout of the building contributes to speedy delivery. The cooperative delivery system that was adopted in Marunouchi district falls under the second category of design of cooperative.

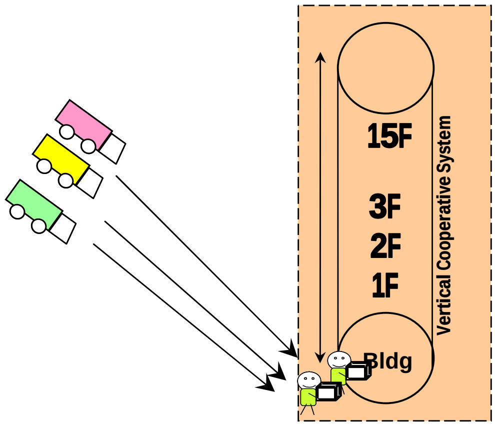


Figure 4-8. Design of Vertical CDS

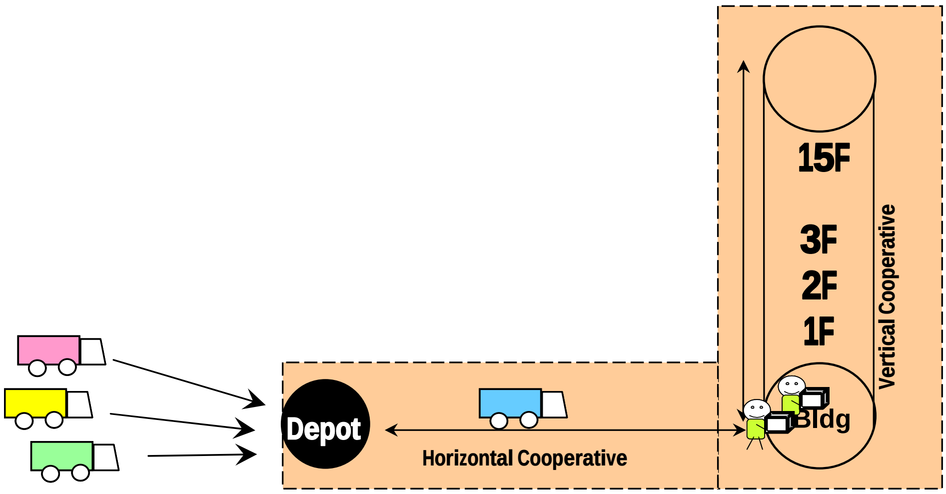


Figure 4-9. Design of combination of Horizontal and Vertical CDS

4.7.2 Freight centers and its role in the CDS

The idea behind its development is twofold: 1) to facilitate logistic activities with location, space (e.g. storage) and transport facilities (transshipment), and 2) to consolidate goods flows by developing certain transport services (Visser et a, 1999). The first idea deals with the facilitation of logistic activities aims at realizing synergies by concentrating business activities, whether from single company or between several companies (BESTFUST, 200). The second idea is to consolidate goods flow aims at increasing the efficiency of the collection or distribution process, thereby reducing the environmental impact of urban delivery activities.

The first freight centers in Europe were established in Paris during the mid 1960s in response to urban congestion. Urban distribution centers (a type of consolidation center) were developed in the UK and later in the Netherlands and Monaco (City Freight, 2002). Handful of countries included the development of freight centers in their national policies. Italy was the first in 1990, followed by Germany in 1992 and France in 1993. Japan as mentioned in Chapter 3 has produced a master plan in 1969 that identify the location of urban distribution centers for Tokyo Metropolitan Area and currently, five facilities exist (Table 4-4).

Table 4-4. Existing public distribution facilities in Tokyo Metropolitan Region

Distribution center	Land Area (ha)	Handling capacity (tons/day)
Adachi, Tokyo	33.3	8,335
Itabashi, Tokyo	31.4	7,262
Keihin, Tokyo	62.9	10,150
Kasai, Tokyo	49.2	7,964
Koshigaya, Saitama	73.2	-

Source: Castro et al, 1999

i) Freight centers classifications

The concept of freight centers is very different among countries and has given many different names. Some of most frequently use terms are clarified: Freight platform, Urban Distribution Center (UDC), Freight Village and City logistics.

Freight platform

BESTUFS quoted REFORM (1999) that freight platform can be defined as areas in which different transport related companies such as forwarders, logistic service providers etc, are established. It is a transshipment area where, ideally, at least two transport modes are connected. Usually these transport modes consist of road and rail, but waterborne and air transport can also be integrated. The concentration of transport related companies inside a freight platform promotes synergies and primary effects, if the process of integration is planned and enforced in co-operation with all the companies and with involved local authorities.

Table 4-5. Classification of freight platforms (BESTUFS, 2002)

	Terminal development		Area development			
	Intra-company synergies	Inter-company synergies	Transport oriented	Transport + other	Industrial + some transport	Port related
	Single-company Urban Distribution Center	Multi-company Urban Distribution Center	Freight village	Industrial and logistic park	Business grouping development	Special logistic area
Transport mode	Road-road Road-rail	Road-road Road-rail	Road-road Road-rail-(bridge)	Road-road Road-rail	Road-road	Road-sea/air Road-rail-sea/air
Main aims	Optimization logistic operations	Optimization logistic operations, urban traffic reduction	Modal shift, urban traffic reduction	Regional economic growth, modal shift	Revitalizing small and medium sized firms	Regional economic growth
Company structure	One single huge forwarder, retailer or transport company	Co-operating transport companies	Mostly small companies	Large industrial companies and transport companies	Wholesalers and transport companies	International oriental companies
Land use	Small areas in urban areas or in the outskirts	Small areas in urban areas or in the outskirts	Large areas in the outskirts	Large areas in the outskirts or at the old industrial areas	Large areas in the outskirts	Near airports and harbors
Spatial orientation	urban	urban	Urban and regional	Regional and international	Urban and regional	international

In short, a freight platform integrates on concentrated area modes, carriers and service related to logistics and freight transport (Table 4-5).

Urban distribution centre

According COST 321 (1998), an Urban Distribution Center (UDC) is a place of transshipment from long distance traffic to short distance (urban) traffic where the consignments can be sorted and bundled. Its main purpose is to achieve a high degree of collection in the goods flows in order to supply efficient transport from the UDC to the city centre and vice versa. (Van Duin 1995). It is this focus on distribution efficiency and its city orientation that separates the UDC from other freight platforms. Therefore, UDCs are sometimes also referred to as city terminals or urban consolidation centers. They can be stand-alone platforms of a singles forwarded or an element in the logistic chain of huge companies. More common however is the integration into logistic urban network. Connected to freight villages in the outskirts, they are used as central urban, multi-company consolidation centers. (REFORM 1999)

City logistics

Eisele et al. (2000) describes City Logistics as: "all coordinated measures comprising logistic collection and delivery activities of logistic service providers in urban areas that aims at the reduction or prevention of commercial traffic and its negative external effects". However, the notion of City Logistics differs a lot between countries. This quite narrow notion of City Logistics is rather common in Germany whereas particularly in the English language areas city logistics is a rather generic term that includes much more than bundling of deliveries or a UDC.

Freight village

Freight village generally focus on bi- or multimodal transport. The distinguishing element of these platforms is the transshipment terminal. Service providers are established on site, as well as large number of forwarders and transport companies. (REFORM 199) Actually freight villages are areas with several terminals (Visser et al. 1999) which can even include and Urban Distribution Center when located close to city borders, interfacing with long distance transport and city distribution services. On the other hand, some freight villages are used as transshipment points on a European scale. In Germany and Italy, freight villages are known as Guterverkehrszentren (GVZ) and Interporti respectively. (REFORM 1999)

ii) Operational models of freight centers

Freight center operations are also different among the countries. Dablanc (1998) classified three general models of freight centers: 1) Monaco model wherein the government owns the facility and contracts the operation of freight distribution to a single transport company, 2) Dutch model wherein licenses are given below by authorities to operators who meet certain criteria to deliver goods in the city, and 3) German model which is a private carrier initiative to consolidate freight and distribute it cooperatively (Figure 4-10). The BESTUFS (2002) study quoting the report of Ministere de l'Equipment (2002) clarify the different models.

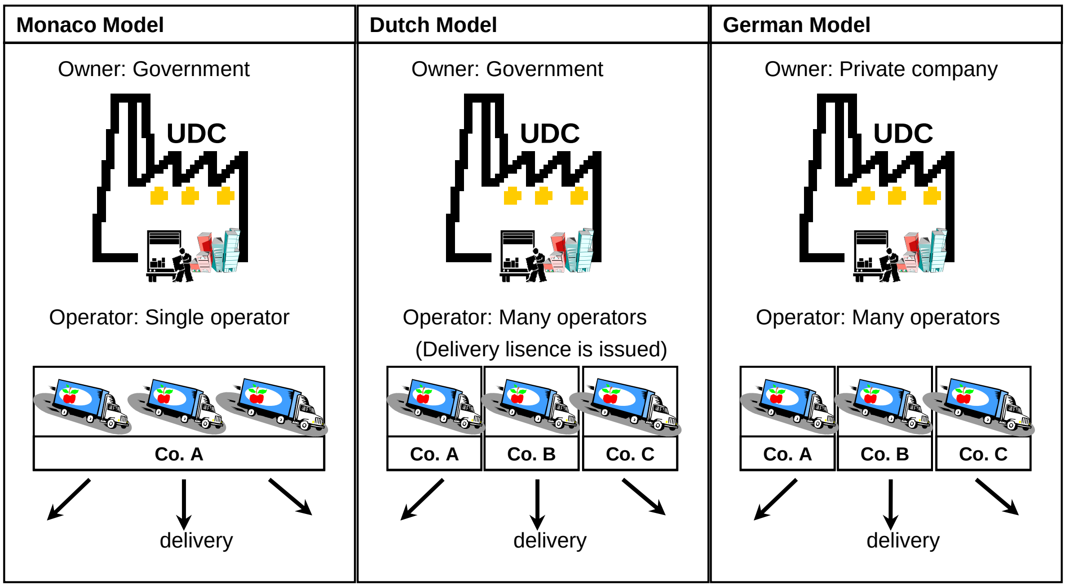


Figure 4-10. Types of Urban Distribution Centers

In Monaco, the UDC is owned and operated by the government. In 1989, the government contracted out the operation of freight distribution to a single carrier (a regional transport company). This sub-contractor was given a monopoly over all the municipal depot. Added to this was a partial monopoly on the delivery of goods. All trucks over a GVWR of 9 tons (this limit should be lowered to 3.5) are banned from the city of Monte Carlo. If they are to deliver goods to client there, they have to go to local freight platform and unload first. The municipal service then takes the final distribution in charge, with specific vehicles. The costs of the service are shared between the municipality, which give financial aid and free warehouse space to the vehicles, and finally the retailers who supposedly pay for the amount of goods they receive through the service (Ministere de l'Equipment, 2002).

Following a national program of energy reduction in cities, the Dutch cities setup a system for urban freight distribution licenses. Strict operating regulations are imposed on operating licensees in exchange for an extended usage of street space and longer delivery hours. Applicant carriers must respect a list of criteria such as good level of truck loading, minimum number of shipments and the use of electric vehicles. This kind of municipal organization can lead to quasi-monopoly of distribution where a very limited number of registered carriers dominate the market of urban distribution. (Ministere de l'Equipment, 2002).

In Germany, at carriers' own initiative, a private service of goods distribution is set up with the help of the locality. Different carriers join together to consolidate freight and distribute it cooperatively. The system provides addition kinds of services, such as home deliveries, collect and recycle service or short time storage. Government support can take the form of the distribution of an official "City Logistik label" on trucks and warehouses. Governments can also participate in the financing of the system (Ministere de l'Equipment, 2002).

After having reviewed different models of UDC, it appears that they can be classified into four categories. These categories are 1) pubic sector funded UDC for single user,

2) public sector funded UDC for multiple users, 3) private sector funded UDC for single user and 4) private sector funded UDC for multiple users (Table 4-6).

Table 4-6. Urban distribution center models

		Provider of infrastructure	
		Public sector	Private sector
User	Single	1) Monaco model	
	Multiple	1) Dutch model 2) UDC of Metropolitan Tokyo 3) Bangkok freight terminals	1) German model 2) Tenjin CDS in Fukouka

iii) Issues and concerns regarding freight centers

Although the idea of freight centers is very interesting in particular to the concept of improving the efficiency of freight traffic through consolidation, there were some reported setbacks to this scheme. A handful number of freight center in the Netherlands, France, and Germany has been terminated for commercial reason and to some extent, lack of sufficient support by public policy. Financial difficulty is one of the most reported cases to the limited success of distribution centers (Ieda et al 2001, COST 321 1999). The following summary of issues regarding freight centers are compiled by BESTUFS which were taken from the results of several researches.

- Lack of economic interest (interruption of the transport chain at the distribution center causes additional costs that are not offset by a corresponding gain in efficiency).
- Lack of willingness to cooperate because of fierce competition (fear of disclosing competitive information about order quantities, products, customers, know-how, etc., fear of losing customers to their competitors).
- Reluctant to relinquish control over merchandise and transport chain, particularly the responsibility for the goods transported.
- Loss of direct contact between the receiver and the delivering company (the act of delivering offers and opportunity for the transport company to promote itself and to establish a customer relationship – it is the company's "business cars").
- Many companies give much higher priority to customer service and competitive advantage than to reduced transport cost.
- Reduced need for multi-company consolidation because of the general concentration process in the transport business (for large retail companies with their own distribution network the benefit of multi-company consolidation is rather small).

4.8 Chapter summary

There are many policy goals that can be pursued to design freight transport measures. Objectives such as economic and efficiency calls for sufficient freight infrastructure that could facilitate the smooth movement of goods especially in the city centers. Environment and safety objectives, on the other hand, dominate policy formulation process nowadays as the deterioration of urban environment is largely blamed to freight transport. Infrastructure and urban structure objectives are also starting to appear and influence measures concerning freight operation. Italy having blessed for a number of old cities are pulling every measure available such as access restriction to preserve these heritage. More so, Paris recently found out that their freight infrastructure (loading bays) are not being taken care by the users thus new measures were taken to safeguard these bays. Clearly, the objectives are very diverse and one measure could hardly meet one or two objectives. In the ideal settings, mixed policy measure has the strongest effect and best potential to serve great number of freight transport objectives.

Congestion and negative impact of freight transport to the environment still continue to be the key drivers of policy interventions as shown by the study done by Lewis (1997). Interestingly, there is a wide array of available measures to improve the current status of freight distribution ranging from infrastructure-based measures to TMD-bases measures. Freight center is one these measures that have enormous impact to the flow of traffic in the city. This facility is very important as it can serve as platform to conduct cooperative delivery among the different carriers. It's scale guarantee enough space where goods could be stored and organized. The existing freight centers discussed above are operated is quite different ways. The differences can be traced to what role the government played in each of them. For instance, facilities in Monaco and the Netherlands (the project has been terminated) are provided by the government while freight centers in Germany are sole initiatives of private sector.

The concept of freight centers is fascinating but is not always successful. For instance, many local governments in France are having difficulty in operating the center for the reason that it is not financially viable due to small number of companies using it as staging point before distributing the freight to the city. This rather lack of interest from the private sector is wide-scope in nature that involves financial, operational, customer relation issues. According to some companies, the idea that they have to bring their goods to the freight center creates additional operating cost while some companies claims that this system will limit their in-person contact with their customers. This issue is both complicated and motivating that further research is needed.

As the chapter advances, the idea that cooperative delivery system is perhaps the most powerful TDM measure to reduce substantially the negative impact of freight distribution is rationalized. The nucleus of the problem is located at the heart of the city where too many vehicles are operating in a very small area. Reducing the number of freight vehicles without reducing the number of freight suppose to arrive would bring enormous improvement to the urban environment. This idea can best fulfill by adopting cooperative delivery system where different logistics operators are surrendering part of management of their goods so it can be consolidate with other cargoes before bringing in into the city center.

The issue at hand appears to be sustainable urban freight transport which aims to reduce social and environmental impact of freight distribution. Again, cooperative delivery system can contribute significantly to the realization of this long term goal. Sustainable urban freight transportation is an ultimate goal that involves lot of strategies to be achieved. For instance, it calls for the reduction of impact of each mode through cleaner engines, cleaner fuels, efficient driving, shift of regular trucks to non-polluting trucks, reduction of number of vehicles in the city, and cooperative operation between shippers and carriers.

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CHAPTER 5

Trends and Recent Developments of Central Business Districts in the world

5.1 Introduction

The previous three chapters (2, 3, and 4) provided significant information to the problems and current trends that shape urban freight distribution. The focus area of this study which the CBD and the logistic issues it faces have been well rationed to be caused by management of trucks. Policy responses of the governments to the said problems were also drawn. The potential of CDS to respond to this problem was also given weight in Chapter 4.

The main objective of this chapter is to characterize the CBD in developing and developed countries and define the areas within the CBD where the CDS may be adopted. Section 5.2 provides the definition of CBD and its typical characteristics. Further discussions on the characteristics of CBD are available in Section 5.3. These discussions compare the characteristics of CBDs in developing and developed Asian cities and some CBDs in Europe and US. The following Section 5.4 presents classification of CBDs as well as some examples for each classification. The chapter concluded in Section 5.5 where all the highlights of the chapter are noted.

5.2 Central Business District

5.2.1 Early theories

Although this research is not intended to analyze CBD itself, this section is important as it provide contextual background on the target area of CDS. Various names are use to refer CBD which includes “central commercial district”, “retail business section”, “downtown business district” , “central business district” and several others. Even “urban core” or “core” are sometimes used to pertain to CBD or the central area of the city. Murphy (1971) provided a compact background on grasping the fundamental functions of CBD as well as on how to delimit its area.

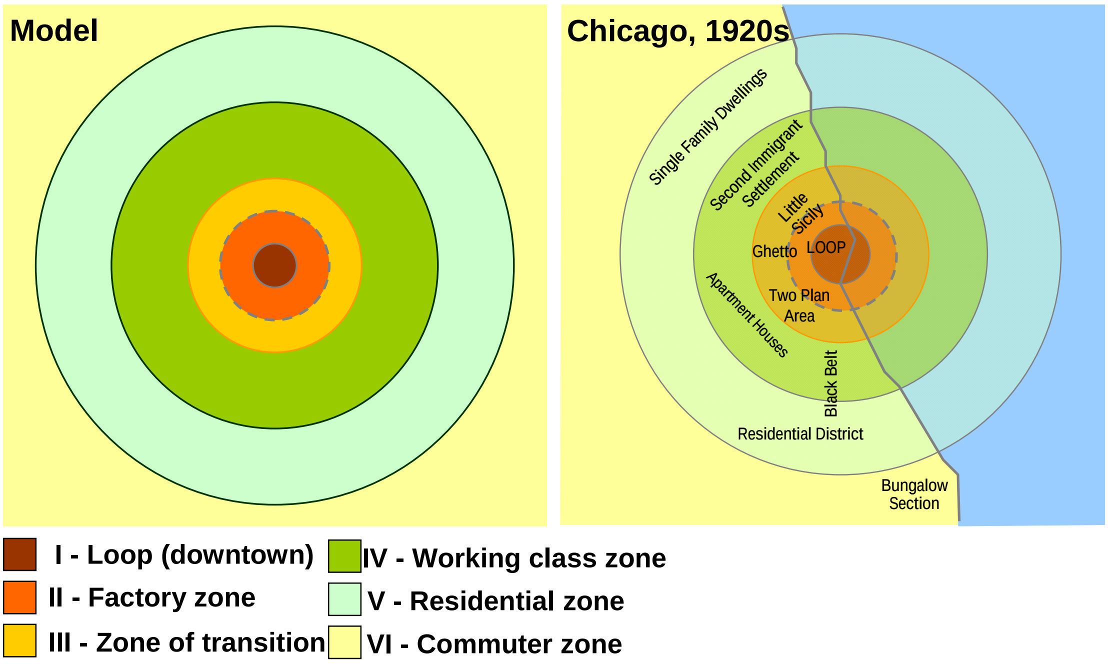

Figure 5-1. Central business district's model of Burgess
Source: http://people.hofstra.edu/geotrans/eng/media.html

Early efforts regarding CBD focus on defining CBD and its delimitation. Burgess (1929), as quoted by Murphy (1977), forwarded the theory that CBD can be one of the six concentric zones of American city (Figure 5-1). He organize the city structure as 1) CBD, 2) factory zone, 3) zone in transition, 4) zone of workingmen's homes, 5) residential zone, and 6) commuters' zone. Burgess has this to say on CBD:

"The Central Business District – At the center of the city as the focus of its commercial, social, and civic life is situated the Central Business District. The heart of this district is the downtown retail district with its department stores, its smart shops, its office buildings, its clubs, its banks, its hotels, its theaters, its museums, and its headquarters of economic, social and civic , and political life".

In the end, the effect of land pricing or rent and the influence of major transportation routes on the pattern of urban growth are reflected in the work of Homer (1939). He argued that as a city grew, competition for land at the center of the city resulted in land values so high that only business could afford the land and the result is the CBD. This growth of land values or rent gradually spread from the center outward of the city. But instead of the rise taking place along a broad circular front, it occurs along main transportation routes.

Another theory explaining the role of multiple nuclei in city growth instead of growth around a single CBD core as in the concentric zone and sector theories (Figure 5-2). This concept is reported by R.D. McKenzie but known especially through the articulation works of C.D. Harris and E.L. Ullman. Contrary to the two theories, multiple nuclei suggest that an urban area may have more than one center and that a new centers of activities or sub-nuclei may be develop within existing nuclei.

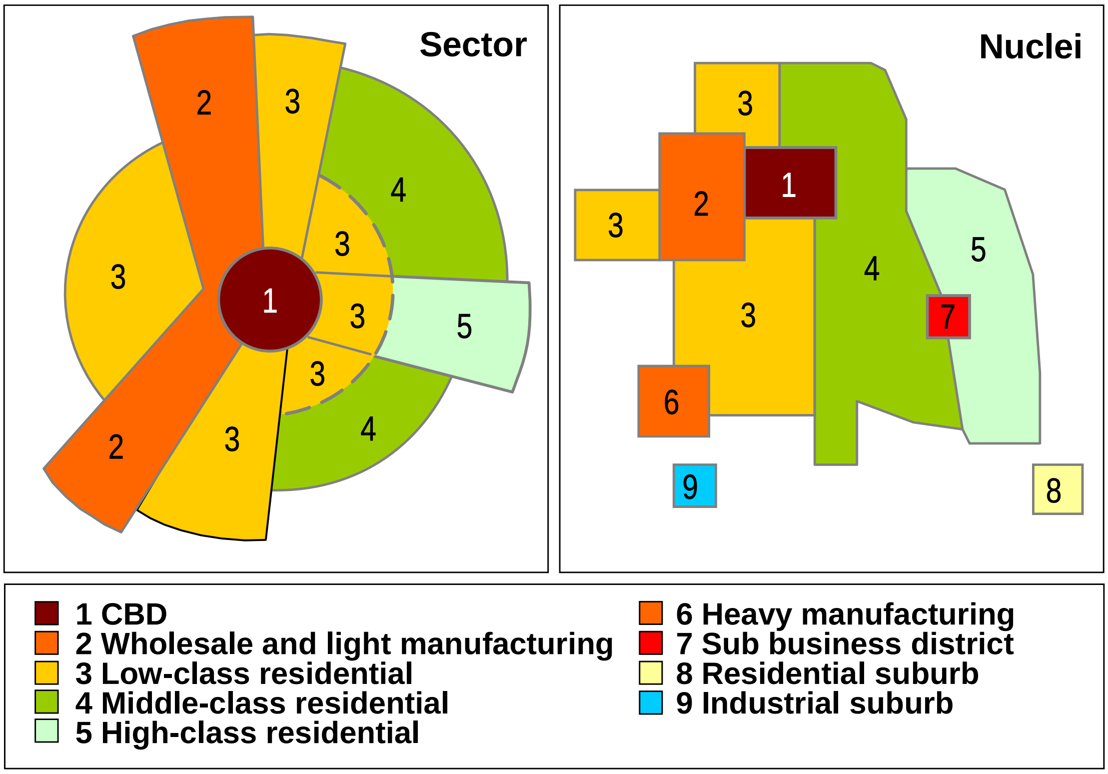

Figure 5-2. Sector and Nuclei Models
Source: http://people.hofstra.edu/geotrans/eng/media.html

Still, another group of researchers tries to tackle CBD in the framework of central-place theory. The idea in this concept is that CBD is only one of the central places that can be recognized within an urban center. Proudfoot (1937) suggested a hierarchical arrangement of retail areas within the city. His work arrived to the following classification: 1) CBD, 2) outlying business center, 3) principal business thoroughfare, 4) neighborhood business street, and 5) isolated store cluster. This classification suggests a hierarchical arrangement within the city. Later, Hans Carol as quoted by Murphy applied the central-place hierarchy idea to the city of Zurich, Switzerland. His classification are: 1) local business district (lowest order), 2) neighborhood business district (low order), 3) regional business district (middle order), and 4) CBD (high order).

Each theory mentioned offers perspective of the CBD. In the beginning, the centrality of the CBD was emphasized before other elements such as the impact of land value (rent) and transportation to the settlement were appreciated. The multi-nuclei theory made a dramatic shift from single-concentric view given to a CBD by recognizing the possibility of having many centers within a city. These theories provided basic foundation to advance understanding of CBD to early researchers. Murphy (1977) has this to say on CBD:

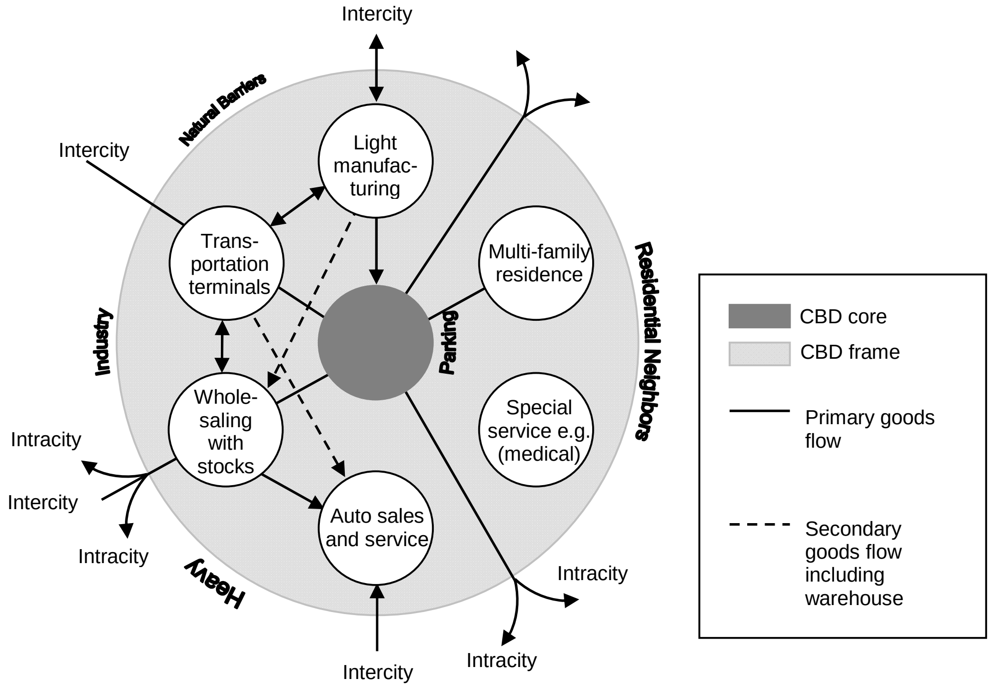

Figure 5-3. Graphic representation of Horwood and Boyce's CBD core-frame differentiation with selected functional centers and principle goods flow
Source: The Central Business District, Murphy (1977)

"The CBD being in the highest order functions at the highest level among these business areas. It is able to offer goods and services superior to those of any business area of lesser order. And, as the city's top-ranking central place, the CBD occupies the location of prime accessibility while other business centers are relegated to less advantageous locations. The CBD is characterized by a concentration of those establishments that need maximum accessibility to the entire city and its tributary areas. Thus, it attracts specialized retailing, large-scale banking, advanced medical services and other functions so unusual that people come from all parts of the urban area and even from smaller, neighboring cities to take advantage of them. In total, the CBD offers a much greater number and variety of goods and service than any other of the city's business areas."

The Core-Frame Concept of Horwood and Boyce (1959) add another element that further isolates the area and services at CBD (Figure 5-3). In their concept, the "core" and "frame" constitute the CBD. At the "core" is where the greatest concentration of economic and social activities while at the"frame" is where different social services might occur. There would be movement of people and goods, though limited, among the services that would be within the "frame". The authors also pointed out that the growth of the area is up-ward and its growth horizontally would be very limited. Reading the Core-Frame Concept brings the images of CBDs that grow horizontally such as Hong Kong, Singapore and Manhattan of New York.

Aside from the work of Murphy, another notable work regarding CBD is produced by Kuse (1980). His work has comprehensive discussion to the effort of past researchers and came up with his own parameters that would be vital in understating CBD. These are: 1) Accessibility, 2) Rent value, 3) City activity, and 4) Land use. And lately, there are scores of CBD-related researches. Some of the new researches with some important contribution are those of Kenworhty and Laube (1999) which drew comprehensive list of CBDs around the world and their basic characteristics, Curtis (1993) which provides illustration of land use patterns in the CBD, Hartshorn (1992) which gives some methods in delimiting the CBD, and to least extent Lewis (1992) which highlights issues in small downtowns.

5.2.2 Defining CBD

The above discussion highlights the difficulty of producing single description of CBD in view of its different forms and functions around the world. One of the common features of each theory, though, is the appreciation to the CBD as the premier commercial region of the city. It is the area which normally has the greater concentration of the tall buildings than any other region of the city. The following characteristics can often be found in any CBD.

- It has a distinct land use pattern that can be delimited from the rest of the settlement.
- It is the geographical centre of the settlement.
- It contains the settlement's main public buildings.
- It contains the major retail outlets
- Similar activities within it are concentrated in certain areas (functional zoning).
- It features vertical zoning.
- It has the greatest concentration and number of pedestrians and traffic in general.
- It is a focal point for transport.
- It contains the greatest proportion of the settlement's offices.
- It has the tallest buildings in the region to maximimise land use.
- It has the highest land values of the region.
- It attracts people from outside its sphere of influence to work and spend money inside.
- It is advancing into new areas (assimilation) and/or losing old commercial functions (discard).

5.2.3 CBD and the role of CDS

CBD holds many institutions, financial and commercial. Figure 5-4 illustrates typical type of CDS in CBD. The depot which serves as consolidation center of goods is just outside at the core area of the CBD. The idea is to locate the depot closer to the building destinations of goods to minimize travel distance of trucks thus its negative impact , i.e. emissions, vibrations, etc., is limited.

In a large CBD, it is ideal to have several depots to ensure the closeness of these facilities to the buildings where the goods will be delivered. A single large depot for CDS might be difficult to realize because it is rare to find vacant space large enough for the facility. Also, as mentioned, this would result for a long route for every truck which would result to accumulation of substantial travel distance and travel time of trucks in the CBD.

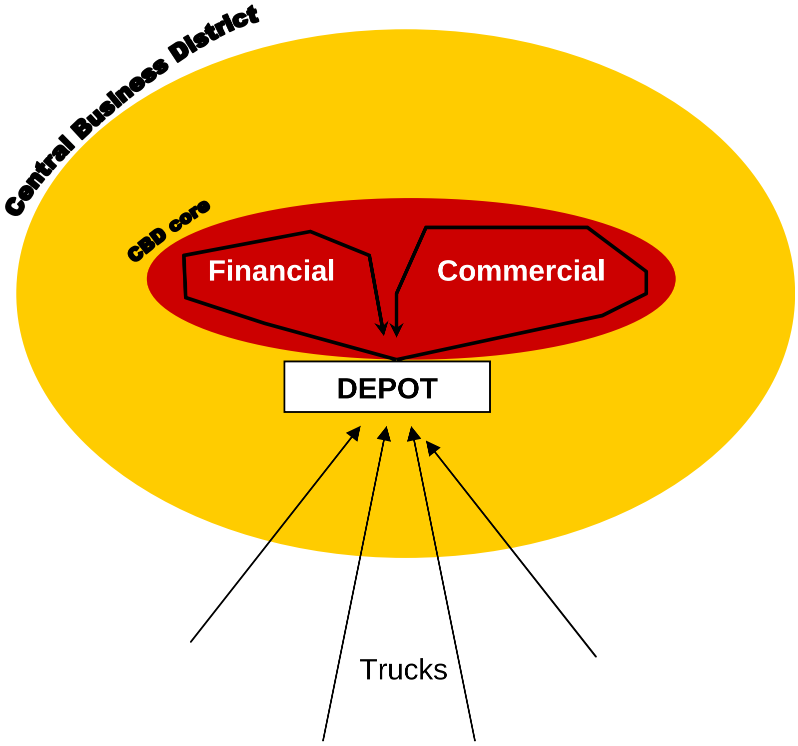

Figure 5-4. Illustration of CBD functions and depot of CDS

5.3 CBD and freight transport

The CBD is normally just very small part of the city but has the highest building and job density (Figure 5-1). For instance, the CBD of New York occupies just 0.30% of the city's total land area but hosts around 22% jobs of the city. One observation that can be deduced in the same table is that those CDBs in developing countries have bigger land area ratio as compared to those in developed countries. This issue along with other important parameters of the CBD is discussed below.

5.3.1 CBD characteristics

i) CBD's common forms and functions

The pattern of CBD is obviously different from one to another which was the result of its long history, economic development, and policies pursued by local authorities. For instance, the core CBD of London and Paris is famous for its 3 to 4-story buildings projecting a unified height when viewed above. At the beginning, legislation in these cities tried to control building height for safety purposes from overcrowded city. In contrast, Manhattan of New York, Shinjuku of Tokyo, CBD of Singapore, and Hong Kong have adopted a policy which promotes the construction of high rise buildings. These two different patterns of growth is often referred as horizontal (the land area covered by the CBD keeps on expanding) and vertical growth (growth of the CBD is upward like Hong Kong and Singapore). Figure 5-5 shows these contrasting figures of core CBD of Paris and Manhattan of New York.

Table 5-1. CBD and transport variables

	Developing Asian cities				Developed Asian cities			European and American cities		
	Bangkok	Jakarta	Kuala Lumpur	Manila	Hong Kong	Singapore	Tokyo	London	Paris	New York
GRP/capita (US$)	3,826	1,508	4,066	1,099	14,101	12,939	36,953	22,215	33,609	28,703
Population	6,356,685	8,222,515	3,024,750	7,948,392	5,522,281	2,705,115	31,796,702	6,679,699	10,661,937	16,044,012
Urban area (ha)	42,580	48,129	53,242	40,135	18,380	31,160	448,000	157,829	231,085	768,310
Urban density (persons/ha)	149.29	170.84	56.81	198.04	300.45	86.81	70.97	42.32	46.14	208.31
Total jobs	2,657,132	2,831,000	1,190,000	2,718,000	2,573,165	1,537,011	8,296,547	6,000,000	5,109,107	10,530,000
Area of the CBD (ha)	2,056	4,313	1,625	3,600	113	725	4,208	2,697	2,333	2,331
Employment at CBD	400,140	877,610	290,000	815,400	193,520	280,000	2,300,738	1,260,500	1,025,000	2,305,545
Population of the CBD	667,579	1,014,137	200,000	1,601,234	12,856	60,000	266,012	170,000	419,214	528,300
Job density inside CBD (ha)	195	203	178	227	1,713	386	547	467	439	989
Job density outside CBD (ha)	56	45	17	52	130	41	14	31	18	11
Motor vehicles	2,045,814	1,649,252	1,424,473	684,778	433,769	452,352	4,429,268	2,781,000	4,547,990	10,254,034
Private cars (%)	43.90	37.20	42.20	76.10	54.60	50.60	60.20	83.50	84.37	86.80
Freight vehicle (%)	16.40	11.50	7.80	7.90	31.00	21.30	28.00	9.13	-	11.48
Buses (%)	1.00	0.20	0.60	0.80	1.90	1.70	0.04	-	-	0.16
Other (%)	38.60	51.10	49.40	15.20	12.60	26.40	11.40	2.62	15.63	-
Total road (km)	3,803	4,448	4,746	4,941	1,529	2,882	122,489	13,305	9,977	84,335
Average speed of traffic (km/h)	13.10	23.60	29.40	25.50	25.70	32.50	24.40	30.20	25.70	25.80
Road supply (m/person)	0.60	0.50	1.50	0.60	0.30	1.10	3.90	1.90	0.93	0.53
Parking supply in the CBD	50,848	No data	86,030	22,000	6,376	45,870	98,755	138,843	172,000	138,148
Parking space per 1000 jobs	127	No data	297	27	33	164	43	121	168	60
Mode split: journey to work (%)										
Public	30	36	26	54	74	56	59	40	36	54
Private	60	41	58	28	9	22	16	46	49	35
Walking/cycling	10	22	17	18	17	22	25	14	15	11

Source: Kenworthy and Laube, 1999

From the perspective of freight transport, both patterns, i.e. horizontal growth and vertical growth, presented different challenges. Old CBDs normally lack appropriate freight transport facilities such as freight elevator and (un) loading zones which makes it difficult to process the delivery of goods. On the other hand, delivering goods to high rise buildings requires parking facilities for trucks since it takes longer time to deliver the goods. Utilization of parking space therefore is low (number of trucks serve is few) while the demand is high. This particular scenario often results for the drivers to park their trucks illegally which cause disruption to the flow of vehicles and contributing to traffic congestion.

In terms of function, as mentioned, some CBDs have integrated function such as residential, commercial and finance all together in a well planed area. London and Paris have all these functions concentrated. Other CBDs on the other hand are planned for specific function to hold. Marunouchi for instance is more of a financial center than commercial district. Ortigas Center by all indication is planned for commercial and financial functions as shown by the presence of headquarters of major industries and well as major shopping centers (see Chapter 6 for detail).

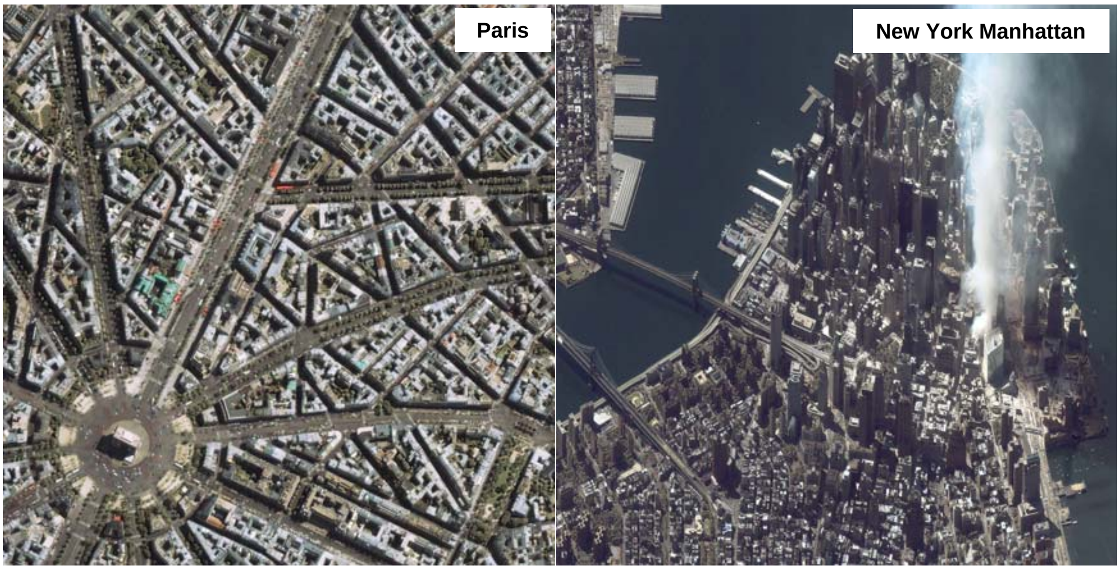

Figure 5-5. The Core CBD of Paris appears flat while the Manhattan of New York is populated with skyscrapers
Source: spaceimaging.com

ii) Employment density

There are many observations that can be deduced from Figure 5-6. First, there is high concentration of jobs to CBDs with high rise buildings like Hong Kong, New York and Tokyo. Second, there is a big gap between the concentration of jobs between the CBDs of develop countries and developing countries. Bangkok, Jakarta and Manila has an average of 185 jobs per hectare while CBDs in developed Asian cities reached 881 jobs per hectare. The difference appears to lie in the fact that the three wealthy Asian cities have developed extensive rail systems able to bring huge number of commuters into tightly confined areas of job concentration with very little space demand. By contrast, the poorer Asian cities have major problems with traffic congestion and poor bus systems which means that the high numbers of central city jobs have to spread out to maintain adequate accessibility (Barter and Kenworty, 1997).

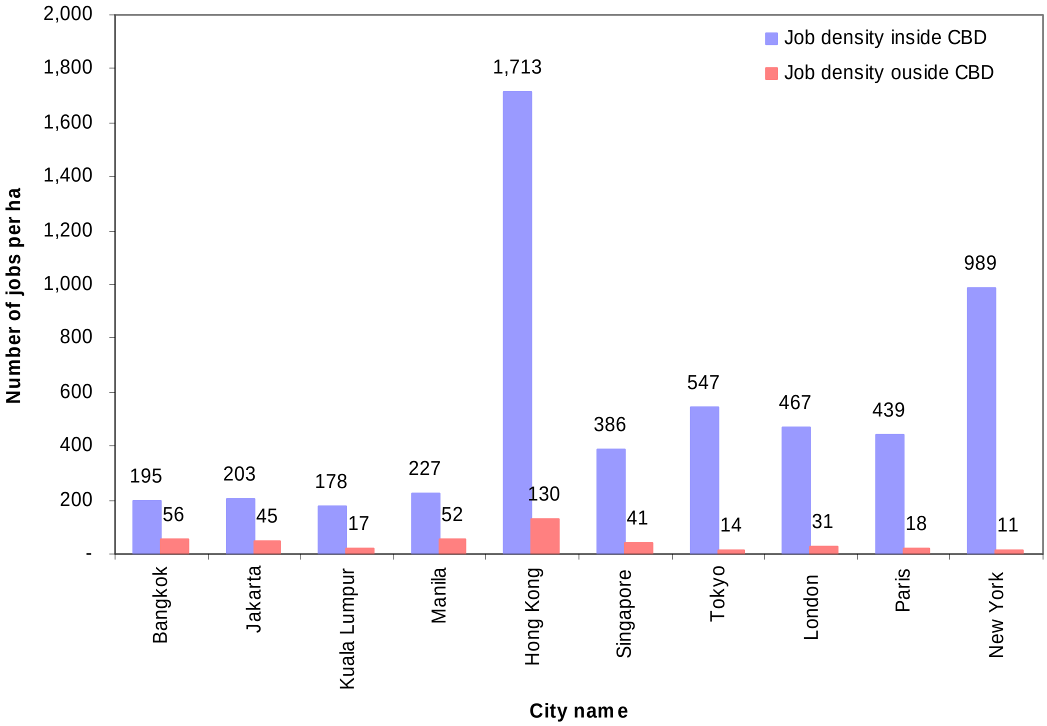

Figure 5-6. Job density inside and outside the CBD

iii) Building use and trip attraction

Land use has tremendous effect to the movements of trucks. Table 5-2 shows that space used for commercial purposes, i.e. either host shop or restaurant, has large number of attracted trips. Moreover, it appears that pulling strength of CBD in terms of attracted trips does not seem to be determined by country's level of economic development. Trip attractions of space for commercial use in Manila are even stronger than the trip attractions in Ginza although smaller than that of Marunouchi district.

Table 5-2. Trip attraction of space use in a building per 1000 sq meter

CBD name	GLA (m^2)	Number of trips	Office	Shops and restaurants
Tokyo (Marunouchi district)	153801	442	2.6	14.1
Tokyo (Ginza district)	218 shops	-	2.9	10.64
Manila	471158	3858	-	12.03*

Note: *data is taken from shopping centers

5.3.2 Freight transport information

i) Parking supply

Parking facilities in the CBD is very important in view of ensuring that freight vehicles have a place to stay while delivering the goods. Lack of it would compel the drivers to park illegally which would disrupt the fluidity of traffic. Figure 5-5 has mix presentation regarding the supply of parking space inside the CBD. Developing Asian countries except Manila has shown high number of parking space indicating that they are beginning to ready the infrastructure to accommodate the growing number of vehicles. These cities together with Metro Manila are experiencing rapid increase of registered vehicles in the past decades as a result of strong economic growth. Normally, when the supply of parking space is low, commuters would have difficulty using their cars which means that other modes of transport should be available for them.

Kuala Lumpur has responded well to the strong use of private vehicles while going to work as shown by the high number of parking supply. Tokyo and Hong Kong where space is premium have low number of parking supply but they have efficient railways which could serve the commuters. Moreover, these cities have adopted policies which try to restrain the growth of car ownership to limit the severe negative effect of traffic congestion. London and Paris despite the high share of public transport (40% and 36% respectively) to trip-to-work still have relatively high supply of parking space (Table 5-7).

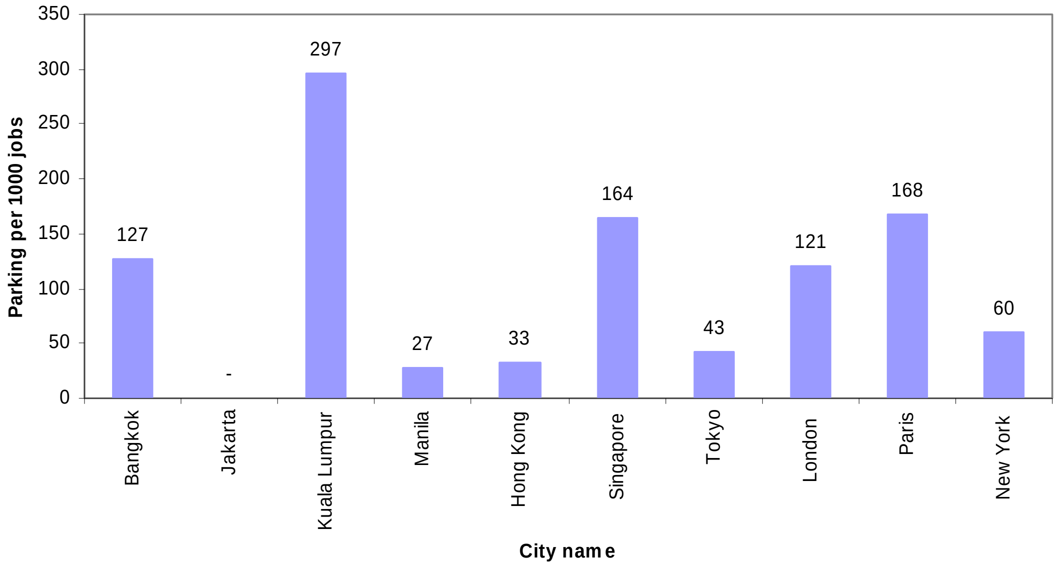

Figure 5-7. CBD parking spaces per 1000 jobs, 1990
Note: London data is1981

ii) Share of Freight vehicles

The share of freight vehicles to the total number of registered vehicles is remarkably low to cities in developing countries (Figure 5-8). Developed Asian cities on the other hand has very high share of freight vehicles almost doubling the share of freight vehicles found in developing countries (average share is 10.90 for developing countries while 26.77 for developed countries). London and New York too are quite similar to that number in developing countries.

Although the share of freight vehicles to the total number of registered vehicles might be different to the actual share of freight vehicle in the road network, there is high probability that where number of register vehicles is high so as the share of freight vehicles in the road network. Tokyo for instance has 45% share of freight vehicles in the road network (Takahashi, 2001). Tokyo together with Hong Kong and Singapore are considered as industry-oriented city, i.e. major industries are located inside the city, which could be the reason to the notable high number of trucks as compared to other cities in developed country such as New York and London. Both Singapore and Hong Kong possessed large ports which perhaps needs services of large number of trucks.

On the other hand, it is worth to note that except for Kuala Lumpur, all the mentioned cities in developing countries have active access restriction measure (truck ban). Presence of this measure can be one of the reasons of the low increase of trucks since companies are becoming less dependence to the services of truck. For instance, in Metro Manila, it was reported that Jeepneys, a type of public utility vehicle, are being used for goods delivery since this vehicle is not covered of the truck ban.

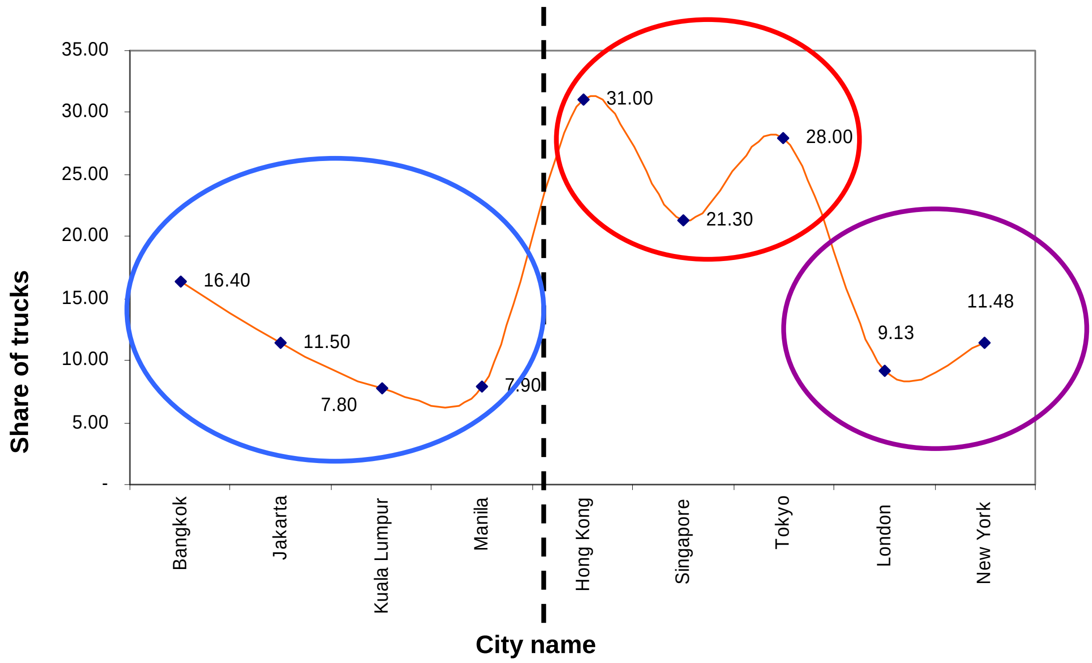

Figure 5-8. Share of Freight Vehicles to the total Registered Vehicles

5.4 Characterizing CBD

5.4.1 Transformation from low density to high density

Obviously, there is large difference between those CBDs in developed countries and those in developing countries. For instance, share of freight traffic in developed countries is quite large while those in developing countries are relatively small. Table 5-3 shows that low density CBDs are mostly located in developing countries while high density CDBs are found in developed countries. This suggests that development in the CBD is strongly link to the economic performance of the country. It can be theorized therefore that continued growth in this low economically region would transform the CBD from low density to high density (Figure 5-9). In such event, increase number of trucks can be expected which would further deteriorate the travel speed in the network.

Table 5-3. Characteristics of CBD

	CBD Name	Description	CBD type	Area (sq. km)	employment	Density
High Density	NY Manhattan CBD	South of 59 st.	High-rise	23.31	1,967,000	84,384
	Hong Kong core CBD	Central and western	High-rise	1.13	193,520	71,257
	Tokyo CBD core	3 wards	High rise	42.22	2,434,163	57,654
	London	Central London	Low-rise	29.01	1,260,500	43,451
	Singapore	Core CBD	High-rise	7.25	280,000	38,621
	Paris	Arrondissements i-x	Low-rise	29.01	1,025,000	35,333
Low Density	Manila	City of Manila	High-rise	36.00	815,400	22,650
	Jakarta	Core CBD	High-rise	43.13	877,610	20,348
	Kuala Lumpur	Core CBD	High-rise	16.25	290,000	17,846
	Bangkok	Core CBD	High-rise	20.46	271,944	13,291
	Shanghai CBD	Pudong devt area	High-rise	28.00	-	-

Sources: Kenworthy and Laube, 1999 and Demographia (http://www.demographia.com/db-intlcbddens.htm)

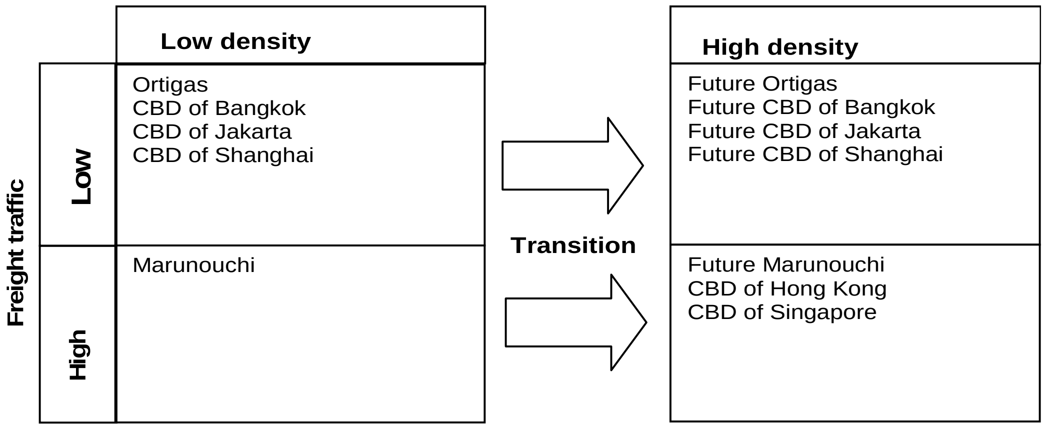

Figure 5-9. Transition of CBD from low density to high density

5.4.2 Framework for Analysis

Important elements in order to evaluate the traffic and environmental impacts of the CDS in the CBD are presented in Figure 5-10. The four main variables are land use, freight transport characteristics, freight transport facilities, and transportation characteristics.

Data of these variables are obtained through survey (see Chapter 6 and Chapter 7 for detail of the surveys) to have a strong basis for analysis. Microsimulation analysis is then utilized to quantify the effect of the CDS policy. The application of the CDS is done to different development levels of the CBD. This means that the present condition of the CBD is first analyzed before proceeding to analyze the future of the CBD.

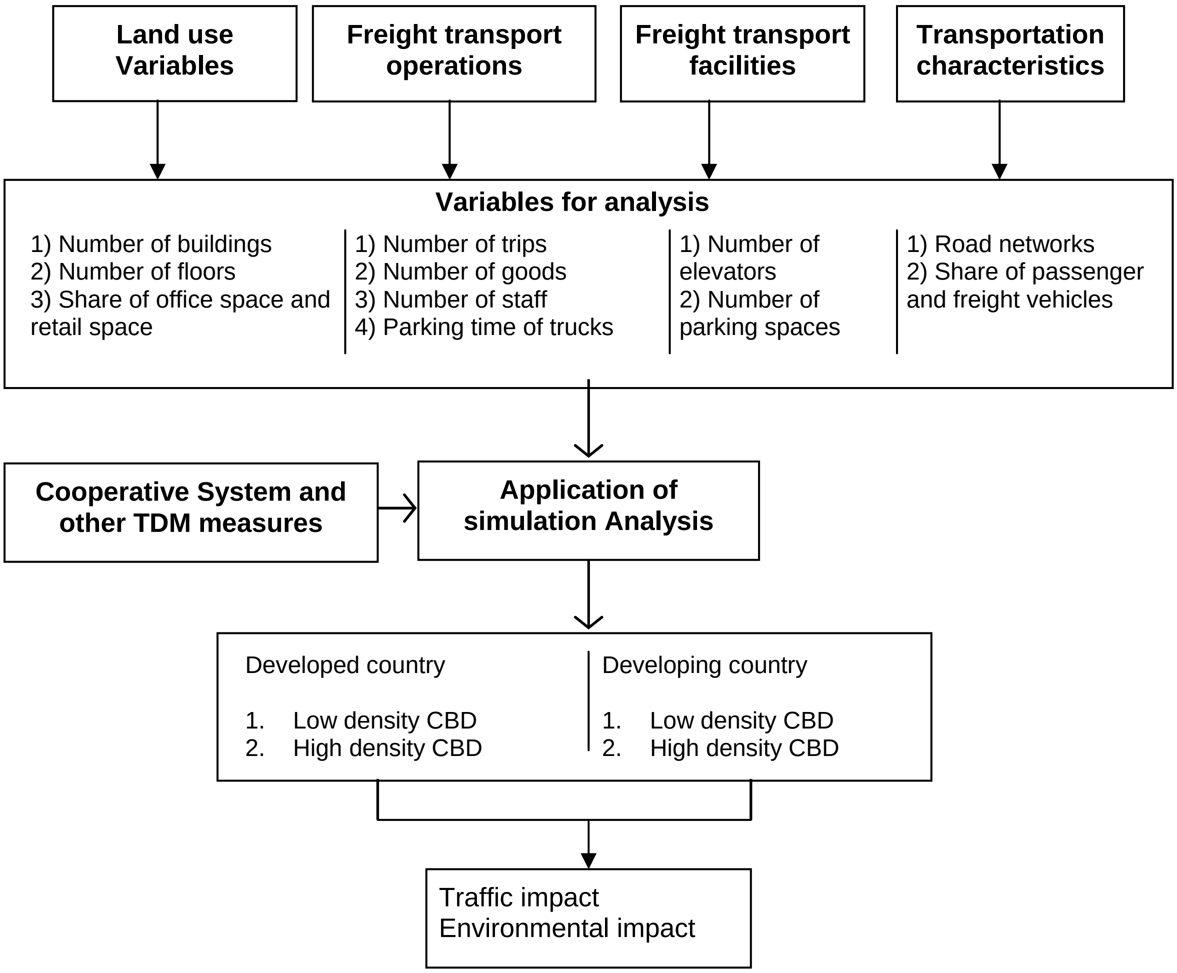

Figure 5-10. Framework for analysis

5.4.3 Some CBD profiles

i) Low Density CBDs

Ortigas Center of Metro Manila

Ortigas Center is the most important commercial and business district after Makati in Metro Manila, Philippines. The district is bounded by the Epifanio Delos Santos Avenue in the northwest, Ortigas Avenue in the northeast, Meralco Avenue in the southeast, and Shaw Boulevard in the southwest and has grown to about 1.08 square kilometer of land area as of 1998 (Figure 5-11. About 8.7 percent of this area is under the jurisdiction of Quezon City while the remaining is divided between Mandaluyong City (44.5 percent) and Pasig City (46.8 percent).

Figure 5-11. Map of the Ortigas center showing its transportation network

The district is home to the main headquarters of the Asian Development Bank and the headquarters of San Miguel Corporation, the country's biggest corporation. SM Megamall, one of the biggest shopping malls in Asia and the premiere mall of the largest chain of shopping malls in the country, can be found here, as well as the Shangri-la Plaza Mall and Star Mall. Shopping malls are one of the biggest trip attractor establishments (both vehicle and person trip) pulling tremendous number of people and vehicles.

For the purpose of comparison, Ortigas is only second in terms of revenue generation to Makati and land value is also much expensive in Makati CBD (Figure 5-12)

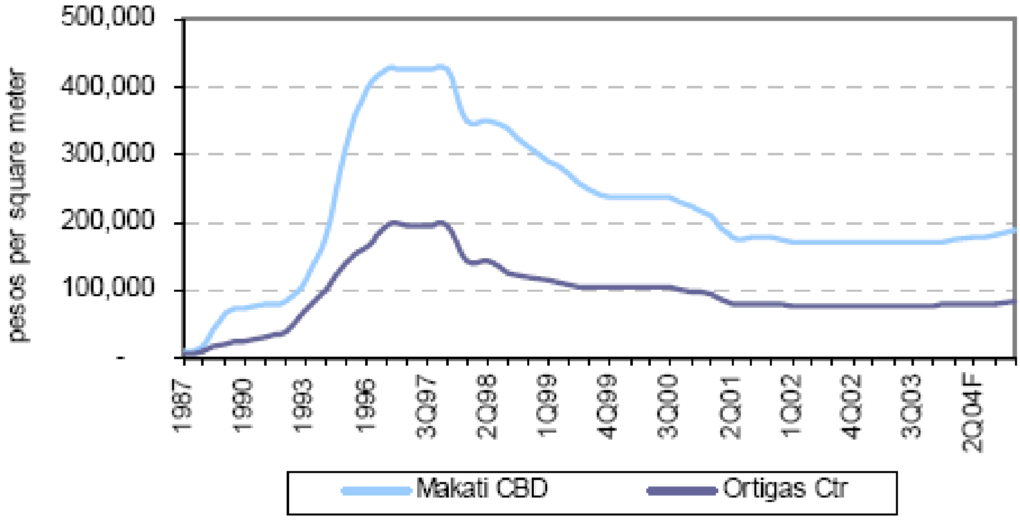

Figure 5-12 Average Land values of Makati CBD and Ortigas Center
Source: Philippine Property Market Overview.Colliers International Quarterly Research Reports: Philippines January 2004.

Pudong District of Shanghai

Pudong New Area in Shanghai has a land area of 533.44 square kilometers of which 28 square kilometer is to be developed as center of finance, business, and trade area (Figure 5-13). In the past, due to the lack of bridges and tunnels across the river, Pudong lagged far behind the old downtown of Shanghai in term of economic growth. But after its consideration as one of new CBDs in Shanghai, rapid development has taken place which offers new lease of life to the town.

The central government has played a key role to this achievement. The area of Pudong was designated by the Chinese government as a high priority project which allows it to receive great attention both from public and private sector. The investments of international firms further accelerate this development and just after 12 years, 621 distinctive buildings have already been erected in the area (Figure 5-14).

Perhaps the centerpiece of this district is the plan construction of Shanghai World Financial Center which would have 101 above-ground floors soaring 492 meters high. This skyscraper will not only host office floors but also a hotel, shops, an observation deck, conference facilities, and a private club.

The entire area has sub-zones to three major districts which would enhance and complement the value and function of each other. These three sub-zones are Lujiazui financial district, Zhuyuan commercial and trade center, and Longyan residence area.

Figure 5-13. Development plan of Pudong in Shanghai
Source: mori.co.jp

Lujiazui Central Financial District
This district would house dozens of super high-rise buildings jostling one another. Some are already erected such as the 468-meter-high Oriental Pearl TV Tower rocketing to the sky, the 94-storey World Financial Center and the 88-storey Jin Mao Mansion.

Zhuyuan Commercial and Trade Zone
This district is to be developed into a commercial and trade center that would both serve domestic and international firms. Transportation infrastructures are currently being developed that would allow it to be readily accessible. Office buildings where some of the most established firms will locate their headquarters are expected to fill the area.

Longyang Residential Area
This district will be developed into a modern commercial and residential center that supports the Financial District and the Zhuyuan Commercial and Trade Center. Rail networks will be extend to this area that would cater people from the two district aftet office hour. The supporting facilities located in this area include banking, insurance, commerce, postal service, and security service. Luxurious residential buildings, shopping centers and various cultural and recreational centers will also be built to further enhance both value and attractiveness of the district. For instance, the Longyu City, a high-grade 200,000 sq. meter residential project invested by the Korean Daewoo Corporation has already started construction since 1997.

Figure 5-14. The Lujiazui Finance and Trade Zone in New Pudong Area

ii) High Density CBDs

Core CBD of Hong Kong

Central and Western District, the CBD of Hong Kong, is located in the northern part of Hong Kong Island. The CBD is one of the 18 districts of Hong Kong which has a 261,884 population in 2001. Central was the site of Victoria City, the first British urban settlement in Hong Kong that they expanded until to its present area. The modernization process of the CBD has its beginning in 1970s as the economy of Hong Kong experienced rapid growth. This effort to develop the CBD into modern and functional district that serves both domestic and international demands was rewarded as the area became the center of financial, insurance and property and business service. Today, scores of skyscrapers that host headquarters of multinational financial services corporations populated the area forming one of the most highly dense business districts in the world (Figure 5-15).

Among the CBDs in the world, the CBD of Hong Kong has the highest job density with 1713 jobs per hectare which is almost twice higher to the CBD of New York (Figure 5-6.

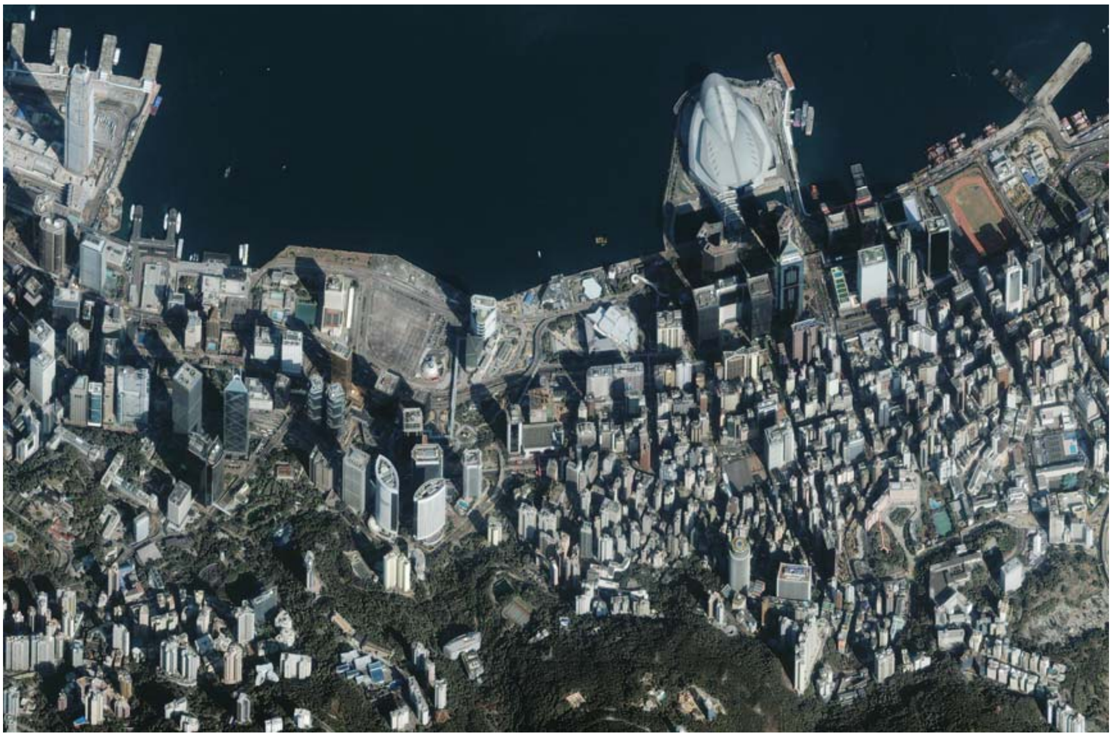
Figure 5-15. Hong Kong’s CBD contains high rise buildings
Source: spaceimaging.com

Manhattan of New York

Manhattan is the cultural and commercial center of the city, and its skyline symbolizes New York City around the world. It has an area of 57 square kilometer and population of 1,537,195 in 2000. The Core CBD of Manhattan has an area of 23.37 square kilometer and its parking supply is 60 per 1000 jobs (Figure 5-4).

The important role of the CBD (or to some extent Manhattan) in the metropolitan economy is apparent. Job density (number of jobs per hectare) is as high as 989 jobs in the heart of the CBD while only 11 in the other part of the city. As far as the role of the whole Manhattan is concern to the economy, the Regional Plan Association, a Committee on A Regional Plan of New York and its Environs, has declared:

Although Manhattan has never exceeded the total of 2.8 million jobs that it had in 1969, the total never slipped below 2.3 million and nearly attained the 1969 peak in 2000. Although its share of employment has been gradually declining for years, nearly one out of every four jobs in the region is still located in Manhattan. (Regional Plan Association, http://www.rpa.org/pdf/Spotlight46.pdf).

Delivering goods in the CBD is quite a real task owing to difficulty of locating parking space. Further, it is expected that parking time of freight vehicles is long since buildings where the delivery is to be made are often high-rise thus the number of vehicles can be severed by the parking space is limited. This is confirmed by a study conducted in 2001 which found out that the average time before a freight vehicles leave a parking space is around 33 minutes (Morris et al., 2001).

i) Core CBD of London

The core CBD of London has an area of 29.01 with an available job of 1.26 million. London as a city adopted building control policy as early as 1191. The control of new structures was borne out of several reasons such as 'prevention of view' of existing buildings and fire precaution measures. In the Financial City, many houses are old with many of them are three or four storey buildings. It is rare to find 20 or 30 storey building with the exception of the No.42 Edifice which has 42-floors and the only skyscraper in the city. Job density inside the CBD is 467 per hectare while 31 outside the CBD (Figure 5-16).

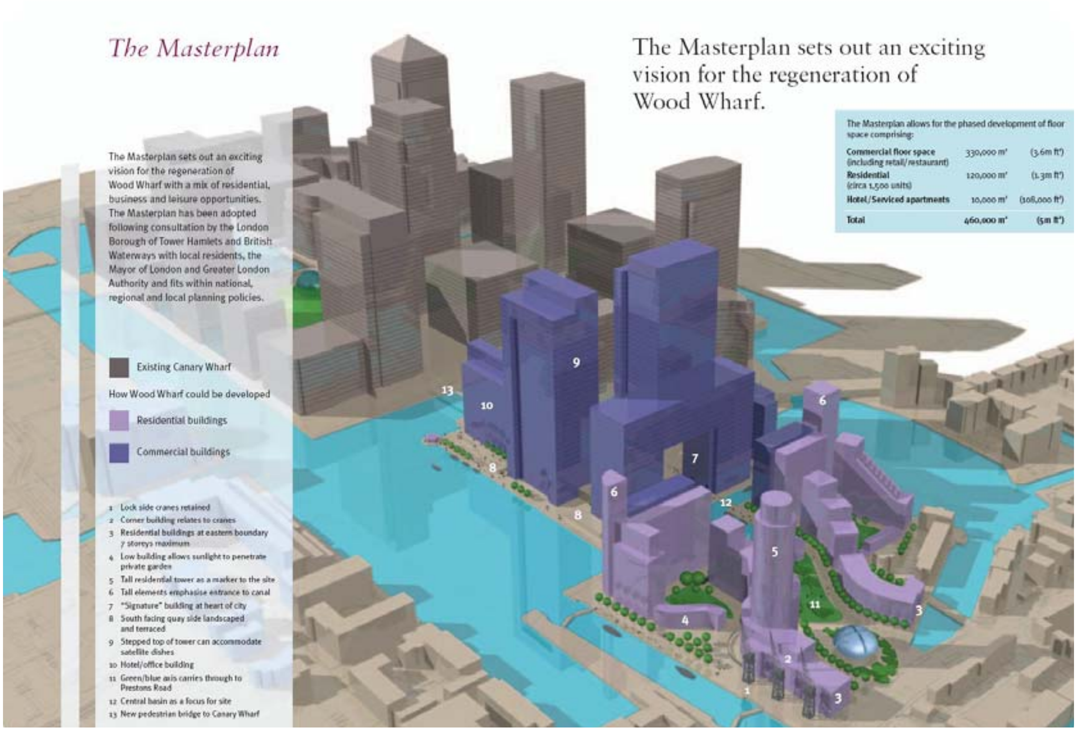

Figure 5-16. The master plan of Canary Wharf business district in London
Source: http://www.woodwharf.com/masterplan/index.html

Lately, there’s a renewed interest in high buildings in London. This case is reflected in a technical report commissioned by Greater London Authority entitled “London’s Skyline, Views and High Buildings” conducted in 2002. The report centered its arguments on the following:

- The role of high building in any city relates to the context. London is different from Paris, Frankfurt, or Berlin, and required a contextually specific approach.
- High buildings do offer the potential to positively contribute to the city. This is defined by their particular role and location, and requires strategic management of their impacts.
- London has a need for tall commercial buildings in key locations that have multi-modal means of access, a large catchment area, and high market demand. This need is derived of a locationally specific demand for large volumes of space, in high value areas, where land availability is limited.

Another notable development concerning CBD in London is the revitalization of Canary Wharf at the East of London that started in 1981 but was only emerge as leading business district in early 1990s (Figure 5-16). The area has 21 square kilometer and already rivaling London's traditional financial centre, The Square Mile.

5.5 Chapter summary

The key parameters that shaped CBD around the world are very diverse at times and unified at times. For instance, there was an opposite direction taken by old CBDs of European cities and CBDs of Asian cities. Although most of the businesses districts of cities in developing countries Asia haven't reach the development maturity of CBDs in European cities or wealthy Asian cities, there is a strong indication that they are heading the direction of large and high density CBDs where skyscrapers pronounce the location of CBD. On the other hand, of all the cities considered in the review, the pull attraction of CBD in employment is apparently strong creating huge gap between the job density inside and outside the CBD.

Pressures from old centers to expand the area of CBD vertically to accommodate growing needs for space are resulting to creation of new centers as observed in London. The traditional financial district of London is facing a stiff competition from this new CBD that although cannot match the prestige of old center but has better facilities for business to offer. In Paris, the city was saved from sprout of skyscrapers and large shopping malls by creating the La Defence CBD outside the old city but very accessible by its railway. Clearly, this strategy demonstrated just how determined the local authorities to keep the old identity of the city in the face of mounting pressure for structure reform.

It appears that CBD of cities in developing countries is in the direction of large and high density CBD. This development would pose a major challenge to cater travel demand. Although there is a sign that these cities are investing to the development of rapid mass rail transport system to meet this demand, there seems to be lack of strategies on how to respond to freight transport demand. Concentration of different economic activities in a confined area would surely result to some transportation problems.

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CHAPTER **6**

Application of Cooperative Delivery System to a Low Density Central Business District: Case of Developing Country

6.1 Introduction

This chapter evaluates the traffic and environmental impacts of cooperative delivery system to Ortigas CBD in Metro Manila. It was assumed that there exists an agreement among shippers and carriers to coordinate their operation that would result to the consolidation of loads using lesser number of delivery trucks. The future changes in the context of supply phenomena of the CBD in the form of increased number of freight vehicles as a result of further development were also considered in the analysis. This process aims to answer if CDS is a suitable policy measure to the present general condition of the CBD or if the CDS is better adopted in high density CBDs.

In the succeeding Section 6.2, brief information of the CBD under consideration is provided. This section highlights some locational characteristics of Ortigas CBD. Also, the overall transportation system affecting it is also discussed, tackling the CBD's accessibility by public and private transport vehicles, as well as mass transit system. The common problems associated to vehicle and human traffic encountered in the shopping centers of the CBD was also underlined. Section 6.3 tackles the method of obtaining necessary data to evaluate the impact of cooperative delivery system measure. This section covers the result of the survey, as well as brief analysis of the data obtained. Section 6.4 explains the simulation analysis procedure, and also the method to validate simulation result. The result of the simulation analysis is thoroughly discussed in Section 6.5 which stresses importance to the benefits gained from cooperative delivery system in the form of improved travel speed, reduced traffic volume, and improved environmental condition. The role of CDS in freight transportation management as the development of CBD intensifies is given in Section 6.6. The chapter is concluded in Section 6.7 where some significant points were revisited.

6.2 Ortigas CBD of Metro Manila

The Ortigas Center located at the center of Metro Manila and is the most important business district of the country next to Makati. Bounded by the Epifanio Delos Santos Avenue in the northwest, Ortigas Avenue in the northeast, Meralco Avenue in the southeast, and Shaw Boulevard in the southwest, the district has grown to about 1,082,891 square meter of land area as of 1998 (Figure 6-1). About 8.7 percent of this area is under the jurisdiction of Quezon City. The remaining area is divided between Mandaluyong City (44.5 percent) and Pasig City (46.8 percent).

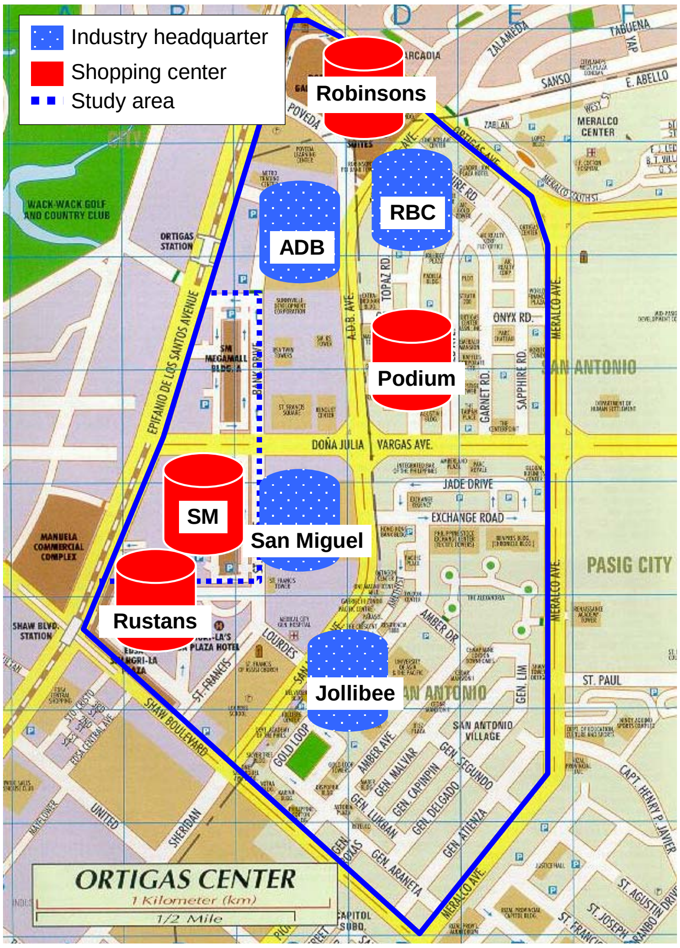


Figure 6-1. Map of Ortigas CBD showing major industries and shopping centers

The district is regarded as one of the country's leading business district. Headquarters of Asian Development Bank and some prominent companies such as San Miguel Corporation, Robinsons Land Corporation, and Jollibee Foods Corporation can be found in Ortigas Center. Famous malls like SM Mega Mall, Robinson's Galleria, Podium and Rustans are located in the CBD. In addition, Ortigas also have number of high-rise buildings mostly used for office space, commercial activities, and hotels.

Ortigas Center is highly accessible to public transport passenger and private vehicles. EDSA and major roads such as Meralco Avenue, Ortigas Ave, Doña Julia Vargas Avenue, and ADB Avenue and Shaw Boulevard provides access to Ortigas Center. Public transport alternatives include Metro Rail Transit (MRT), bus via EDSA, FX, and taxi.

6.2.1 Transportation system and freight transport

The CBD is well connected to the rest of Metro Manila either by bus or by railway. The main avenue of the capital, which is EDSA, provides an easy access to the CBD either by bus or by other public transportation mode such as FX and Jeepney. The Bus services along EDSA corridor ferries large amount of passengers to and from almost every corner of the Metropolis, while the MRT transports passengers either to the northern or southern side of the capital.

Concerning freight transport, approximately 85% of Philippine foreign trade passes through the Port of Manila; 90% of imports enter this port for distribution to other principal cities via trucks and inter-island vessels, where some are providing Roll-On-Roll-Off (RO-RO) services. Most of the Philippine's national importers and distributors are also located in Manila.

Trucks do the distribution of goods from port to destination and vice versa. While the truck ban prohibits trucks from passing EDSA from 6:00 am to 9:00 pm, there happens a shift in the time of delivery of trucks from daytime to nighttime, which sometimes, causing delays in container deliveries. With such time of delivery adjustment, residential districts suffer from noise and vibration caused by the trucks.

The implementation of truck ban along EDSA resulted to the proliferation of small trucks that are not covered by the ban. Small trucks having gross weight of less than 4,000 kg, instead of the conventional large vehicles, do the pick-up and delivery. Loading and unloading of goods are done inside the commercial buildings with built-in parking spaces and/or loading-unloading bays.

6.2.2 Problems associated to shopping centers in the CBD

Central business districts in developing countries is home to many shopping centers wanting to take advantage of the potential commerce brought by the large volume of people from different zones in and around the Metropolitan. Generally, shopping centers pull tremendous number of people that are usually coming either by car or by public transport, given their various trip patterns and characteristics. This process of trip attraction or generation obviously leads to several problems such as traffic congestion due to roads that are often exceeding their volume capacity (Figure 6-2),

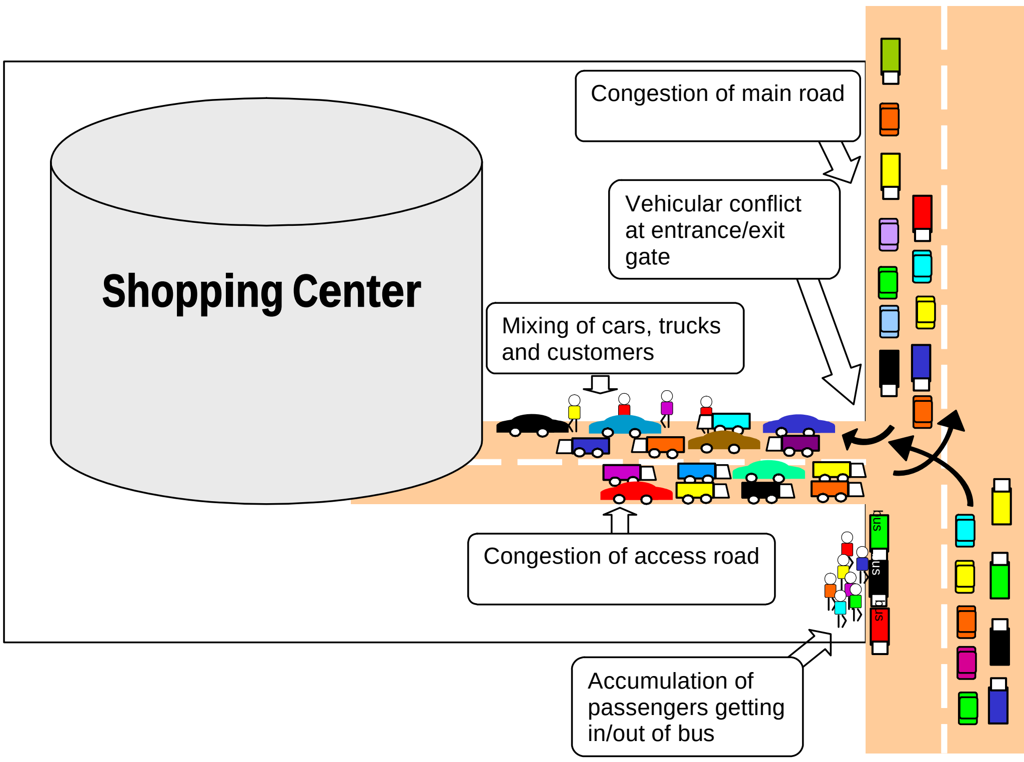


Figure 6-2. Typical traffic congestion scenario at the shopping center's access road and immediate environment

increased vehicle to vehicle and vehicle to pedestrian conflicts, and also queuing of loading and unloading buses at unauthorized areas. Moreover, at this instance, buses competing for passengers tend to outmaneuver each other, resulting to buses stopping beyond the bus bay. Therefore, the capacity of road is reduced and cars behind have to wait until the buses move. Add to this chaotic situation are the Taxi service vehicles loading and unloading almost everywhere.

During mid-day or rainy day, shoppers tend to deviate from the pathways dedicated for pedestrians as they try to find the shortest path that would bring them to the shopping mall or certain bus stop. This situation where cars and people are mixing together brings high probability of accident occurrence aside from disruption on the flow of traffic. Among the factors making the scene worse are poorly designed access facilities, inefficient personnel of the shopping centers being tasked on traffic flow management inside the jurisdiction of the malls and also, uncooperative pedestrians and drivers.

6.3 Data collection

Understanding the characteristics of freight transportation, particularly the CBD's associated traffic flow and environment requires set of data for use as input parameter in the simulation process. This includes information concerning modal share, total volume of vehicles, road networks, volume of goods, parking time, and delivery time, among others. Freight transport data for Metro Manila is often difficult to find due to limited numbers of studies conducted about it. In most cases, a primary data survey is needed to obtain information required in a study.

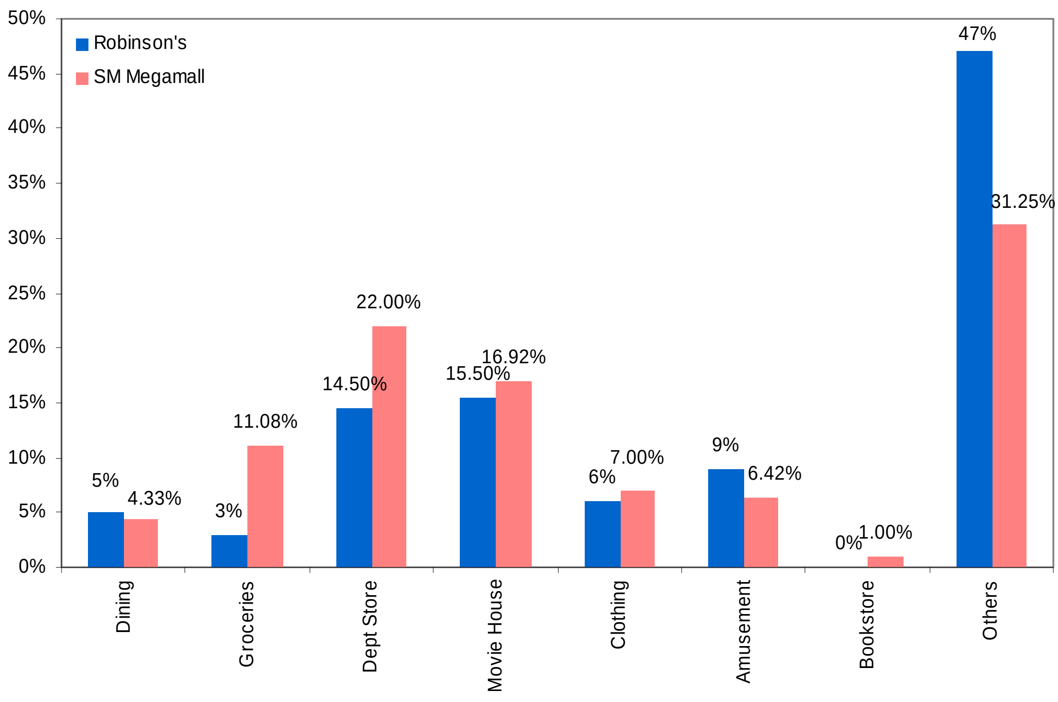


Figure 6-3. Distribution of space usage

Note: Distribution of floor usage to SM Megamall is estimated using data of Palmiano (1999).

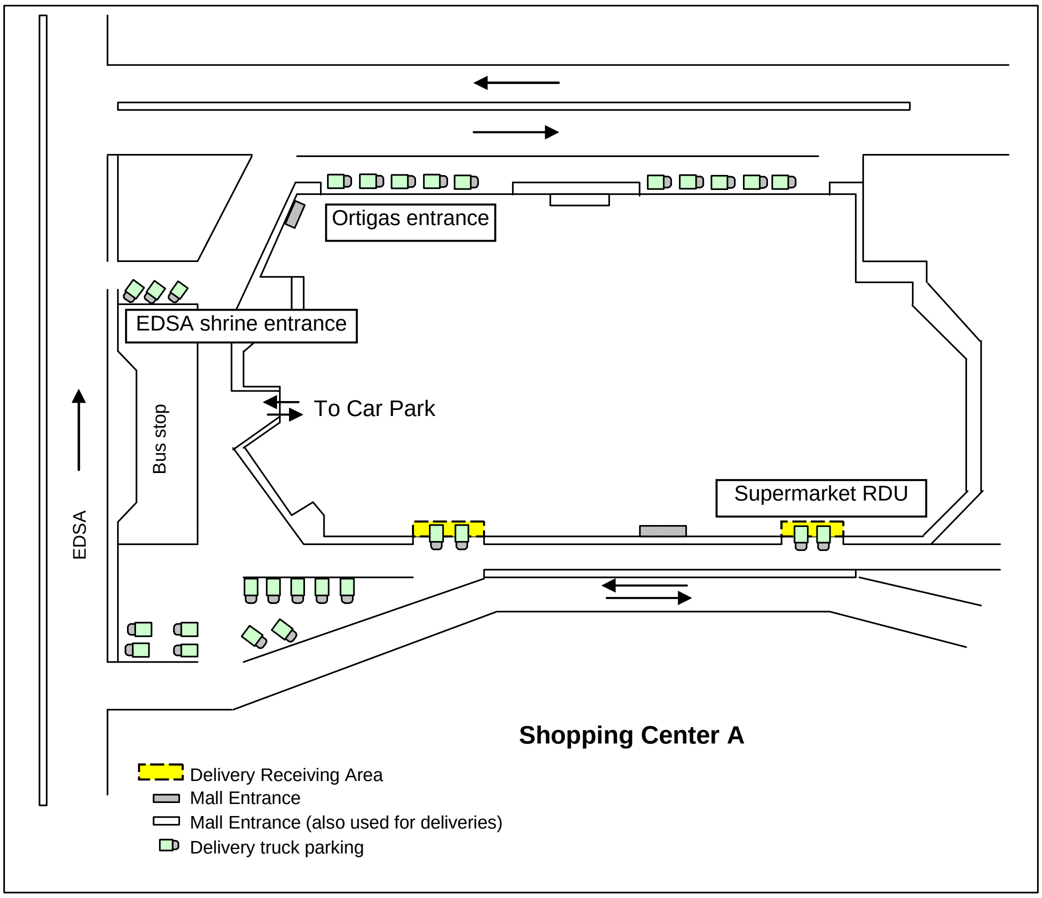


Figure 6-4. Robinson's Galleria showing delivery/receiving areas

Originally, the study intended to obtain the same set of data or information on freight and traffic flow for the two shopping centers, i.e. Robinson's Galleria and SM Megamall, in the CBD in order to have a comparative look (Figure 6-1). In such a way, their influence to the total freight traffic in the CBD may be identified and analyzed. However, the failure to obtain permission from SM Megamall to avail of its freight data hampered this effort. As a result, freight delivery and traffic volume data were availed and produced for Robinson's Gelleria, while SM Megamall only has traffic volume data for input to simulation (Figure 6-4 and Figure 6-5).

The SM Megamall has a big role to the analysis of CDS's impact on traffic and environment because it is located at the center of the CBD where vehicular traffic flow is extremely high. If only that the freight delivery data was obtained for SM Megamall, comparative analysis could have been performed for more interesting findings, solutions and perhaps, policy recommendations.

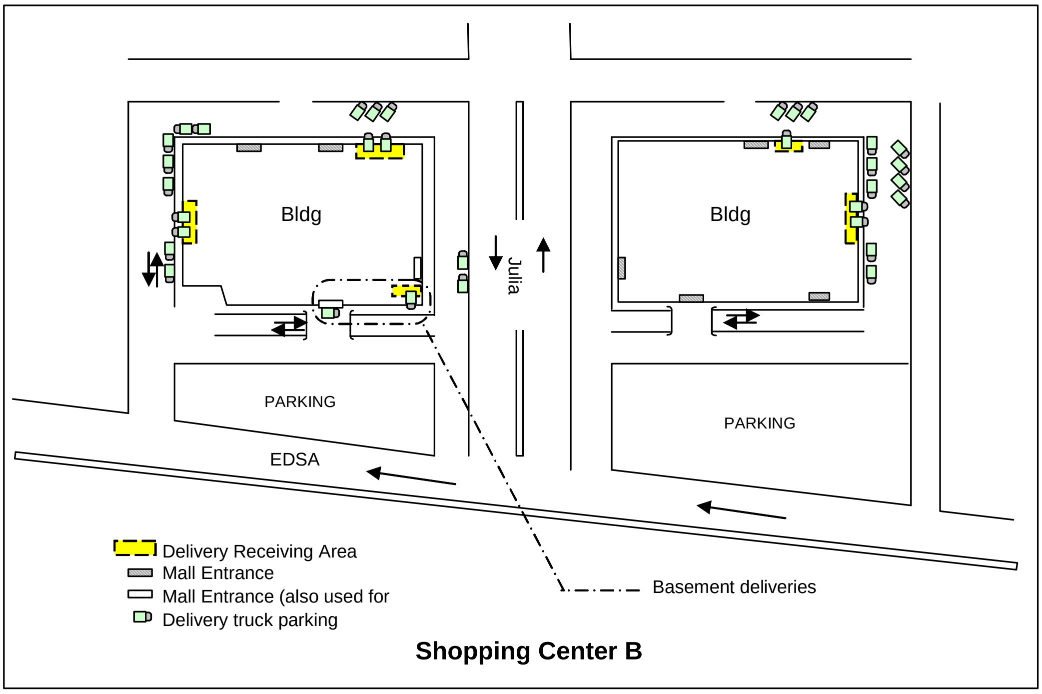


Figure 6-5. SM Megamall showing the delivery/receiving areas

6.3.1 Brief introduction of the two shopping centers

The two shopping centers are located along EDSA corridor. This road being the backbone of Metro Manila's transport network system stretches some 54 km, connecting northern and southern parts of the Metropolis. The all-day truck ban is enforced in this road in the effort to improve traffic flow and give preference to passenger cars. The two shopping centers are separated by 300 meters or so and both can be reached by train, bus, and car and FX using EDSA. Robinson's Galleria has a gross leasable area (GLA) of 99,888 square meters while the estimated GLA of SM Megamall is 209,848 square meters.

Shopping centers in the Philippines normally allot considerable space for department stores, movie houses, groceries (supermarket), which are managed by the center's owner (Figure 6-3). The composition of the remaining floor area herein referred to as "others" includes novelty shops, public areas for resting, multi-purpose stage, non-merchandizing uses such as banks, telecommunication and computer products and services, health clubs; and recreational facility sites such as skating rinks, bowling alleys, and indoor parks (Palmiano, 1999).

Parking space for private cars is normally well provided in the large shopping centers of Metro Manila. Aside from in-building parking spaces, open space parking facility is also provided, equipped with necessary markings and signage for maneuvering and safe parking (Table 6-1). Docking area for delivery vehicles are also prepared which are curved from the establishment itself (Figure 6-4 and Figure 6-5). Unlike parking spaces for cars, freight delivery areas are properly located near the establishment to minimize delivery time. Aside from the driver, additional staffs working on the handling of the goods can also be observed, although it was not inquired if those staffs work for the goods of certain shops or for the whole shops in the shopping center.

Table 6-1. Number of parking space

	Robinson's	SM Megamall
Total number of parking space	1625	4078*
Parking space for cars	1574	
Parking space for trucks	51	

*****Estimated using the ratio of GLA and total parking space

6.3.2 Survey

6.3.2.1 Survey design

Permission before the implementation of the survey was sought to the administrator of Robinson's Galleria and SM Megamall. The idea is to get their assistance to avoid misunderstanding between the surveyors and the guards manning the shopping centers during the survey. Permission to conduct a survey was granted by the Robinson's Galleria while approval from the administrator of SM Megamall was not obtained prior to the survey proper. But interestingly, the administrator of SM Megamall showed considerable interest and willingness to cooperate with the survey, however due to the limited time where the survey must be conducted, the permission was not secured.

Secondary data for Robinson's Galleria such as size of the shopping center, number of parking spaces and other information associated to vehicular traffic was obtained from its administrator. In the case of SM Megamall where permission was not obtained, Internet and the paper of Palmiano (1999) were used to estimate the breakdown of space usage (Figure 6-3).

Figure 6-6. SM Megamall, one of the biggest shopping centers in Asia located along EDSA
Source: http://www.smprime.com.ph

6.3.2.2 Survey implementation

The failure to obtain permission from SM Megamall hampered to position the surveyors inside the area of the establishment (Figure 6-6). The original plan is to have surveyors in every delivery zone of both shopping centers to record the number of incoming vehicles and their parking time. Also in the interest is the overall delivery time of the goods to its particular recipient center.

Table 6-2. Data recorded by surveyors at SM Megamall

Location	Number	Total	Data Collected
1, 2, 3	2	10	Truck arrival, number of trucks in queue, parking time, number of goods delivered
4	2	4	Truck arrival, number of trucks in queue, delivery time, parking time, number of goods delivered
5, 6, 7	2	4	Number of stopping bus, FX or taxi dwelling time
2, 6	1	5	Entry and exit volume (classified volume count)
2, 4	2	2	Classified volume count (passing only)

The administrator of Robinson's Galleria gave approval to conduct the survey inside the area of establishment (not inside the building) in order to record the freight transport related activities. However, for SM Megamall, surveyors were positioned outside the area of the shopping center. This came to be a difficult task and required 20 surveyors due to the numerous entrance/exit points of the establishment (Figure 6-7).

Aside from recording the truck's arrival and documenting the transport of goods movement, the vehicle traffic passing along the thoroughfare bounding the shopping center was also counted (Table 6-2). This data is essential input to the simulation modeling which may illustrate the traffic flow characteristics in the area, thereby identifying potential bottlenecks.

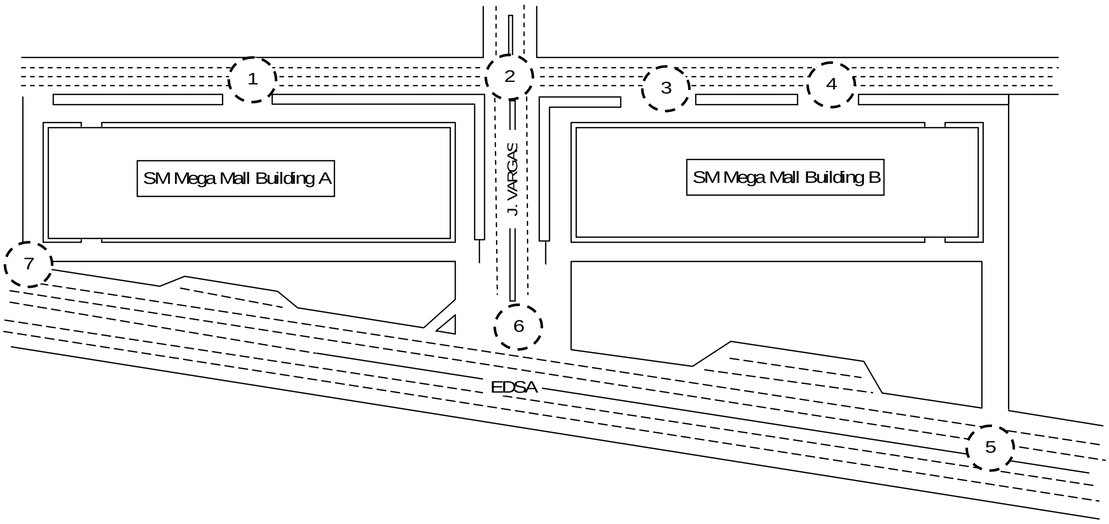


Figure 6-7. Locations of surveyors

6.3.2.3 Findings from the survey

Robinson's Galleria

Initially, the data on goods was recorded by interviewing the driver of the trucks arriving at the shopping center. Surveyors deployed around the shopping centers would immediately approach the driver upon the arrival. This approach went well, as all of the drivers were familiar with the quantity and description of his truck's load. Apart from the surveyors conducting interview of the drivers, another surveyor recorded the parking time of the trucks.

Table 6-3. Types of delivered goods

Types of delivery	Description	Number of goods	Number of trucks
Boxes and bags (pcs)	For shops (e.g. clothes)	696	47
Trays and crates (pcs)	For restaurants (e.g. bread)	652	28
Perishable goods (kgs)	For Supermarket (e.g. meat)	4111	13
Appliances (pcs)	For shops (e.g. radio)	795	10

The goods arrived in the shopping center were classified into four groups: 1) boxes and bags, 2) trays and crates, 3) appliances and other hard products, and 3) perishable goods (Table 6-3). Regarding the parking time of trucks, it was observed that trucks delivering the supermarket goods have the longest time spent (Table 6-4).

Table 6-4. Parking time of trucks

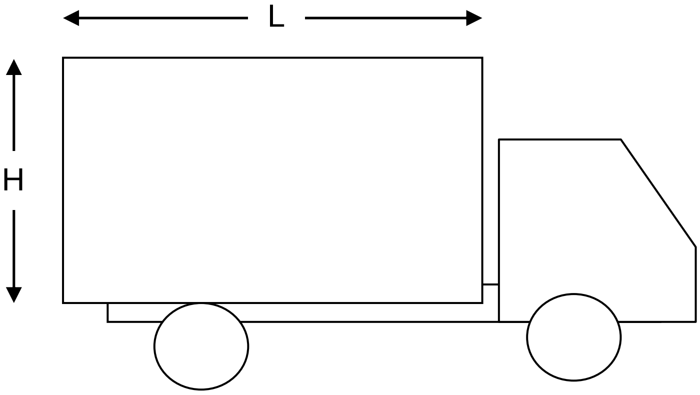
Unloading area	Description of the area	Average parking time (min)	Share of trucks
Ortigas Entrance	Goods mostly delivered to shops and restaurants	35	70%
Supermarket RDU	Goods delivered to supermarket	37	12%
EDSA Shrine Entrance	Goods for shops and restaurants	28	18%

See Figure 6-2 for the location of each unloading area.

Vehicles used for delivery

Several types of vehicles were being used to deliver goods into the shopping centers in the CBD such as small trucks, vans, and even jeepneys. During the survey, one jeepney was observed loaded with supermarket goods. Actually, this practice has already been mentioned in the paper of Castro (2003) where some companies are utilizing jeepneys to transport their goods from the port of Manila. The reason for utilizing such vehicles, which appears not suitable for cargos, is that they are not covered by the truck ban and therefore, not restricted to move in any part of the metropolitan at any time.

As a general observation, most of the vehicles used for delivery are small having a gross weight of not more than 4 tons to avoid the restrictions of the truck ban (Figure 6-8). Most of these vehicles are delivery vans.



Typical Delivery Van

Gross Wt:	3,000kg
Net Capacity:	1,650kg
L x W x H:	8x6x6 ft

Typical Delivery Truck

Gross Wt:	4,000kg
Net Capacity:	2,000kg
L x W x H:	10x6x8 ft

Figure 6-8. Illustration of typical van used for goods' distribution

SM Megamall

Since permission was not granted, activities related to delivery of goods from the docking area going inside the shops were not recorded. Traffic volumes however were recorded. This shopping center lies at the heart of the district and therefore, it is of interest to have its traffic flow recorded as this will be vital for the simulation phase and analysis. Table 6-5 provides the number of vehicles recorded for SM Megamall, as well as information for other shopping centers. The idea is to have a comparison of the traffic characteristics with other shopping centers and to know if the volume of vehicles during the survey day can be considered as normal.

6.3.2.4 Data analysis and output

There were 53,684 vehicles recorded at the vicinity of SM Megamall during the duration of the survey however only 79% of the vehicles passed the gate of the establishment (Table 6-5 and Figure 6-10). Obviously, private cars have the highest share, which accounted for 52% while delivery vehicles (combined number of delivery vans and trucks) have a modest share of 1.02%. Out of 837 delivery vehicles recorded, only 85% were observed to deliver goods at the shopping center.

Table 6-5. Traffic composition

Shopping Center	CAR	TAXI	FX	MCYCLE	PUJ	DELVAN	TRUCK	TRI	TOTAL VEHICLES
*EGO	60%	24%	4%	4%	1%	4%	0%	4%	10,997
*EGA	52%	6%	6%	7%	10%	3%	0%	17%	6,933
*SM Alabang	51%	10%	12%	3%	2%	4%	1%	17%	23,551
*SM Fairview	62.4%	26.3%	4.5%	2.1%	1.6%	2.6%	0.3%	0.2%	19,327
SM Megamall	50%	30%	9.1%	3.6%	0%	1%	.02%	0.0%	53,684

*Data taken from Palmiano (1999)

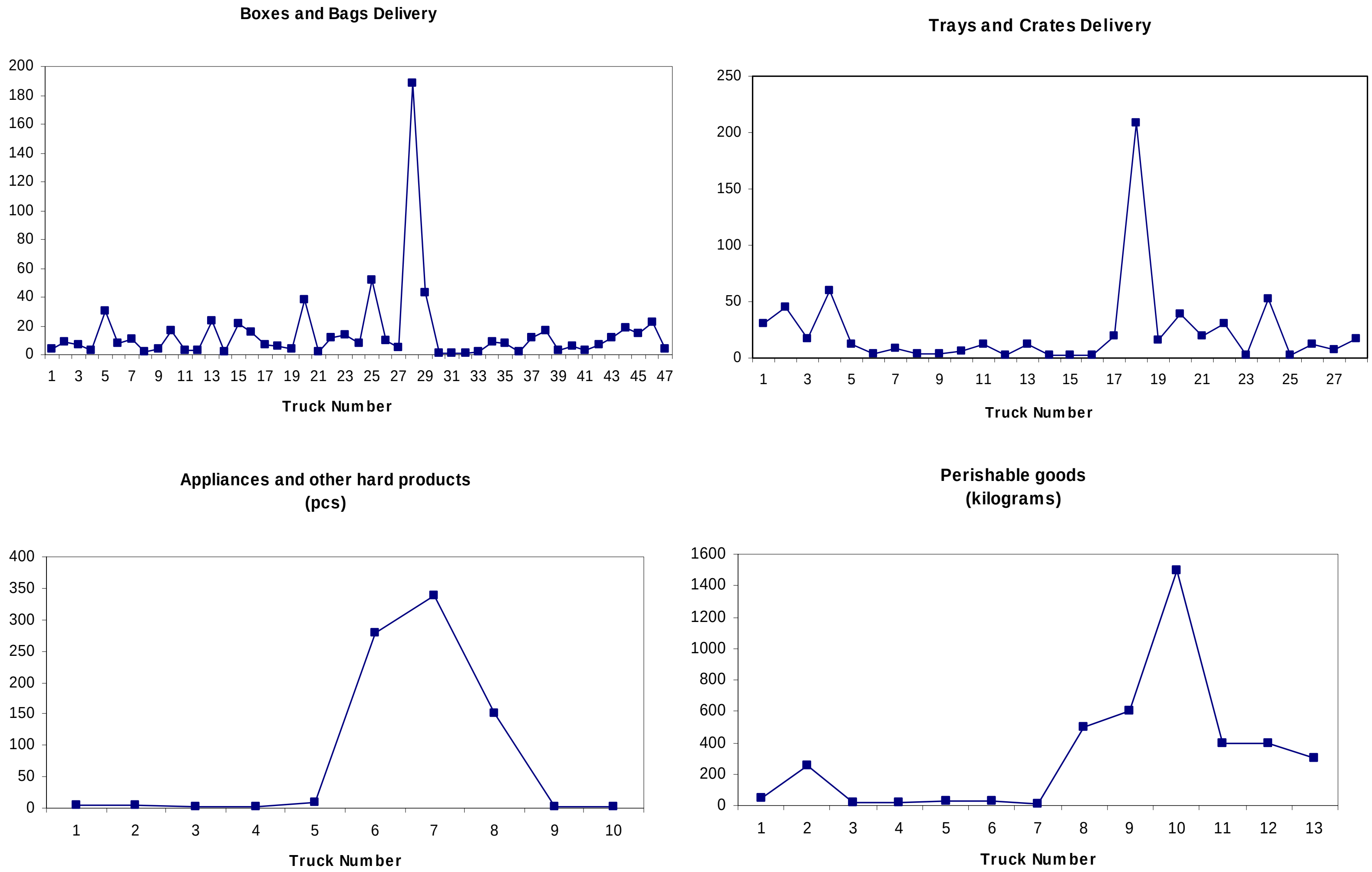


Figure 6-9. Types of goods delivery in the shopping center

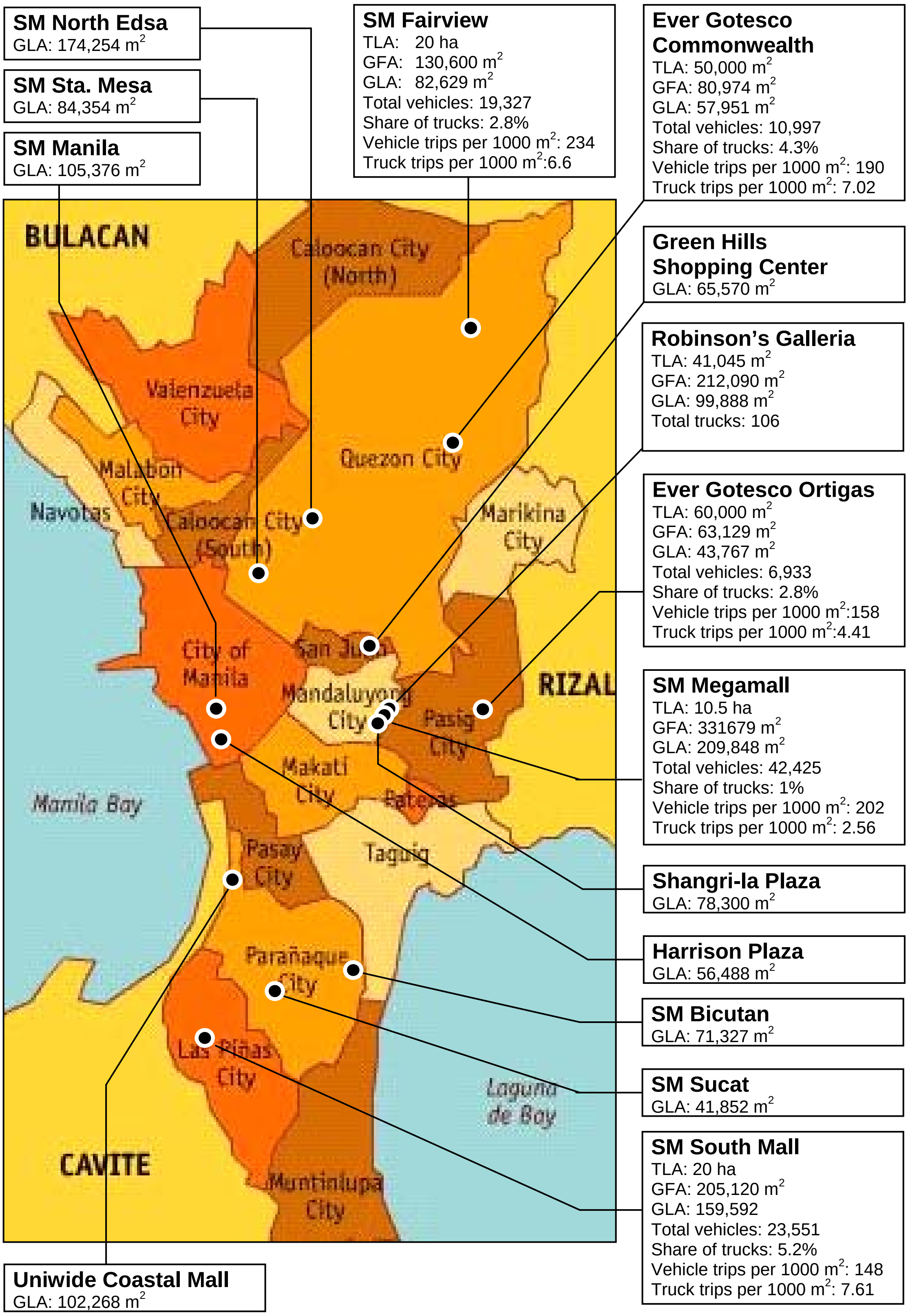


Figure 6-10. Quick facts to surveyed shopping centers and other shopping centers in Metro Manila

Although the focus of the study is on freight transportation management in the CBD, it was perceived to establish more meaningful findings by comparing the freight and transportation data of shopping centers in the Ortigas CBD with those in other CBDs. This would provide a comparative picture and idea on how these shopping centers fare with others in terms of traffic attraction and size.

Raw data of other shopping centers except Robinson's Galleria and SM Megamall were taken from the study of Palmiano (1999). Figure 6-10 reveals that SM Megamall B has the biggest GLA with the highest volume of vehicles generated (42,425). In SM Alabang, the share of freight vehicles is observed to be high compared to SM Megamall. One possible reason for this low share of freight vehicles is due to the proximity of this shopping center to EDSA where there is an active restriction to large delivery trucks brought by the truck ban scheme. It is then possible that some of the deliveries were made during the times outside of the truck ban coverage. The traffic survey at the surroundings of the shopping center started at 9:00AM.

6.4 Simulation Analysis for traffic and environmental improvement

6.4.1 VISSIM simulation software

The VISSIM 3.5 was used as the tool for simulation and analysis. It has an excellent modeling capability and graphic presentation. It is a microscopic, time step and behavior based simulation model developed to analyze the full range of functionality classified roadways and public transport operations.

The first step in modeling using VISSIM is to import aerial photo or schematic drawing of the study area into simulator (Figure 6-11). The next step is building of the networks and applying its attributes (i.e., lane widths, speed zones, priority rules, etc). Links are generally straight or follow the curvature of the road. Connectors, which are used to connect links, are typically used to model turning areas and lane expansion and contractions.

Table 6-6 shows the typical types of vehicles using the road network of Metro Manila. These modes along with trucks and motorcycles constitute the vehicle traffic component of the simulation model.

Table 6-6. Public Utility Vehicles (PUVs) in Metro Manila

PT Mode	Description	Passenger Capacity
Jeepney	An indigenous Filipino PUV; evolved from the wartime U.S. Jeeps, 2 passengers sit with the driver in front while the rest of the passengers sit in rows face to face on either side; fixed PT route	16 to 20
FX	Toyota Tamaraw car model and evolved into a PUV; functions like an air-conditioned jeepney; flexible route but with route endpoints defined	10
Taxi	Common taxi cab; maybe air-conditioned or not; flexible route	4
Bus	Fixed, long distance routes; not always available (depends on location of establishment)	60

Source: Palmiano, 1999

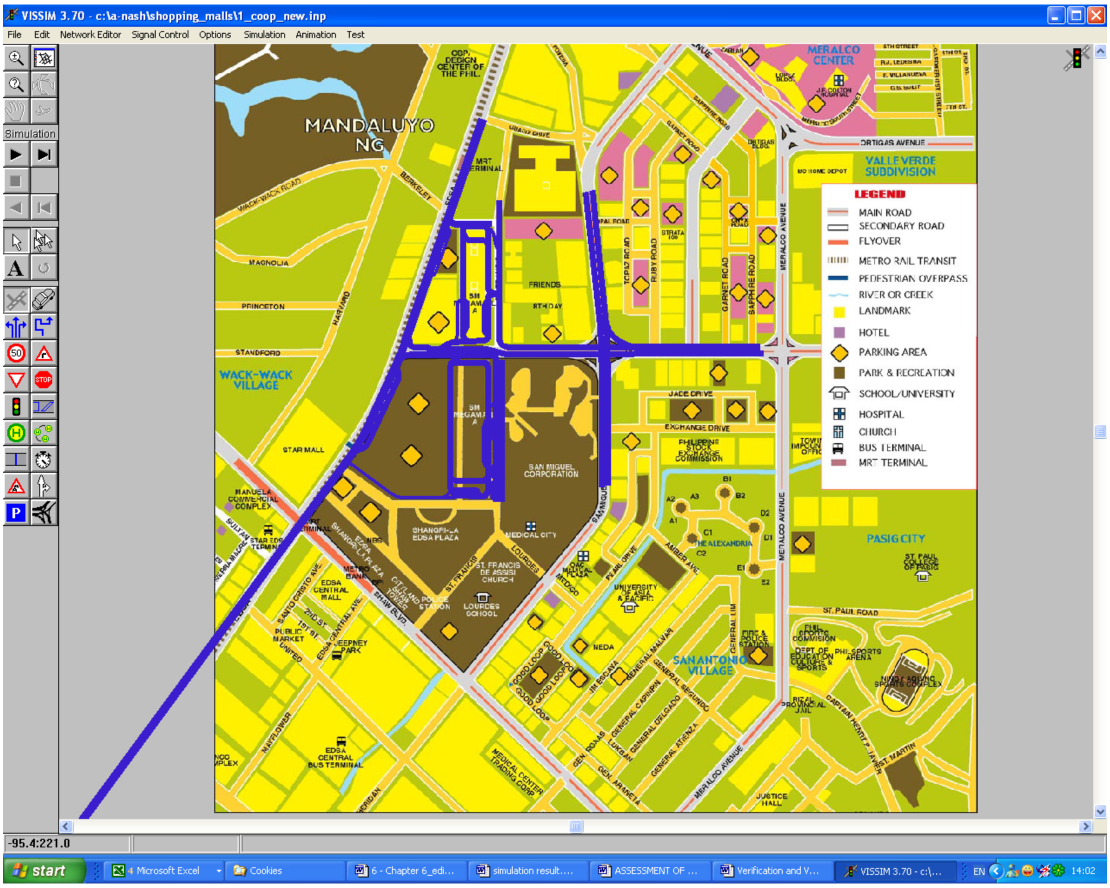


Figure 6-11. Screenshot of the simulation network with map background

6.4.2 Alternatives considered for traffic improvement

There are several alternatives that can be pursued to improve traffic flow in the district under study. Measures such as road pricing, provision of truck parking and loading facilities, cooperative delivery system, and time window are proven to enhance the fluidity of the road traffic. However, for this study, only cooperative delivery system and time window are adopted for they are simple and realistic to implement. Applying road pricing requires comprehensive data that in order to determine the traffic analysis zones (TAZ) cordon line. Moreover, this measure might bring negative impacts to road users since they will be paying to use the roads that are traditionally used free of charge. Truck parking and loading facilities are usually located in the shopping centers. These facilities are hard measures that are essential to cater the amount of truck traffic generated by the shopping centers. The descriptions of the two adopted measures are given below.

Time window: This measure prohibits the delivery of trucks into the district from 9:00 to 10:30 in the morning and from 2:30 to 6:30 in the afternoon. The volume of vehicles is observed to be high during these periods (Figure 6-12).

Cooperative Delivery System: This measure assumes that a cooperative delivery system exists among the carriers and shippers in the district, which would reduce the number of trucks, needed to deliver the same amount of goods.

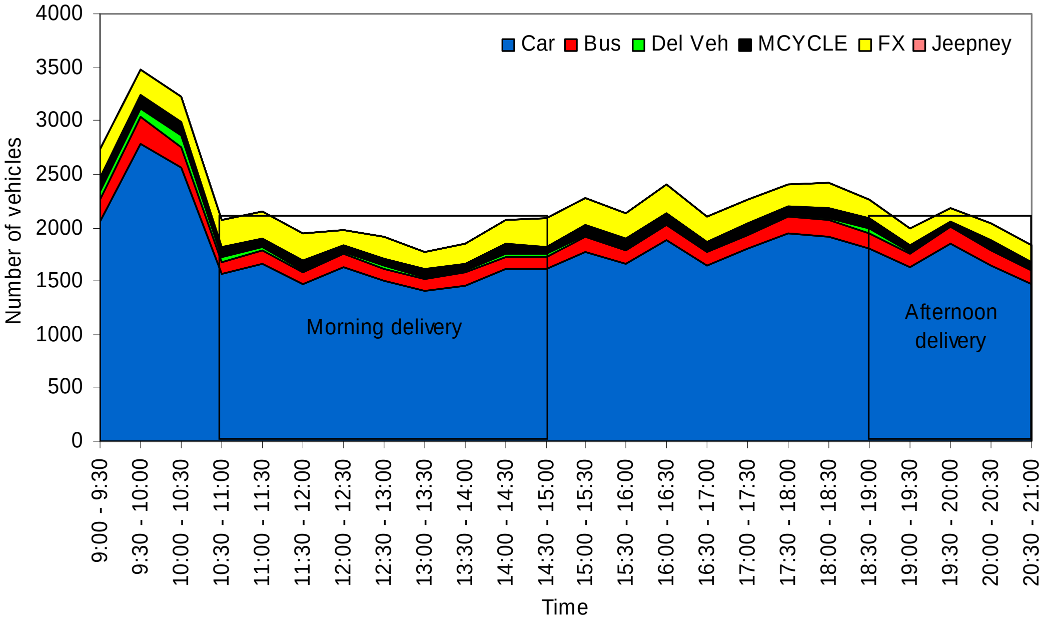


Figure 6-12. Time window

Each of the two alternatives is expanded into five cases (Table 6-7). This means that cooperative delivery system will be applied in which the road network is assumed to contain the volume of trucks share as 5%, 10%, 15%, and 20% of the total traffic. The same cases are also applied to time window.

In all cases, the volume of other vehicles is kept constant while the share of trucks is increased (Table 6-7). The idea of increasing the volume of trucks is based on three assumptions: 1) number of freight vehicles will increase when the development of CDB intensifies, 2) number of freight vehicles will increase when the truck ban is lifted, and 3) passenger cars will not substantially increase due to the completion of the railway networks.

Table 6-7. Data input

Alternatives	Del Veh	Car	Bus	MC	FX	Jeepney	Total
Present volume (trucks)	837	42924	3156	1919	4827	21	53,684
Share of freight vehicles is 5%	3844	42924	3156	1919	4827	21	56,104
Share of freight vehicles is 10%	5332	42924	3156	1919	4827	21	57,592
Share of freight vehicles is 15%	7997	42924	3156	1919	4827	21	60,258
Share of freight vehicles is 20%	10663	42924	3156	1919	4827	21	62,924

Trucks servicing perishable goods such as meat, frozen goods are normally excluded in a cooperative delivery system. The reason is that these types of goods require special handling facilities, which make it difficult to include especially if the consolidation center is not sophisticated enough. Table 6-8 shows that “trays and crates” delivery and “perishable goods” were not affected by cooperative delivery system as far as the number of trucks servicing them is concern.

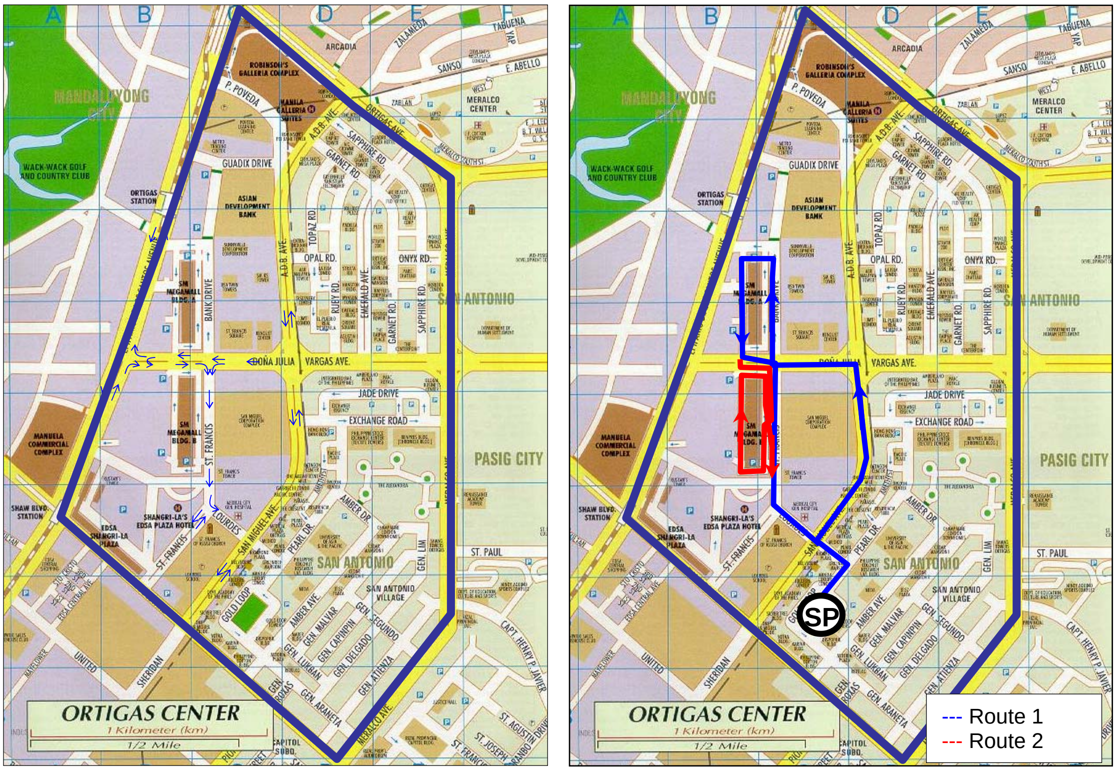
The ratio of freight vehicles to each type of delivery is derived from the survey conducted in the Robinson's Galleria (Figure 6-9 and Table 6-3). With the present volume, the required number of trucks delivering goods in the district could be reduced from 713 trucks to 137 when a cooperative delivery system is adopted.

Table 6-8. Comparison of number of trucks with and without CDS

Types of delivery	Boxes and bags (pcs)	Trays and crates (pcs)	Perishable goods (kgs)	Appliances and other hard products (pcs)	Total
Ratio	0.48	0.29	0.13	0.10	1
No. of goods per truck without cooperative	15	14	1500	17	
No. of goods per truck with cooperative	188	14	1500	399	
Present volume (trucks)	342	204	95	73	713
CDS (trucks)	27	204	95	4	329
Share of freight vehicles is 5%	1843	1098	510	392	3844
CDS (trucks)	147	1098	510	20	1775
Share of freight vehicles is 10%	2557	1523	707	544	5332
CDS (trucks)	204	1523	707	27	2462
Share of freight vehicles is 15%	3835	2285	1061	816	7997
CDS (trucks)	306	2285	1061	41	3693
Share of freight vehicles is 20%	5114	3047	1414	1088	10663
CDS (trucks)	408	3047	1414	55	4924

6.4.3 Route of cooperative delivery system

Delivery vehicles follow the normal routes in the district without the cooperative delivery system (Figure 6-13a). On the other hand, when the CDS is applied, delivery vehicles have particular routes to follow (Figure 6-13b). There are no changes to the



a) Without CDS **b) With CDS**

Figure 6-13. Truck routes with and without CDS

routes of other vehicles such as cars, buses, and jeepneys. The 124 delivery vehicles that were not observed to make delivery at the shopping center (Megamall) will retain their routes also. Following the cooperative delivery system's model discussed in Chapter 3, the depot should be located outside the CBD in order to reduce the number of trucks in the district. The depot in this study is assumed to be located in the border of Shaw Boulevard at the end of the truck routes shown in Figure 6-11b. The Survey result showed that large volume of delivery vehicles (44%) came from this direction. Furthermore, there is difficulty of locating the depot to the other sides of the CBD due to prevalent presence of one-way traffic scheme.

6.4.4 Validation of simulation result

The aim of the validation process is to ensure that the behavior of vehicles in the network is close enough to the behavior of vehicles in the actual system. This can be done by comparing the input data recorded by survey and the data recorded by the simulation. The vehicle count from survey data is 53684 while the simulation count is 51622, which brings the difference of merely 4% (Figure 6-14).

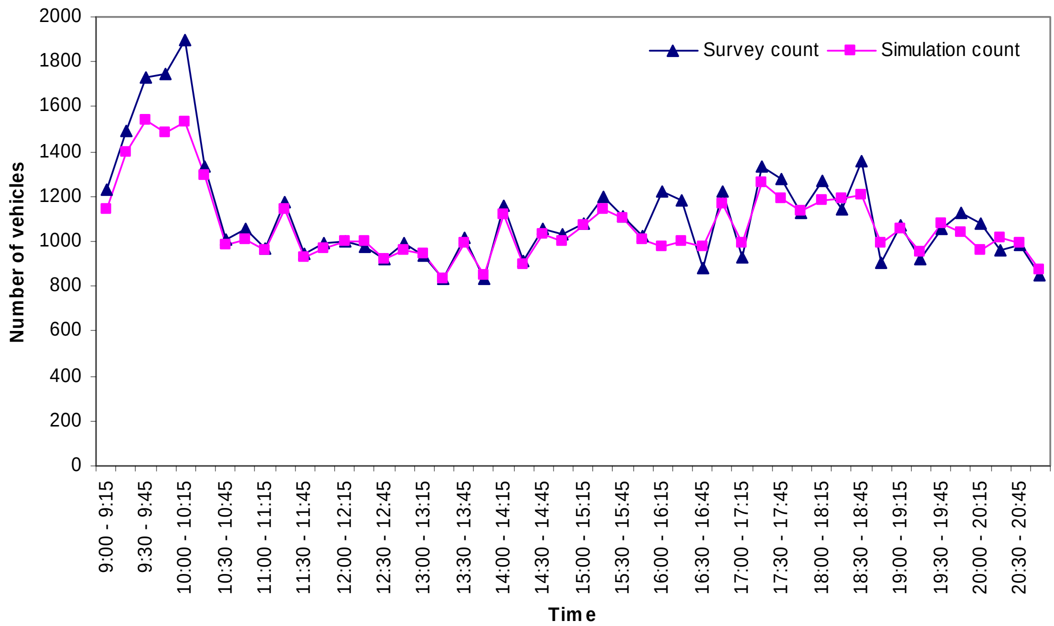


Figure 6-14. Comparison of survey count and simulation count

There are three (3) generation points in the simulation process where vehicles in the simulation model originate (Figure 6-21). Comparing modal share in each generation point using survey data and simulation data would provide a picture on how close is the simulation in replicating real number of vehicles per type. Table 6-9 shows that the simulation closely replicated the real distribution of vehicles with the difference of not more than 10% except for Jeepney. This high difference is due to the small number of Jeepney in the network, which is only 7 while the simulation has 6 (Table 6-9).

Table 6-9. Difference between survey count and simulation count per vehicle mode

Type of vehicles	Generation point 1 (To EDSA right)	Generation point 2 (To EDSA)	Generation point 3 (EDSA)
Total vehicles	5,951	7,497	40,236
Car	6%	2%	0%
Bus	3%	-	-
Del Veh	1%	0%	0%
MCYCLE	4%	8%	5%
FX	5%	0%	2%
Jeepney	8%	-	14%
Total	5%	1%	1%

Note: % difference from survey data

6.5 Results of the Simulation Analysis

6.5.1 Traffic impact

The total traffic reduction achieved by adopting cooperative delivery system under the present traffic condition is just 0.72% (Figure 6-15). This small traffic reduction can be attributed to the small share of trucks in the road network of the CBD, which stands to only 1.02%. However, despite this limited traffic reduction achieved through cooperative delivery system, it can be assumed as significant impact on the traffic flow in the form of improved travel speed. Truck's size is considerably larger than ordinary vehicles thus, any reduction of its number would equal to some amount of freed space that can be utilized by other vehicles. Furthermore, trucks have slow acceleration, which adds further delay in a congested network.

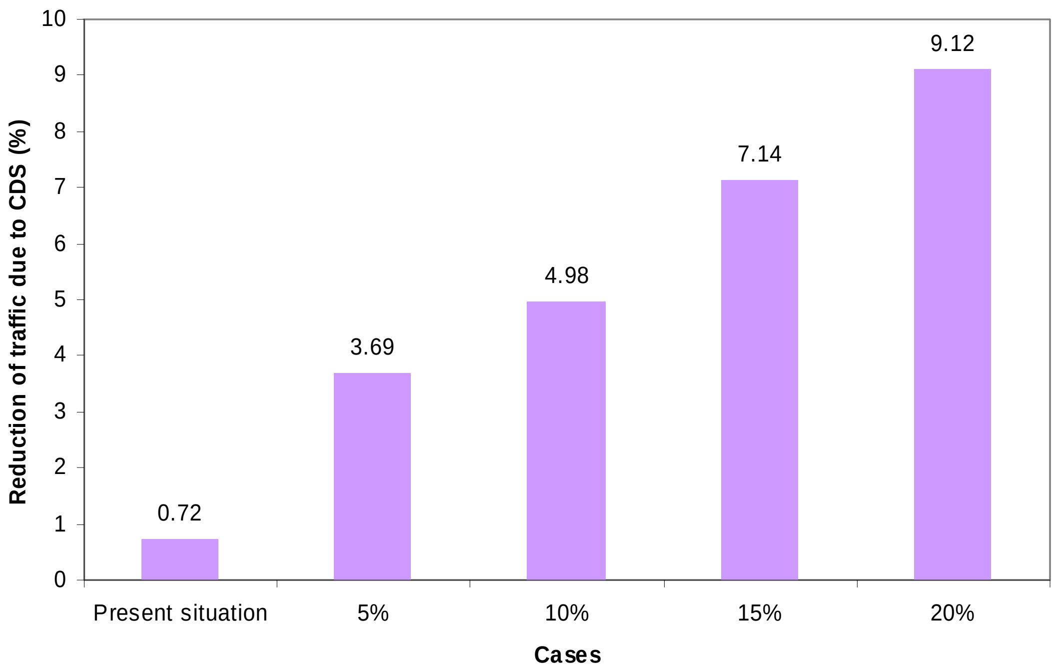


Figure 6-15. Reduction result of CDS to total traffic

In the same figure, as the share of trucks in the total traffic increases, the traffic impact of cooperative delivery system also increases. This implies that as the development of CBD intensifies, the role of CDS is becoming more important in view of reducing the number of trucks delivering goods to the CBD.

6.5.2 Environmental impact

6.5.2.1 Emission factors

The environmental impact of CDS is determined by utilizing the travel speed and travel distance for each link derived from the simulation model. Environmental emissions are then calculated by multiplying traffic volume per mode to its respective emission factor for each environmental pollutant (i.e. CO, NOx, SOx, SPM). Pollutant emissions are assumed to be dependent on travel distance, travel speed, and emission factors for each vehicle type.

Emission factors depend on variety of factors including speed, age of vehicle, load factor, weight of truck, frequency of stops and acceleration, altitude, temperature, operating conditions, and others (Campbell, 1995, Minato, K. *et al* 2003, Noda, A. *et al*, 2003). Satisfying these conditions is very difficult so the simplified emission factor on the study "Metro Manila Urban Transport and Integration Study" (MMUTIS), which is also available in the paper of Castro (2003) was used (Table 6-10). Emission factors of some vehicles (i.e. utility vehicles and motorcycles) are not available in the former reference so another source was used (Table 6-11). Emissions can be estimated as:

Pollutant (i) = travel distance × emission factor at average travel speed
(veh-km) (g/veh-km)

Table 6-10. Emission factors (g/km)

Pollutant Type	Vehicle Type		Average Speed < 10 km/h	10 - 20 km/h	> 20 km/h
CO	Gasoline	Car	27.57	23.5	18.7
		Small truck	47.58	52.2	41.14
	Diesel	Car	7.85	6.54	5.94
		Small truck	8.02	6.8	6.2
		Large truck	8.12	7.11	6.5
NOx	Gasoline	Car	2.75	2.76	2.78
		Small truck	4.7	3.59	3.53
	Diesel	Car	5.65	4.28	3.89
		Small truck	8.95	7.66	7.01
		Large truck	11.24	10.59	9.22
Sox	Gasoline	Car	0.013	0.011	0.011
		Small truck	0.015	0.011	0.01
	Diesel	Car	0.14	0.08	0.07
		Small truck	0.18	0.121	0.11
		Large truck	0.2	0.15	0.1
SPM	Gasoline	Car	0.07	0.05	0.05
		Small truck	0.07	0.06	0.05
	Diesel	Car	1.2	0.07	0.07
		Small truck	1.8	0.9	0.81
		Large truck	2.3	1.5	0.80

Source: Castro et al, 2003 Note: Bus is treated as large truck

Based on Table 6-10, there is an increasing amount of pollutant emissions as the vehicles speed is reduced. The table further shows that carbon monoxide (CO) is higher in gasoline-fueled trucks while NOx is higher in diesel-fueled trucks. CO and NOx emissions from cars also follow the same pattern. For utility vehicles, gasoline powered has higher emission of CO and NOx (Table 6-11). SPM is considerably low in gasoline-fueled cars and small trucks and higher in diesel-fueled cars, small and large trucks.

Table 6-11. Emission factors for utility vehicles and motorcycles (g/km)

Pollutants	Utility vehicle		Mcycle
	Gasoline	Diesel	
CO	60	2.5	26
NOx	3	1.4	0.2
SOx	0.014	0.115	0.004
SPM	0.12	0.9	2

Source: Vergel, K. (2002)
Note: FX and Jeepney were treated as utility vehicles

Identifying the fuel use of each vehicle covered by the survey is very difficult and would require lot of efforts. One way to address this difficulty is by adopting the historical data of registered vehicles by fuel type, which is normally available in the government agency tasked with vehicle registration. In the Philippines, the Land Transportation Office (LTO) is responsible for such a task. Historical data of vehicle registration by fuel type from 1998 to 2004 is availed and presented in Table 6-12. Using such data, the share of gas-fueled and diesel-fueled vehicles for the computation of emission pollutant is produced in Table 6-13.

Table 6-12. Proportion of gasoline and diesel vehicle registration in Metro Manila (1981- 2004)

Year	Total vehicles	Share
Car gas	8,198,886	96%
Car diesel	384,543	4%
UV gas	3,935,424	46%
UV diesel	4,658,303	54%
Truck gas	138,780	11%
Truck diesel	1,076,873	89%
Bus gas	14,089	8%
Bus diesel	168,004	92%
Motorcycle gas	2,518,915	100%
Motorcycle diesel	6,517	0%
Trailer	256,014	

Source: Land Transportation Office (LTO) - www.lto.gov.ph

For the span of more or less 23 years, the dependence of cars to gas fuels is very apparent (96%), while utility vehicles have relatively fair usage of gas and diesel fuels. Trucks and buses dependence to diesel fuels were at 89% and 92% respectively. For obvious reason, motorcycles have 100% usage of gas fuels.

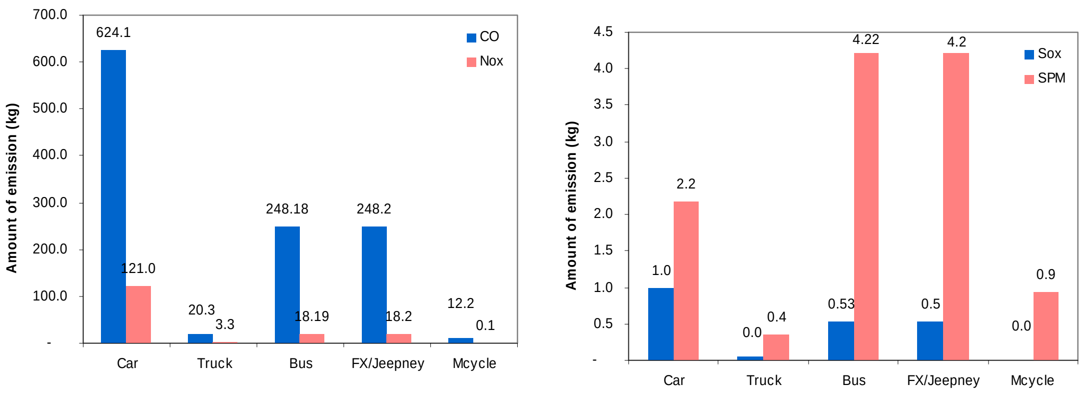
Table 6-13. Proportion of gasoline and diesel vehicles used in the computation of emissions

Type of vehicles	Type of fuel used (%)	
	Gasoline	Diesel
Car	96	4
Truck	11	89
Bus	8	92
FX/Jeepney	46	54
Mcycle	100	0

6.5.2.2 Amount of emission from each mode (simulated)

Figure 6-16 shows the amount of pollutant emissions by mode in a typical day between 9AM to 9PM. Cars have the highest share of carbon monoxide emitted, mainly due to its high dependence on gas fuels and high emission factor. The amount of CO emission caused by FX and Jeepney were almost as high as those of the buses, which is almost 40% of the CO emission by cars (Figure 6-16a). In terms of SOx and SPM (Figure 6-16b), cars recorded an amount of 1.0 and 2.2kg respectively, while buses, FX and jeepneys are almost close to doubling (4.22 and 4.20kg) the amount of emission produced by cars except SOx. Buses, FX and jeepneys are known for dependence on diesel fuels; hence the high amount of emitted SPM. The emission of NOx pollutant (Figure 6-16a) is noted high for cars only.

Carbon monoxide (CO), nitrogen oxide (NOx) as well as suspended particulate matter (SPM) are identified as components of ground-level ozone, which poses serious and harmful threat to human health and the environment. Such can occur through inefficient burning of gas by vehicles, where CO emission becomes hazardous and deadly.



(a) **(b)**

Figure 6-16. Amount of pollutant emissions by mode (present situation)

Looking at the emission share of each mode in Figure 6-17, car has the highest record in terms of gaseous pollutants such as CO, SOx, and NOx. The share of trucks on such emission was at about 2% for CO, SOx, NOx and 3% of SPM. On the other hand, in terms of CO, SOx and SPM, the Buses, FX and jeepneys emission ranged between 20% and 40%.

The above distribution provides useful indicator to properly address the issue of pollutant emissions contributed by the transport sector. For instance, a substantial shift of car users to other modes such as rail or public transport modes with appropriate travel demand measures would translate to significant reduction of CO, SOx, and NOx while continuous increase and patronage of cars using the transportation network would yield for opposite impact. Reduction of the SPM emission can likewise be addressed through strict implementation of policy measures towards diesel-intensive vehicles, like non issuance of operation permit due to poorly maintained engines or perhaps some form of regulation in the chemical content of fuels that are widely used by vehicles.

As to what should be compromised in the process of mitigation and intervention among the forms of pollutants mentioned above, there can be no clear declaration about it since all emissions are undesirable to human health and the built environment. One way to look at it could be on the basis of morbidity and cost of negative impacts to the environment and also, close monitoring if emission occurrences conform to specified standards.

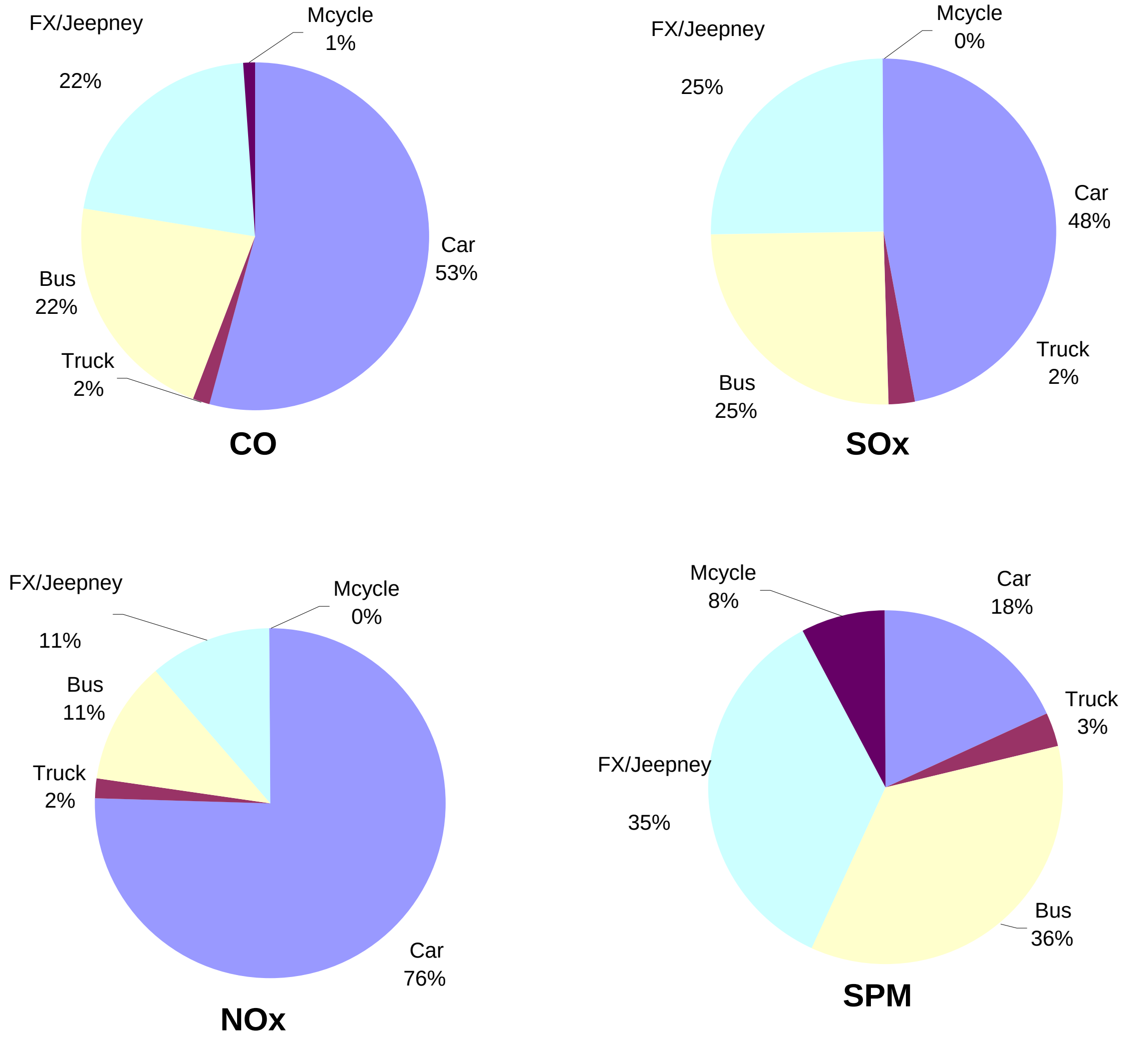


Figure 6-17. Emission share by transport mode

6.5.2.3 Impact of Cooperative Delivery System

There is so much potential in the reduction of pollutant emission through CDS (Figure 6-18 and Table 6-14). As can be observed, the highest reduction achieved is with the CO (1.93%) followed by SPM (1.72%), NOx (1.65%) while the smallest reduction is with SOx (1.36%). As the share of trucks increases, the emission reduction rate due to CDS also increases, indicating significance of CDS a policy measure.

On the other hand, it appears that there are no benefits gained from time window in terms of environmental variables (Figure 6-19 and Table 6-14). This scheme is rather increasing the volume of emissions as the share of freight vehicles is reaching 10%. This indicates that the travel speed of vehicles in some of the links in the network deteriorates, thus emission pollutants increases.

The total amount of emission from different schemes adopted is available in Table 6-14. In this table, vehicle kilometer (total distance traveled by vehicles) is also presented. Under the base case volume of vehicles, a reduction of 0.52% (from 51,211 to 50,944) of the total vehicle kilometer is achieved which increased to 6.8% when the share of delivery vehicles reached 20% of total traffic. Other notable benefit of the CDS is the reduction of delivery time in the district. Delivery time of trucks can be reduced to 54% (1,099 min to 509 min) under the base case volume of vehicles.

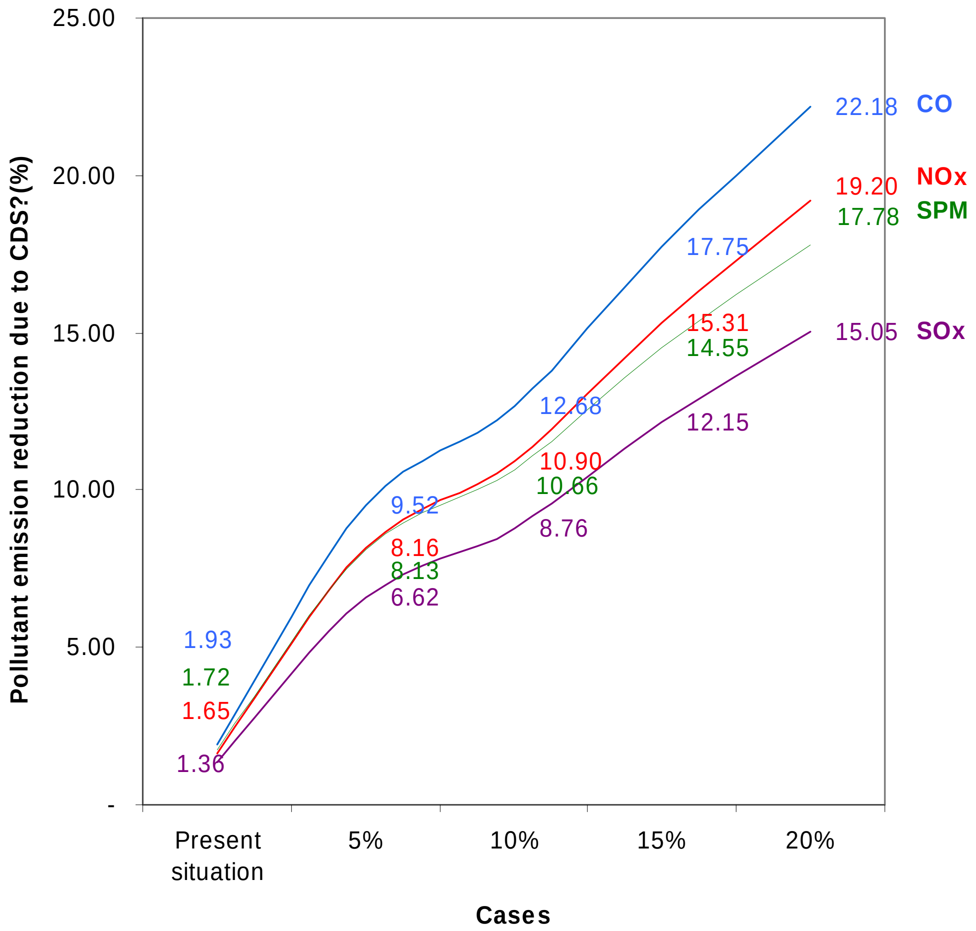


Figure 6-18. Reduction of pollutant emissions derived from cooperative delivery system

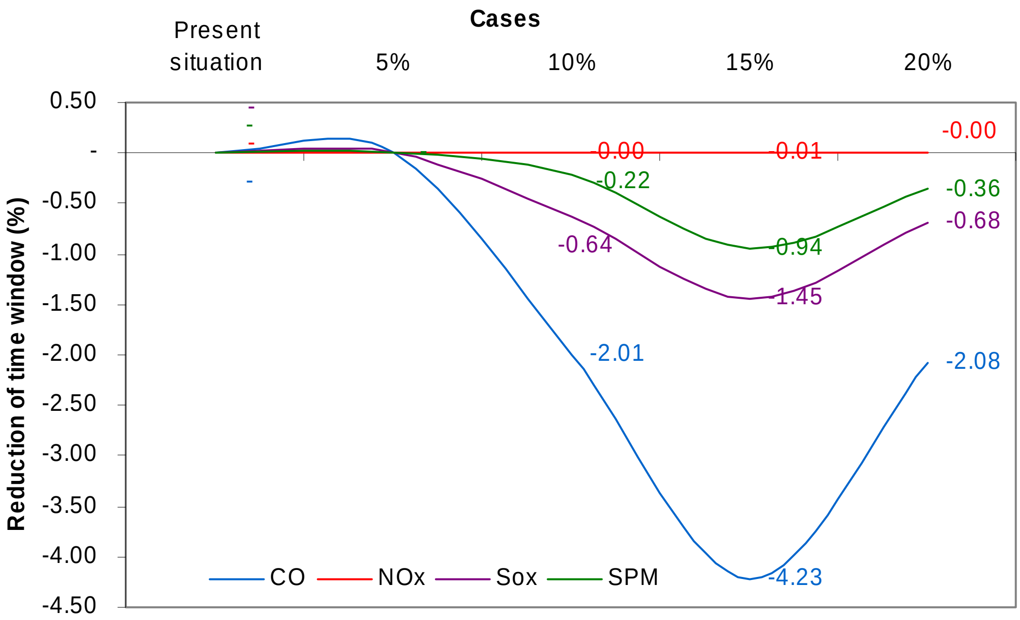


Figure 6-19. Pollutant emissions appear to increase under the Time window scheme as the share of trucks reaches 10%

Table 6-14. Comparison of environmental impacts of CDS and Time Window

Cases	Sub-cases	Distance (km)	CO	NOx	SOx	SPM
Present volume (base case)	Without CDS	51,211	932.16	168.18	1.93	11.23
	With CDS	50,944	914.13	166.41	1.90	11.03
	Time window	51,211	932.16	168.18	1.93	11.23
	CDS Reduction (%)	0.52	1.93	1.05	1.36	1.72
	TW Reduction (%)	-	-	-	-	-
Share of freight vehicles is 5%	Without CDS	53,380	1,021.41	14,923.16	2.15	12.80
	With CDS	51,946	924.19	14,913.66	2.00	11.76
	Time window	53,380	1,021.41	14,923.16	2.15	12.80
	CDS Reduction (%)	2.69	9.52	0.06	6.62	8.13
	TW Reduction (%)	-	-	-	-	-
Share of freight vehicles is 10%	Without CDS	54,411	1,063.83	20,640.84	2.25	13.55
	With CDS	52,422	928.97	20,627.66	2.05	12.11
	Time window	54,411	1,085.18	20,641.40	2.26	13.58
	CDS Reduction (%)	3.65	12.68	0.06	8.76	10.66
	TW Reduction (%)	-	+2.01	+0.00	+0.64	+0.22
Share of freight vehicles is 15%	Without CDS	56,258	1,139.80	30,881.16	2.43	14.89
	With CDS	53,275	937.54	30,861.40	2.13	12.73
	Time window	56,258	1,187.98	30,882.76	2.47	15.03
	CDS Reduction (%)	5.30	17.75	0.06	12.15	14.55
	TW Reduction (%)	-	+4.23	+0.01	+1.45	+0.94
Share of freight vehicles is 20%	Without CDS	58,105	1,215.79	41,125.33	2.61	16.23
	With CDS	54,132	946.14	41,099.00	2.22	13.35
	Time window	58,105	1,241.11	41,126.10	2.63	16.29
	CDS Reduction (%)	6.84	22.18	0.06	15.05	7.78
	TW Reduction (%)	-	+2.08	+0.00	+0.68	+0.36

6.5.3 Travel speed improvement

The enforcement of time window appears to generate benefits in terms of travel time reduction although not substantial. Even the congested road of EDSA improved its travel speed from 34kph to 35kph. Under CDS, the travel speed on EDSA increased to 38kph for all vehicle types (Figure 6-20 and Figure 6-21).

Vehicles turning to the CBD (Ortigas Center) from EDSA registered 7% improvement of travel time (47kph to 50kph) while CDS has the highest gained benefits through increased speed of 52kph. However, vehicles leaving the CBD and merging to the major thoroughfare that is EDSA experienced further delay while time window scheme is in place. This can be attributed to the large number of trucks exiting after having delivered goods to the shopping centers in the CBD. Under the same scheme, the travel speed on the same road declined from 30kph to 28kph while it improved to 32kph under the CDS. Another road (C to EDSA in Figure 6-21), which serves access to EDSA, also benefited from both time window and CDS with 42kph and 46kph improvement from the original travel speed of 40kph.

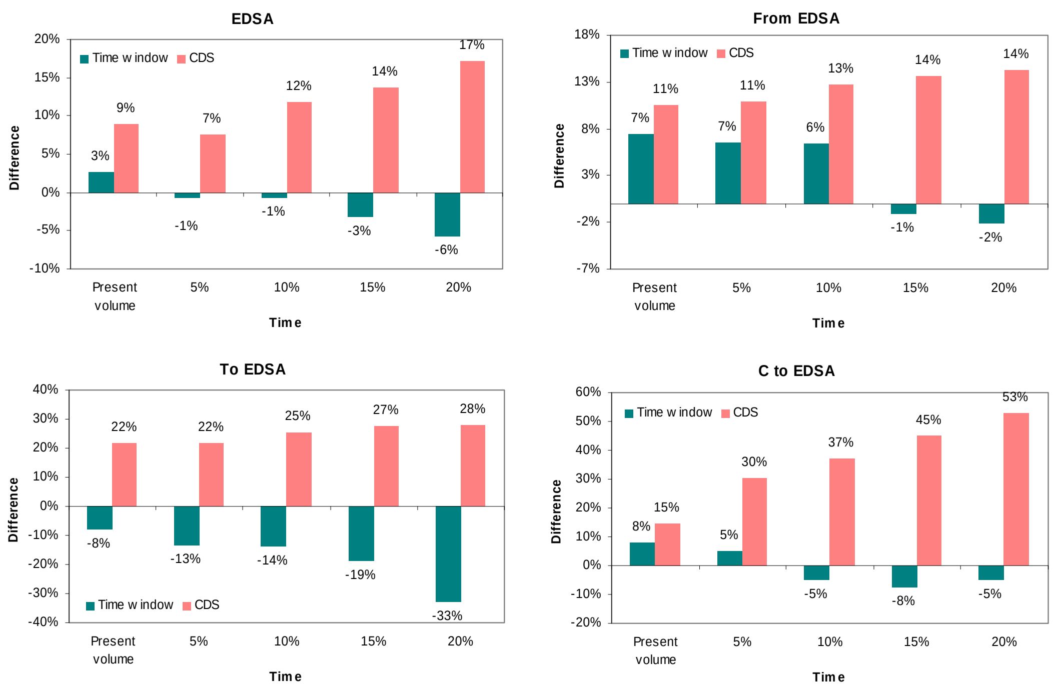


Figure 6-20. Travel speed

Cooperative delivery system shows consistent travel time improvement as the share of freight vehicles increases, while time window appears to show the other way around. As the share of trucks increases, the travel speed of vehicles under the time window scheme deteriorates which could be attributed to the reduced capacity of the network to accommodate the large volume of trucks at the moment the time window commences at 10:30 in the morning. It can therefore be inferred that time window hardly work as a measure to improve traffic flow in a congested network.

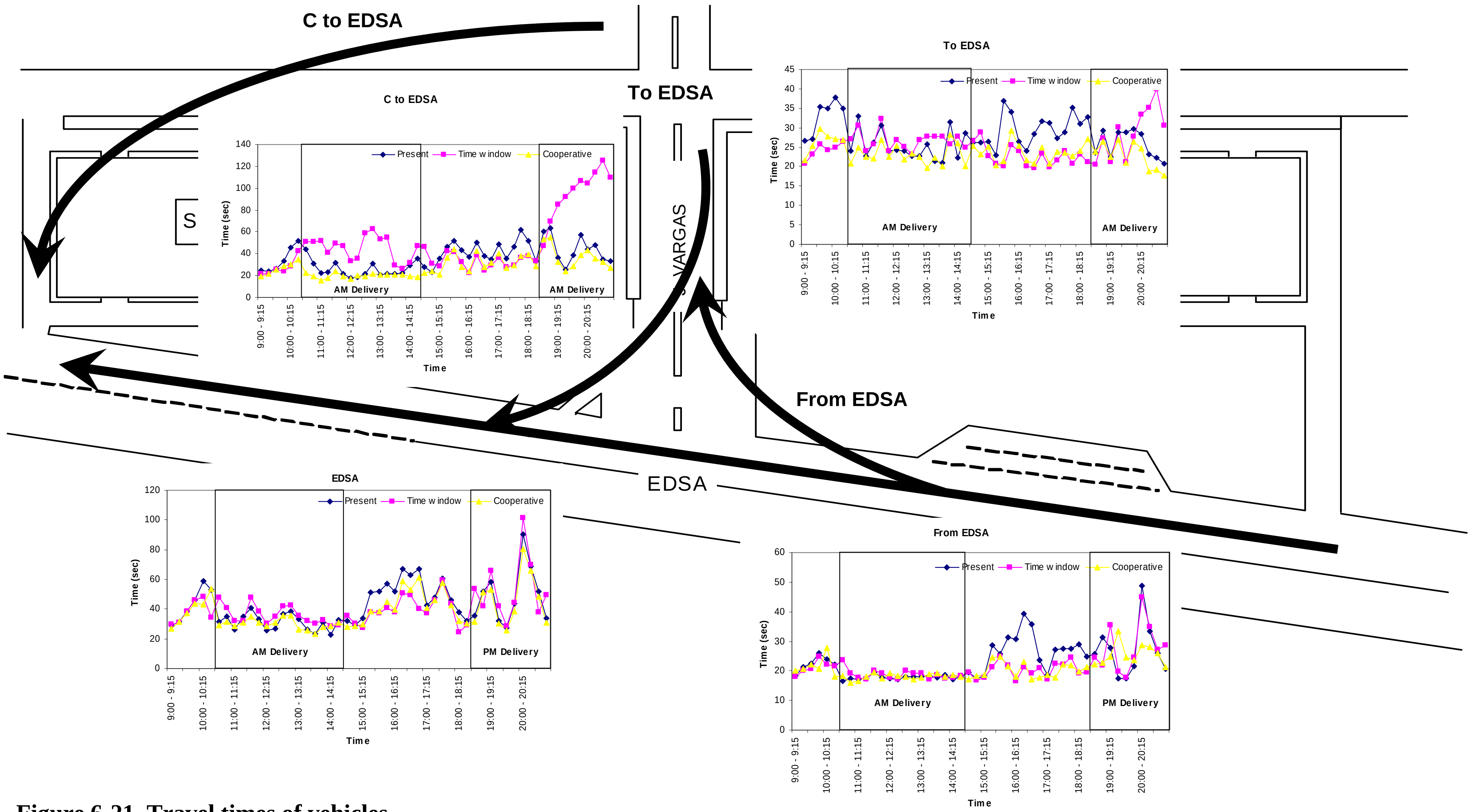


Figure 6-21. Travel times of vehicles

6.6 Role of CDS to the transformation of the CBD from low density to high density

Catering the road-based demands of vehicles in cities of most developing countries can be of great concern among authorities. While hard measures are typical form of intervention to urban related transport demands, mere improvement of the road infrastructures through expanding its capacity is most of the time restricted by the lack of funds. Thus, the growing number of vehicles, cars in particular, cannot be ended nor controlled easily due to the absence of appropriate counter-mechanisms. This tends to put pressure on the existing infrastructures to absorb additional demand, which is already beyond its capacity.

Transportation Demand Management (TDM) measures play significant roles in the intervention and control of the abovementioned dilemma. Among such, as far as freight transportation is concerned is the consideration of CDS for adoption in addressing logistics and transport network related issues such as optimum system use, efficient service delivery, as well as economically and environmentally sound techniques in freight movement and management. CDS has shown bright potentials to achieve the goals such as economic efficiency, social benefits and environmental sustainability through series of empirical analyses.

Further development of the CBD from low density to high density can translate into increased freight traffic, thereby imposing critical look into CBD's travel demand measures and system management tools. As there can be strong pressure on the limited road space, the issue of rising number of car owners and users will inevitably surface. Therefore, it should be included in exploring best solutions and approaches to freight transport issues, since freight vehicles and private cars as well as other modes of transportation share common access network and directly or indirectly affect each other's mobility over the road network. Issues on high car usage should then be analyzed in the context of modal shift from private to mass transit system.

On the other side, freight movements to and from a CBD cannot be shifted to other modes of transportation so, strategic management of truck operation is necessary given the difficulty of providing new infrastructures in view of limited ability to generate fund.

The absence of CDS means increased demand for trucks, which also means, increased trips of trucks with some unutilized extra cargo spaces. This is not a healthy practice both in economic and social point of view. Experience of European cities (see Chapter 3) shows that normally, when problems arise concerning freight vehicles, authorities usually respond by imposing access restriction, which limits the freedom of trucks to operate. This policy forces truck carriers to organize themselves.

In essence, cooperative delivery system can be more appreciated as the development of the CBD intensify. The limited capacity of infrastructure necessitates management-based measures that would limit the number of trucks while serving the same amount of goods. Moreover, the failure of time window scheme to provide substantial improvement to travel speed and reduction of emission pollutants underlines the importance of selecting suitable freight policy. In this regard, social experiment (policy is implemented in a limited area for certain time for trials) can be a tool to assess effectiveness of a policy before implemented in the whole area permanently.

6.7 Chapter summary

Cooperative delivery system has potential to deliver economic and environmental benefits even in developing countries where road infrastructure is largely congested. The more the area is congested, the more it requires appropriate policy measure that would bring significant improvements and benefits. For the case of CDS, although the reduction to the total traffic appears to be limited, its impact to travel times is very notable. Such improvement to travel times coupled with reduced number of trucks brings benefits to the environment and the society as a whole. Although the monetary cost that can be saved from CDS was not discussed explicitly, the reduced vehicle kilometer (VHK) can be interpreted as benefits related to distribution cost.

Central business districts in Metro Manila and other capital of developing countries, for instance Kuala Lumpur and Bangkok, normally houses large shopping centers attracting large volume of both people and vehicles. Although these establishments normally provide ample parking spaces, the access roads are suffering from serious traffic congestion especially during peak hours. This problem is more serious during weekends when most people crowd the center as a way to spend the day off.

The survey result confirms the dominance of cars in the network of Metro Manila, which accounted for 50%. This high share of private cars speaks the importance of completion of mass railway system as alternative mode, coupled with formulation of measures that would discourage the use of cars. This is one way to refrain the rapid increase of travel demand that often exceed the capacity of infrastructure.

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CHAPTER 7

Application of Cooperative Delivery System to a Low Density Central Business District: Case of Developed Country

7.1 Introduction

In the preceding chapter, the impact of CDS to traffic flow and environment in the CBD of a developing country was evaluated. It was learned that the role of CDS is becoming crucial as the development of CBD gears up and attracts large number of freight vehicles. CDS can help decongest the road network by limiting the number of trucks that distribute the same volume of freight. Although some benefits are gained such as improved travel speed and less pollutant emissions, the situation in the urban environment of developing country is still far from desirable as much can still be done to tackle the rampant use of cars which easily create serious traffic congestion to the limited road network capacity.

In this chapter, aside from estimating the traffic and environmental impact of the CDS in the CBD, the ratio of truck trips needs to be covered by the CDS in order to avoid queues of trucks and eliminate their waiting time is also estimated. The setting is also shifted from CDB of a developing country to CBD of developed country seeing that difference of transport environment between these two CBDs requires separate analysis.

Section 7.2 focuses on the conceptualization of the social experiment and provides necessary background of the district the Marunouchi district. The result of the experiment as well analyses of the data gathered is presented in Section 7.3. Comprehensive analysis to the merit of CDS using simulation modeling in the district is available in Section 7.4. This analysis includes the evaluation to the ability of CDS to absorb increasing truck trips when the district changes from office-oriented CBD to commercial type of CBD. Comparison of CDS's traffic and environmental impact between Manila and Tokyo is presented in Section 7.5. The chapter is finally concluded in Section 7.6.

7.2 The Social Experiment

7.2.1 Location of Marunouchi District

The Tokyo's core central business districts are Chiyoda-ku, Chuo-ku, and Minato-ku with a total area of 42.13 km^2 and offering jobs to 14.6%. Marunouchi district is located in Chiyoda-ku and hosts over 4,000 company offices which employs more than 240,000 people (Figure 7-1). Historically, the concentration of working force in this district started as early as 19^{th} century after the Meiji revolution. By that time, the district is the biggest CBD, which holds true to present time. The presence of the Imperial palace, the official residence of the Imperial family, prompted the limitation of building height to 31-meter which has been modified lately into 260-meters.

Figure 7-1. Map of Tokyo showing the location of Marunouchi district

Of similar importance is a 2002 survey of a real estate developer which observed that the supply of large-scale office buildings (building with floor space of over 10,000 m^2) is concentrated in three central wards of Tokyo, namely, Chiyoda-ku, Minato-ku, and Chuo-ku (Figure 7-2). Mori Building Company Ltd. further noted that this trend will continue and fierce competition among these wards would persist. Figure 7-2, which was taken from the same report, shows the amount of supplied office spaces in Tokyo. Aside from the three mentioned wards, two additional wards composing the five central wards are Shinjuku-ku and Shibuya-ku.

7.2.2 Background of the Social Experiment

Most of the important functions of the country had been absorbed by Tokyo, especially by the three central wards, namely Chiyoda, Chuo and Minato. Figure 7-3 provides a comparison numbers between the three central wards, the rest of the Tokyo wards, and Japan.

Marunouchi District, located between the Tokyo Railway Station and the Emperor's Palace, is the oldest and the biggest central business district in Japan since late 19th century, after the Meiji Revolution, up to this day. Similarly, most large company head offices are concentrated in the Marunouchi District in pursuit of better communication and business chance. The relaxation of the 31-meter building height restriction in this district has paved the way to urban revitalization activities.

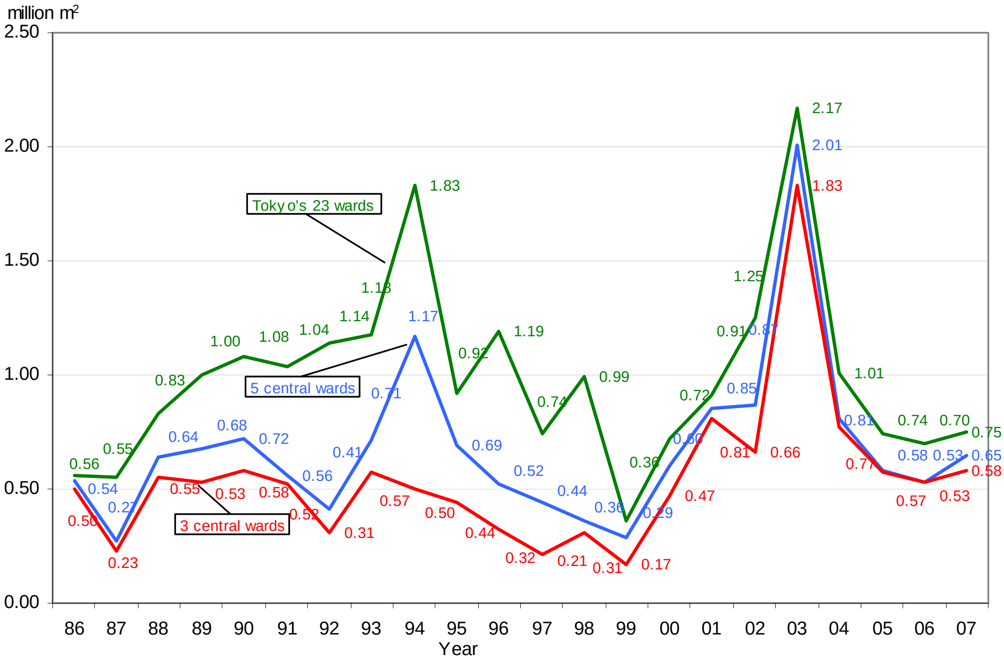


Figure 7-2. Supply Volume of Large-scale Buildings by Area in Tokyo

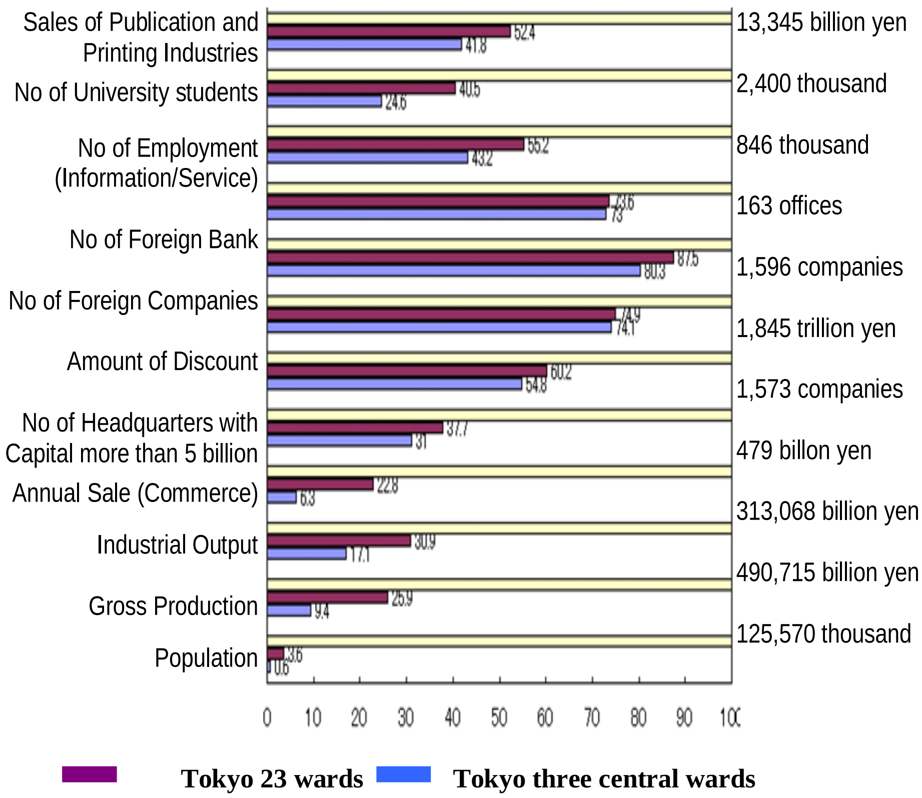


Figure 7-3. Tokyo's 3 central wards and 23 wards ratio of functions to Japan

The government of Tokyo made a redevelopment plan for Marunouchi District. It espouses change in function from a business or office-oriented district into a multi-use complex which includes business, culture and commercial functions. In September

2002, Marunouchi Building was rebuilt as the first redevelopment project in this district and will be followed by other many projects. These redevelopment projects, however, would cause some city problems that necessitated appropriate responses, which has been strongly recognized by public and private sectors. Among these is the increase in the number of delivery vehicles plying the district that would disrupt the physical environment. It is also expected that some of these trucks would load/unload their freight on-road and thus disrupt the traffic flow. In addition, as building height increases, the freight deliveries would require longer staying period of trucks at the docking area. Normally, the increase in delivery time inside the building produces a long queue of vehicles outside.

In recognition of these problems, all concerned parties such as the building owners, tenants, carriers, the Metropolitan Police Agency and Ministry of Land and Transportation, has organized a committee called “An Executive Committee for Improving the Efficiency of Freight Delivery in Marunouchi District” or better known as Executive Committee. The purpose of this committee is to discuss the possibility of introducing a new freight delivery system which could improve the efficiency of freight delivery, limit air pollution, and improve parking control. In February 2002, the Executive Committee conducted a social experiment of freight transportation in Marunouchi District. The experiment area, which has a size of 630 m by 240 m, is shown in the map in Figure 7-4. Table 7-1 provides detail information of the buildings involved in the project.

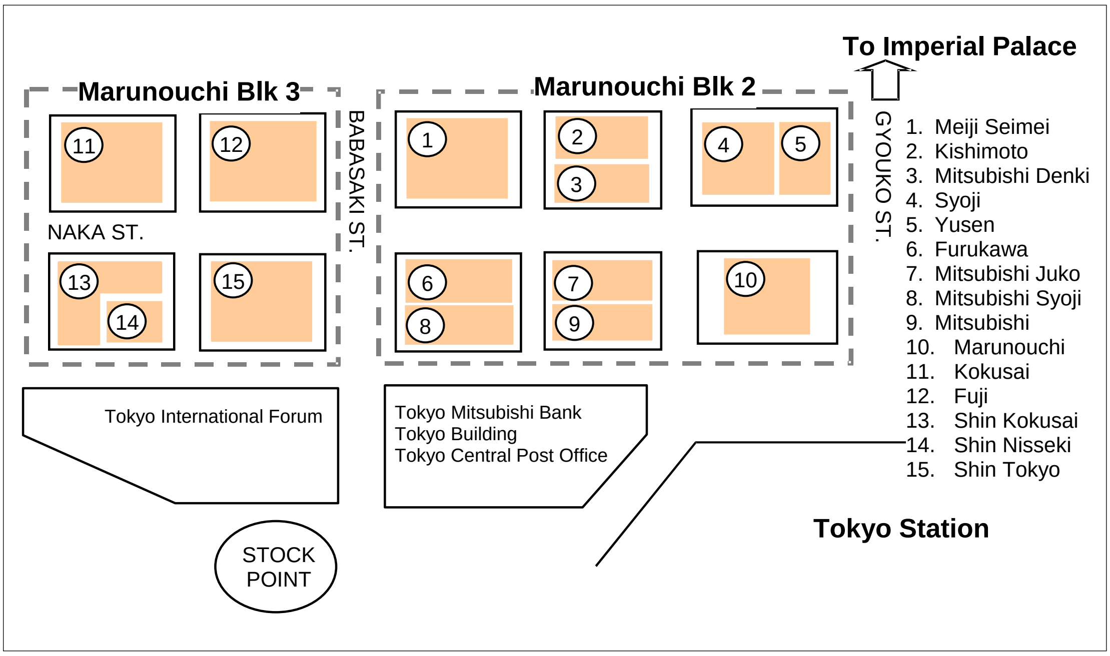


Figure 7-4. Map of Marunouchi District (Building 6, 7, 8, and 9 were covered by the experiment)

7.2.3 Outline of the Social Experiment

Two major components of transportation management, cooperative delivery and parking management, were included in the social experiment from February 5 until

February 28, 2002. Five (5) major carriers and 13 small-scale carriers had taken part in the experiment. Freight had to be carried first into the SP by the carrier participants, then, loaded unto a natural gas truck altogether and then delivered to each building.

7.2.4 Properties of the Buildings under the Experiment

The district is has just recently been known as shopping district and has been primarily home only to designer clothes shops. The figures in Table 7-2 show that it is more of an office-oriented area where big portion of the space is allocated to office firms.

Table 7-1. Policy Instruments of the Experiment

<table>
<tr><th colspan="3">Experiment Area</th><th>Five buildings in Marunouchi, Tokyo</th></tr>
<tr><td colspan="3">Term of Experiment</td><td>February 1 to February 28 (19 weekdays), 8 am to 5 pm</td></tr>
<tr><td rowspan="11">Policies</td><td rowspan="7">Coop Delivery</td><td rowspan="5">Horizontal Coop Delivery</td><td>Cooperative delivery by 5 major carriers and other participants</td></tr>
<tr><td>Delivery through SP to each building</td></tr>
<tr><td>Natural gas trucks</td></tr>
<tr><td>Fee from SP to offices of the buildings is 50 yen per freight</td></tr>
<tr><td>Mail, papers, packages except cold storage and frozen foods, etc.</td></tr>
<tr><td rowspan="2">Vertical Coop Delivery</td><td>Staff deliver freights from underground of the buildings to offices inside the building</td></tr>
<tr><td>Drivers drive through buildings without delivering freights</td></tr>
<tr><td colspan="2" rowspan="4">Parking Management</td><td>Guards control illegal on-road parking</td></tr>
<tr><td>Ban on bringing in freights to the front entrance of the buildings</td></tr>
<tr><td>To use freights elevators for delivering</td></tr>
<tr><td>30 min free parking at underground parking space of buildings</td></tr>
</table>

Table 7-2. Properties of Buildings Covered by the Experiment

No	Building name	No. of floor	Gross floor (m^2)	Leasable space (m^2)	Leasable %	Office space (m^2)	Shops and restaurants (m^2)
6	Furukawa	9 (4)	51637.00	30029.47	58%	27749.94	2279.53
	Yaesu	9 (1)	18379.00	13598.44	74%	13330.54	267.9
7	Mitsubishi	15 (4)	62906.38	40483.66	64%	40248	235.66
8	Mitsubishi Juko	10 (4)	45985.00	31861.06	69%	30447.23	1413.83
9	Mitsubishi Syoji	15 (4)	55259.00	37829.04	68%	37829.04	0
	Total	58 (17)	46833.28	153801.67	67%	149604.75	4196.92

Note: ( ) number of basement floor

7.3 Result of the Social Experiment

7.3.1 Observed Behavior of Cooperative Delivery System

The district has at least 15 high-rise buildings but not all were covered by the experiment due to perceived difficulty of managing wide-area for experiment and, to some extent, unwillingness of other companies to participate in the project.

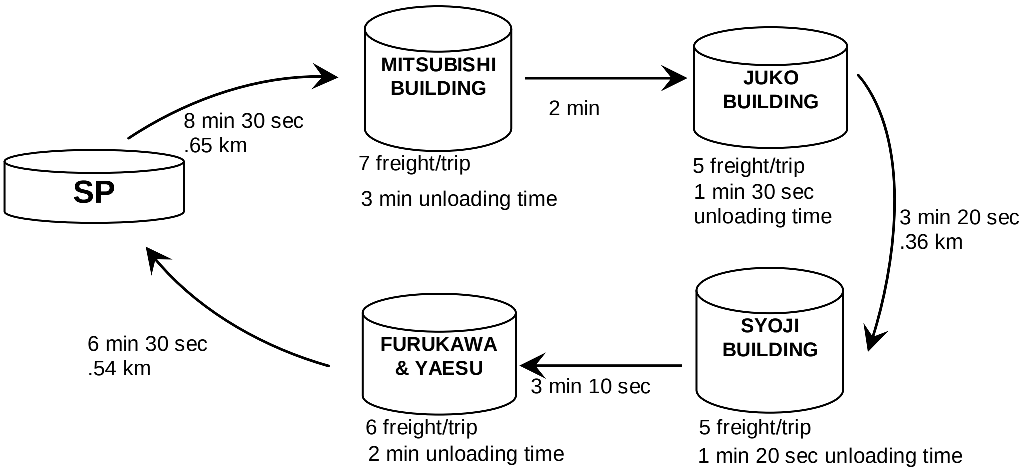


Figure 7-5. Horizontal Cooperative Delivery System

The unloading time for freight in the four (4) buildings has an average of 15 minutes before the experiment. The combined effect of two CDSs reduced this time to merely 2.35 minutes (Figure 7-5). Average unloading time for freight at each building is shown in Figure 3 as well as the average number of freight delivered. Further, the distance of each building from one another is also reflected and the average travel time of the CNG truck.

7.3.2 Number of Trips and Freight Attracted to the Four (4) Buildings

Table 7-3. Number of Trips and Freight into the Buildings under the Experiment

No	Building name	Total no. of trips	Trips to offices	Trips to shops & restaurants	Total no. of freight	Freight to office	Freight to shops & restaurants
6	Furukawa	89	74	15	198	133	65
	Yaesu	13	10	3	14	11	3
7	Mitsubishi	116	93	23	456	271	185
8	Mitsubishi Juko	92	74	18	284	184	100
9	Mitsubishi Syoji	132	132	0	772	772	0
	Total	442	361	81	1724	1199	525

Note: Furukawa and Yaesu buildings are sharing some logistics infrastructure and treated as one

Table 7-4. Distribution of trips within a day

No	Building name	No of freight vehicle's trip per day				No of freight per day			
		8:00 - 9:30	9:30 - 12:00	12:00 - 17:00	Total	8:00 - 9:30	9:30 - 12:00	12:00 - 17:00	Total
6	Furukawa & Yaesu	19	37	46	102	73	65	74	212
7	Mitsubishi Juko	24	29	39	92	112	84	88	284
8	Mitsubishi Syoji	29	46	57	132	116	228	428	772
9	Mitsubishi	19	42	55	116	118	218	120	456
	Total	91	154	197	442	419	595	710	1724
	Percentage	21	35	45	100	24	35	41	100

A one-day survey conducted in four buildings in the district recorded both the total number of trips (442) to each building and the amount of goods (1724) delivered. As noted in Table 7-3, most of the freight was delivered to the offices which accounted around 70 percent. The number of freight and number of trips are not proportional as more than 81 percent of the trips were intended for the offices. Taking into account the total number of freight and the total number of trips, each trip has an average of four (4) freight loads per trip.

Aside from identifying the destination of freight and trips, either to the office or to the shops and restaurants as shown in Table 7-3, the survey also recorded the time arrival of each trip which is reflected in Table 7-4. For the span of 90 minutes, there were 91 trips made in the morning, which suggest that the interval between trips is quite close or less than one minute. The same can be said to the 9:30 – 12:00 time span where 154 trips were recorded. The afternoon schedule suggest longer time interval between trips compared to the two other schedules in the morning with an average of 5.45 minutes.

The recorded number of freight shown in the same table could come up with the presumed delivery trip attribute that the early morning schedule has an average of less than five (5) freight loads in every trip and the mid-morning and afternoon schedules have an average of less than four (4) freight loads per trip.

7.3.3 Comparison of delivery style before and during the experiment

The experiment changed the pattern of delivery from individual delivery truck separately delivering their freights to a consolidated shipment originated from the SP. Freight loaded by the natural gas trucks are handled by the two staff members assigned to each building. This process allows the truck drivers to move out of the building immediately. The guards stationed at the surrounding roads controlled the illegal on-road parking and guide cars into underground parking spaces. In addition, it was also restricted for all truck drivers to bring in their freights into the front entrance of the building. The changing pattern of delivery is illustrated in Figure 7-6 while Table 7-5 shows the detailed information regarding the policy of the experiment.

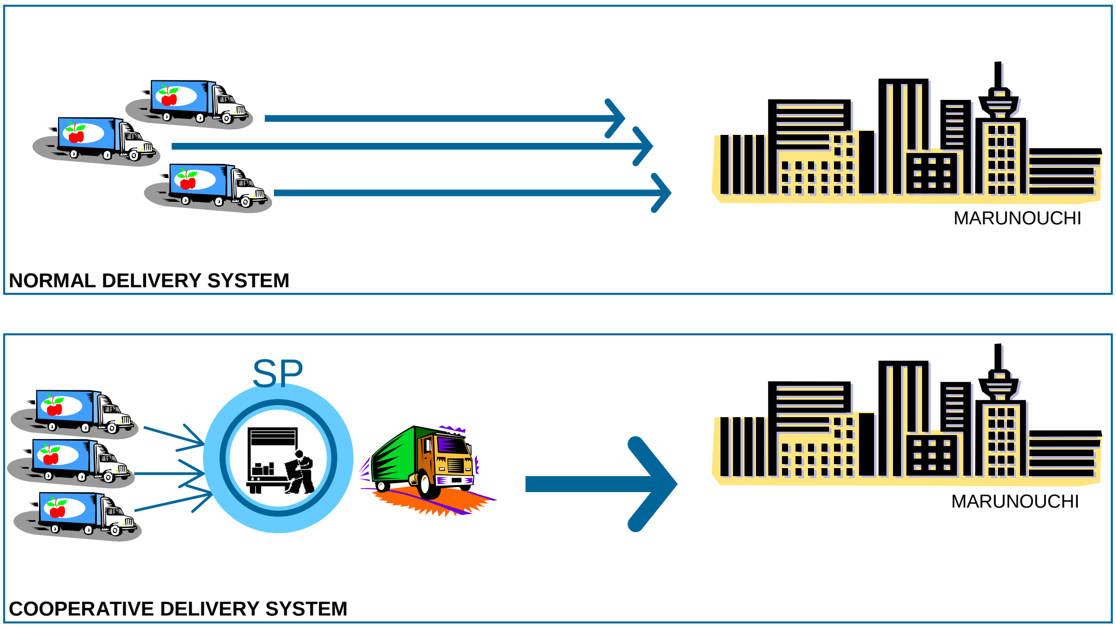


Figure 7-6. Delivery pattern before and after the experiment

Table 7-5. Measures of observation

Daily Reports	by drivers at stock point by staffs at underground and loading space
Surveys	on-road parking and underground parking lot traffic volume utilization of freight elevators stock point
Questionnaire	for participants, non participants, tenants, building owners, office staffs, shoppers, and staffs of experiment
Others	by car navigation systems and digital pedometers

Out of 232 total numbers of carriers operating in the area, 7.8 percent joined the experiment including five major and 13 minor carriers. The delivery trucks that belonged to the carriers who did not join the experiment continued to deliver their freights directly to the building establishments. They are not, however, allowed to utilize the unloading spaces reserved for the experiment. Drivers of these trucks are expected to look for parking spaces on their own.

As shown in Table 7-6, although the number of carriers participated accounted for only 7 percent, 22 percent of freights were covered.

Table 7-6. Share of participants in the experiment

	Total in the area	Participants	Share of participants
No of carriers	232	18	7.80%
No of trucks	442	32	7.20%
No of freights	1724	383	22.20%

7.3.4 Analysis on Horizontal Cooperative Delivery and Parking Management

Table 7-7. The number of Trucks that Transshipped Freights at SP

	No of trucks arrived at SP	No of trucks started from SP	Reduction rate of the number of trucks
Total of 19 days	186	125	33%
Average per day	9.8	6.6	33%

Only 30 percent of the freight by the carriers who joined the experiment was delivered to the SP for consolidation. Seventy percent of freights had been delivered directly from their own depots near the experiment area to each building without stopping at the SP. Table 5 shows the number of trucks originating from the SP. The presence of the SP resulted in the reduction of 33 percent of the total number of vehicles supposed to deliver in the district (Table 7-7). On the other hand, the policies such as preparing underground unloading spaces, 30 minutes free parking, ban on bringing in the freight through main entrance of buildings, and restriction of on-road parking resulted to 50 percent reduction of on-road parking and 35 percent increase of underground parking space utilization rate as shown in Figure 7-7.

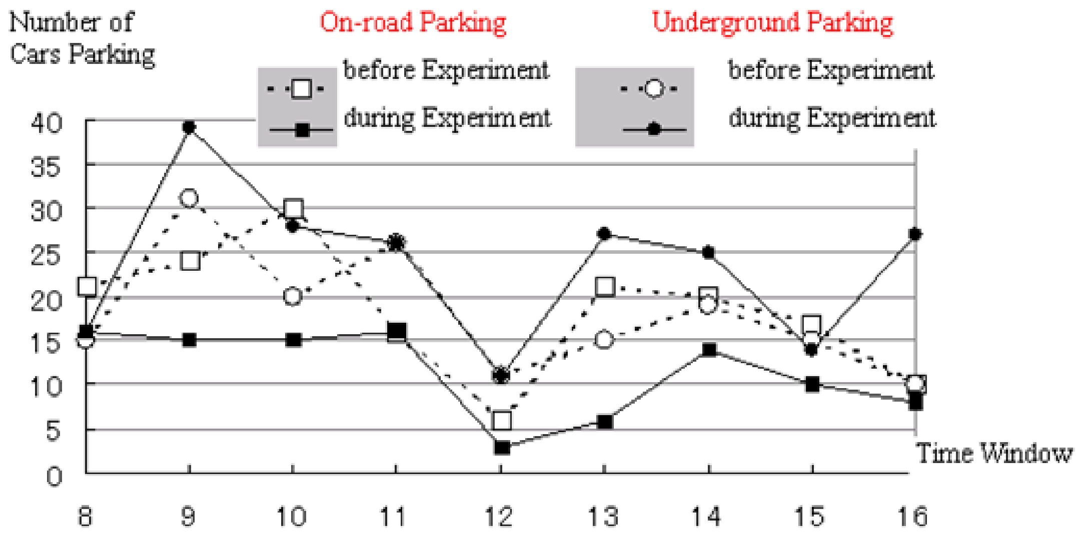


Figure 7-7. Change of the number of truck parking

7.3.5 Setting up the attraction units of the four buildings

The attraction unit as explained in Chapter 4 is useful to estimate the number of trips and goods that are expected to be shipped to the buildings based on the size of their leasable space. Obviously, attraction unit of a space occupied by shops and restaurant is higher than a space which housed offices. This is the reason for computing separately the attraction unit of shops and restaurants and office space as shown in Table 7-8.

Table 7-8. Attraction unit of trips and freight

Building name	Trips/100 (m^2)		Freight/100 (m^2)	
	Office	Shops & restaurants	Office	Shops & restaurants
Furukawa	0.27	0.66	0.48	2.85
Yaesu	0.08	1.12	0.08	1.12
Mitsubishi	0.23	9.76	0.67	78.50
Mitsubishi Juko	0.24	1.27	0.60	7.07
Mitsubishi Syoji	0.35	-	2.04	-
Total	0.26	1.41	0.92	8.41

Note: - there was no observed trips and freight to shops and restaurants

7.3.6 Estimating Freight Vehicles' Trips To The District

The estimated number of trips and freight to each building in the district is shown in Table 7-9, which was obtained by utilizing the attraction unit of trips and freight in Table 7-8. Obtaining this data is crucial to estimate the impact of the cooperative delivery in the district in the assumption that all trips are covered by CDS.

A look into the same table would reveal that of the 741,741 square meters total leasable space in the district, shops and restaurants occupied only 2.72 percent. Although the share of shops and restaurants is small, their share of trips and number of freight are remarkably high with 13 percent and 20.4 percent respectively.

Table 7-9. Distribution of trips and freight's to the buildings in the district

No	Building	Leasable space (m²)	Office space (m²)	Shops & Restau-rants (m²)	Trips per day			No of freight per day		
					Office	Shops & Restaurants	Total	Office	Shops & Restaurants	Total
1	Meiji Seimei	96673	94036	2637	244	37	282	865	222	1087
2	Kishimoto	22082	21479	602	56	8	64	198	51	248
3	Mitsubishi Denki	29966	29149	818	76	12	87	268	69	337
4	Shouji	35918	34938	980	91	14	105	321	82	404
5	Yusen	33569	32653	916	85	13	98	300	77	377
6	Furukawa & Yaesu	43628	41080	2547	84	18	102	144	68	212
7	Mitsubishi Jyukou	31861	30477	1414	74	18	92	184	100	284
8	Mitsubishi Shouji	37829	37829	0	132	0	132	772	0	772
9	Mitsubishi	40484	40248	236	93	23	116	271	185	456
10	Marunouchi	104000	101163	2837	263	40	303	931	239	1169
11	Kokusai	75975	73902	2073	192	29	221	680	174	854
12	Fuji	53220	51768	1452	135	20	155	476	122	598
13	Shin Kokusai	50365	48991	1374	127	19	147	451	116	566
14	Shin Nisseki	17268	16797	471	44	7	50	155	40	194
15	Shin Tokyo	68903	67023	1880	174	27	201	617	158	775
	Total	741741	721534	20238	1870	285	2155	6632	1702	8335

** Shaded rows contained actual data obtained during the experiment*

7.3.7 Distribution of trip attraction to the district

The figures obtained in Table 7-9 show the total trip and freight received by each building in a day. These figures are then distributed according to the observed trips and freight distribution recorded during the experiment. The trips are distributed in this pattern: 21 percent for the 8:00 to 9:30 time schedule; 35 percent for 9:30 to 12:00 time schedule and 45 percent for the afternoon schedule.

By following the said distribution of trips arrival and its corresponding amount of freight, the pattern of trip arrival in the district is shown in Table 7-10.

Table 7-10. Distribution of trips and freight to the buildings in a day

No	Building name	No of freight vehicle's trip per day				No of freight per day			
		8:00 - 9:30	9:30 - 12:00	12:00 - 17:00	Total	8:00 - 9:30	9:30 - 12:00	12:00 - 17:00	Total
1	Meiji Seimei	58	98	126	282	264	375	448	1087
2	Kishimoto	13	22	29	64	60	86	102	248
3	Mitsubishi Denki	18	30	39	87	82	116	139	337
4	Syoji	22	36	47	105	98	139	166	404
5	Yusen	20	34	44	98	92	130	155	377
6	Furukawa & Yaesu	19	37	46	102	73	65	74	212
7	Mitsubishi Juko	24	29	39	92	112	84	88	284
8	Mitsubishi Syoji	29	46	57	132	116	228	428	772
9	Mitsubishi	19	42	55	116	118	218	120	456
10	Marunouchi	62	106	135	303	284	404	482	1169
11	Kokusai	46	77	99	221	208	295	352	854
12	Fuji	32	54	69	155	145	207	246	598
13	Shin Kokusai	30	51	65	147	138	195	233	566
14	Shin Nisseki	10	18	22	50	47	67	80	194
15	Shin Tokyo	41	70	89	201	188	267	319	775

7.3.8 Distances between buildings and from stock point

The size of the district where these 15-buildings stands is around 870 m^2. The stock point's distance to each building has an average of .68 km which means a delivery truck can reach even the farthest building in few minutes. On the other hand, the average distance that truck would travel from one building to another is 422 meters (see Table 7-11).

Table 7-11. Distance of the buildings from the stock point

No	Building name	Km/trip
1	Meiji Seimei	0.78
2	Kishimoto	0.77
3	Mitsubishi Denki	0.77
4	Syoji	0.77
5	Yusen	0.77
6	Furukawa & Yaesu	0.77
7	Mitsubishi Juko	0.77
8	Mitsubishi Syoji	0.65
9	Mitsubishi	0.65
10	Marunouchi	0.65
11	Kokusai	0.65
12	Fuji	0.65
13	Shin Kokusai	0.54
14	Shin Nisseki	0.54
15	Shin Tokyo	0.54
	Average	0.68

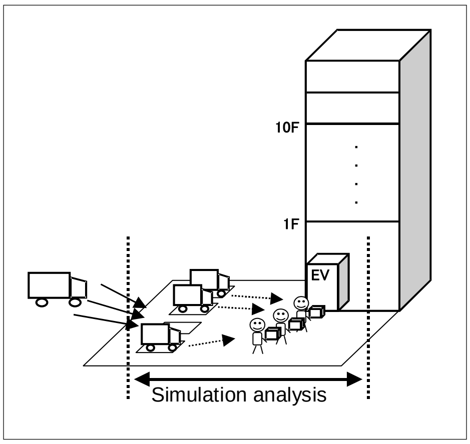
The distances of each building from the stock point and other buildings in the district are important to estimate the average traveled distance of each truck entering the district. Under the CDS therefore, the average traveled distance of a truck is 1.78 (Table 7-12). This was obtained by combining the distances traveled by the truck: outgoing trip including first stop in a building to deliver goods is .68 km, second stop to deliver the remaining goods is .422 km, and the return trip's distance is .68 km again.

Table 7-12. Distances between the buildings in the district

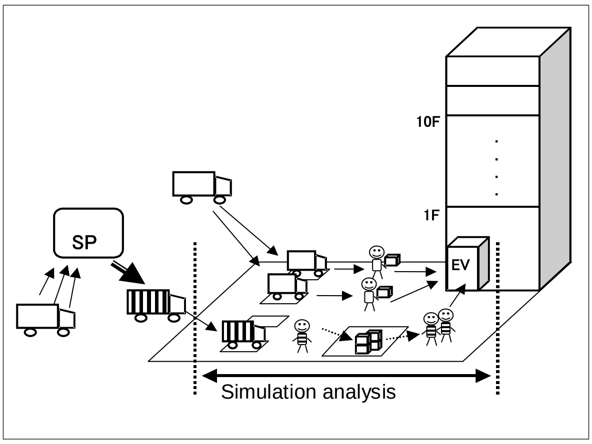
OD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Average
1	-	.36	.36	.36	.36	.24	.48	.24	.48	.48	.51	.51	.63	.63	.63	.418
2	.36	-	0	.12	.12	.48	.24	.48	.24	.24	.63	.63	.75	.75	.75	.386
3	.36	0	-	.12	.12	.48	.24	.48	.24	.24	.63	.63	.75	.75	.75	.386
4	.36	.12	.12	-	0	.48	.24	.48	.24	.24	.63	.63	.75	.75	.75	.386
5	.36	.12	.12	0	-	.48	.24	.48	.24	.24	.63	.63	.75	.75	.75	.386
6	.24	.48	.48	.48	.48	-	.36	0	.36	.36	.63	.63	.51	.51	.51	.402
7	.48	.24	.24	.24	.24	.36	-	.36	0	.12	.75	.75	.63	.63	.63	.378
8	.24	.48	.48	.48	.48	0	.36	-	.36	.36	.63	.63	.51	.51	.51	.402
9	.48	.24	.24	.24	.24	.36	0	.36	-	.12	.75	.75	.63	.63	.63	.378
10	.48	.24	.24	.24	.24	.36	.12	.36	.12	-	.75	.75	.63	.63	.63	.386
11	.51	.63	.63	.63	.63	.63	.75	.63	.75	.75	-	.12	.24	.24	.24	.492
12	.51	.63	.63	.63	.63	.63	.75	.63	.75	.75	.12	-	.24	.24	.24	.492
13	.63	.75	.75	.75	.75	.51	.63	.51	.63	.63	.24	.24	-	0	.12	.476
14	.63	.75	.75	.75	.75	.51	.63	.51	.63	.63	.24	.24	0	-	.12	.476
15	.63	.75	.75	.75	.75	.51	.63	.51	.63	.63	.24	.24	.12	.12	-	.484
														Average		.422

7.3.9 Situation At The (Off) Loading Area With And Without Cooperative Delivery System

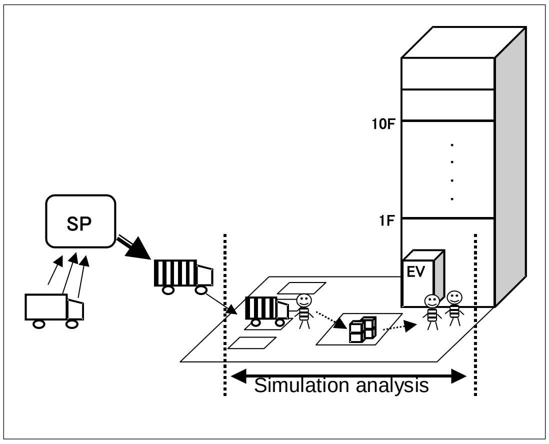
Generally, three different scenarios are intended to be analyzed – regular form of delivery (without CDS), when some of the trips were covered by the CDS and when all the trips into the district were covered by the CDS (Figure 7-8). This means that all of the firms and carriers agreed to have taken part the CDS.



Without CDS



With some trips covered by the CDS



With full participation of firms into CDS

Figure 7-8. Simulation cases

With the regular form of delivery, each driver of freight vehicle will deliver their load to the recipient across the building floors after parking the vehicle at the loading / unloading spaces. This form of delivery would allow the freight vehicle to stay longer at the loading / unloading area thus reducing its utilization rate. Queues of vehicles can be also expected to the buildings where firms with high demand for trips and freight are situated. When some of the trips were covered by the CDS, there would be staff members waiting at the loading / unloading area. Freight vehicles participated the CDS would receive support from these staff once reaching the reserved parking spaces. This arrangement, however, is not available to the drivers who did not participate in the CDS and they are expected to locate their own parking space.

A more organized form of freight transport is expected to realized, however, when all incoming trips of freight vehicles are covered by the CDS. This form of freight delivery would not only reduce the number of trips but as a result, would also improve the state of environment due to the less number of vehicles emission.

Comparison of the Number of Trips and Freight With and Without CDS

The Marunouchi building (building 10) is taken as a case study in this section of the paper because it is the one having the highest attraction of trips. Therefore, the trips difference between with and without cooperative system can be easily spotted. The estimated trips and freight attracted to the building is shown in Table 7-13. Without the CDS, a short interval between trips with few number of freight can be expected.

Table 7-13. Total trips and freight in the Marunouchi bldg without CDS

Time	Total time (m)	No of trips	Interval bet trips (m)	No of freight	Ave freight per trip
8:00-9:30	90	62	1.45	284	4.58
9:30-12:00	150	106	1.41	404	3.81
12:00-17:00	300	135	2.22	482	3.57

Table 7-14. Number of trips and freight when the CDS covers 20% of trips to the Marunouchi bldg

Time	Total no of trips	Total no of freight	No of trips with CDS	Interval bet trips (m)	No of freight	No of trips without CDS	Interval bet trips (m)	No of freight
8:00-9:30	62	284	12	15	57	50	1.24	227
9:30-12:00	106	404	21	30	81	85	1.24	323
12:00-17:00	135	482	27	60	96	108	2.25	386

Table 7-15. Number of trips and freight when all trips to Marunouchi bldg is covered by the CDS

Time	No of trips	Interval bet trips (m)	Total no of freight	Ave freight per trip
8:00-9:30	6	15	283	47
9:30-12:00	5	30	402	80
12:00-17:00	5	60	480	96

Table 7-14 shows the difference in terms of number of freight carried by delivery vehicles of CDS and those delivery vehicles performing normal distribution of freight. The numbers of trips under the CDS were obtained by multiplying the total trip in a time schedule (62) to the rate of trips covered by CDS (20 percent). The committee responsible for the social experiment set the time intervals 15, 30, and 60 minutes and being followed for the simulation analysis. The same process was performed in order to obtain the number of freight expected to be received by the building in a certain time interval.

The expected trips to Marunouchi building can be reduced to 3.6 percent if all the incoming trips are covered by the CDS (Table 7-15). This system would also improve significantly the load factor of delivery vehicle and the long time intervals between trips would allow the parking spaces to accommodate all incoming trips.

The procedures discussed show the estimation of trips depending on the rate covered by the CDS. This procedure was applied to all the buildings in the district which was used as an input data of the simulation model.

7.4 Simulation Modeling

Estimating the impact of the CDS to the district is not possible without the generated data discussed earlier because simulation analysis required detailed input data. Although these data were not obtained through a survey, they have a strong basis to be accurate since the foundation of obtaining them comes from the surveyed data of the four-building.

As discussed in Section 5.3 in Chapter 4, simulation approach suits in a problem where multiple alternatives are being consider – i.e. what is the impact of the CDS to logistical activities if 10 percent of the trips is covered (this incriminations is done until 100 percent is covered). Further, this powerful analytic tool is often used to identify opportunities and evaluate solutions to a complex problem that cannot be easily brought to light by other models and analysis.

7.4.1 About SIMUL8

The simulation analysis of the study was entirely designed in the commercially available manufacturing simulation software SIMUL8. This software combines the graphical interface and spatial simulation. The works on the principle of drawing from different spatial components of study area composed of organization/establishment to be analyzed. Data specifying the dimension of the organization/establishment or that would define the behaviors of the workers or vehicles can be done by filling in numerical information ready available.

The drawing of simulation model is done by clicking buttons and dragging the objects to their location. In the study's model, first created were those fixed objects such as Stock point, loading dock, floors of the building. Routes between these objects were made by clicking the arrow and entering appropriate figure say speed, distance and other dimensions that characterize the behaviors of elements of the model. On the other hand, controlling the arrival of freight vehicle is made by selecting appropriate distribution built-in the software.

The software further enhance its analytical power by allowing the user to control virtually all the objects inside the simulation by permitting external sources like spreadsheets or Visual Basic. Working environment of the software and the screenshot of the study's model is shown in Figure 7-9.

7.4.2 Properties of the Simulation model

The properties of simulation model are shown in Table 7-16. These figures were obtained during the social experiment. The average unloading time per freight from the vehicle up to the elevator is 19.8 seconds while it took 27 seconds to deliver each good from the elevator up to the receiver. It can be observed that the delivery time is longer as compared with the unloading process since the delivery staff sometimes has to wait for the receiver.

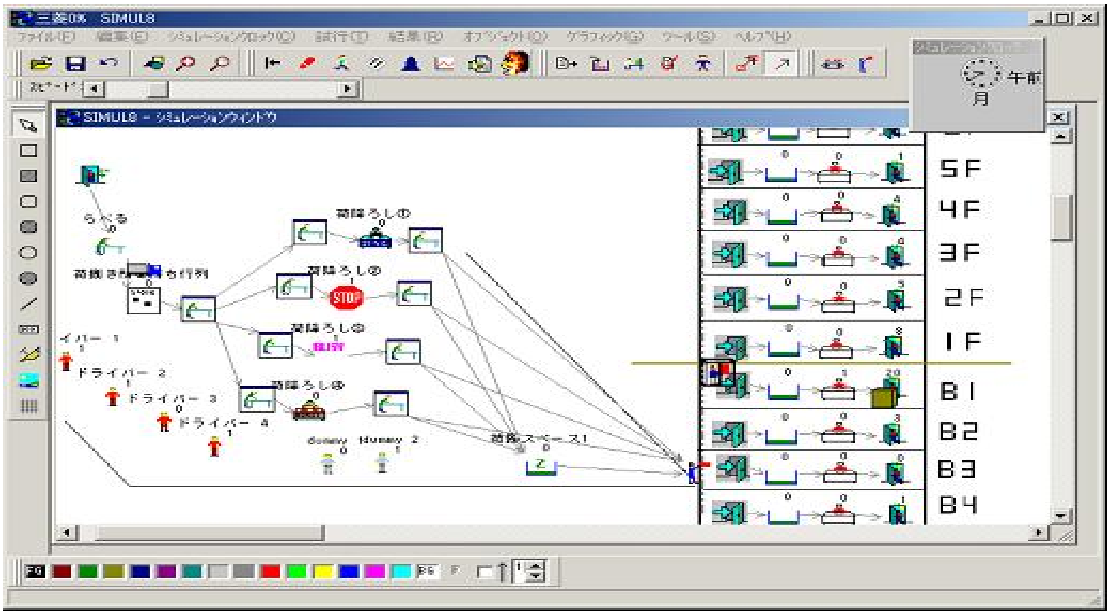


Figure 7-9. Screenshot of the simulation model

Table 7-16. Properties of the simulation model

	Without CDS	With CDS
Unloading time	19.8 sec	19.8 sec
Delivery time	27 sec	27 sec
Elevator time per floor	5 sec	5 sec
Elevator's maximum capacity	20	20
No of workers	0	Based on the number of elevator plus 1 staff

During the experiment, it was recognized that the two staff assigned at each building were not able to hold the incoming freight to the buildings where attraction of trips are high. Further, the 15-minute interval between trips is too close for the two staff members to deliver the first trip and clear the (off) loading area before another trip arrives. In this paper, the number of staff stationed at a building was based on the number of elevator. One additional staff is provided, aside from the mentioned number of staff, designed to be permanently station at the loading / unloading area to help unload the freight from the vehicle with the driver and sign the document confirming that the freight were delivered. This process would allow the driver to move immediately making the loading / unloading space available for another income trips.

The shown number of parking spaces in Table 7-17 excluded the spaces assigned for private cars.

Table 7-17. Properties of the buildings in the district

No	Building name	Gross floor (m^2)	Leasable space (m^2)	No. of floors	No. of elevator	No. of parking slot for freight vehicles
1	Meiji Seimei	14727.73	96673.02	30 (4)	5	8
2	Kishimoto	33972.00	22081.80	11 (2)	2	4
3	Mitsubishi Denki	46102.00	29966.30	10 (4)	1	4
4	Syoji	55259.00	35918.35	15 (4)	1	4
5	Yusen	51645.00	33569.25	15 (3)	2	4
6	Furukawa & Yaesu	70016.00	43627.91	9 (4)	1	4
7	Mitsubishi Juko	45985.00	31861.06	10 (4)	1	4
8	Mitsubishi Syoji	55259.00	37829.04	15 (4)	1	4
9	Mitsubishi	62906.38	40483.66	15 (4)	1	4
10	Marunouchi	160000.00	104000.00	37 (4)	5	8
11	Kokusai	116885.00	75975.25	9 (6)	1	4
12	Fuji	81877.00	53220.05	10 (4)	1	4
13	Shin Kokusai	7748.00	50364.60	9 (4)	1	4
14	Shin Nisseki	26566.00	17267.90	11(2)	1	4
15	Shin Tokyo	106005.00	68903.25	9 (4)	2	4

* Number in the parenthesis is underground floors

7.4.3 Setting-up the Arrival Distribution of Freight Vehicles

The arrival of freight vehicles for the case of CDS follows the format set by the Committee designed the social experiment – 15 minutes interval from 8:00 – 9:30; 30 minutes interval from 9:30 – 12:00 and; 60 minutes interval from 12:00 – 17:00.

For the case of normal form of delivery, the distribution pattern of the recorded arrival time of the one-day survey is followed (Table 7-3). The arrival of freight vehicle follows exponential curve as reflected in Figure 7-10. Close to 35 percent of trips has equal or less than 1-minute interval while close to 40 percent has 1 to 2 minutes interval. The said distribution is used as input data that determines the arriving pattern of freight vehicle in the simulation. For the case of CDS, however, a fixed interval between trips is used.

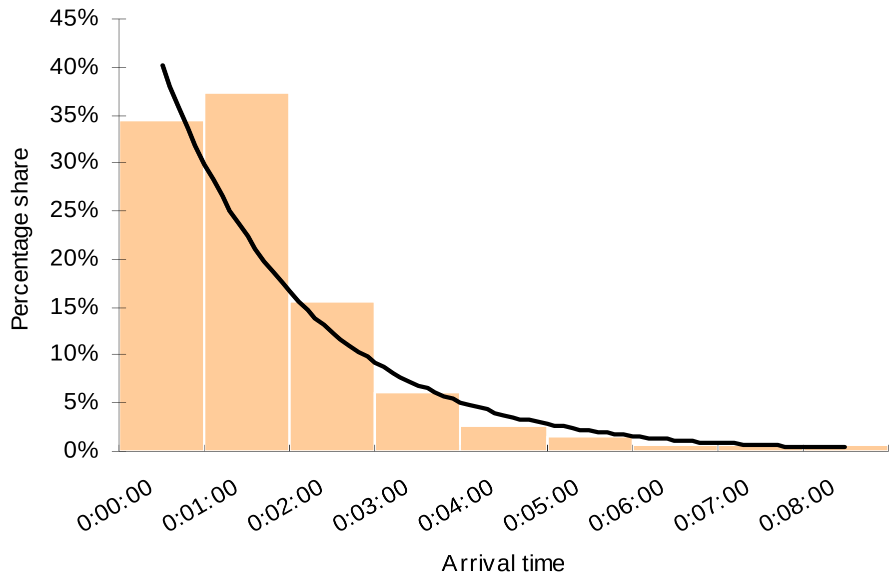


Figure 7-10. Distribution pattern

7.4.4 Results from the Simulation Analysis

As explained, pooling together all concerned parties of urban goods movement is very difficult. Lies ahead are a long process of negotiation that has to consider interest of each stakeholder which are hard to meet. With that in mind, the simulation model tried to observe the number of waiting trucks, their average waiting time before a space is available for their use. Those trucks who are not able to secure a space before five o'clock (delivery time assumed to be 8:00am to 5:00pm) were also noted.

Observed number of delivery trucks that were not able to deliver due to the shortage of parking space reached 124 to the whole district (Figure 7-3). This is a clear example where demand (2155 trips) is hardly met by supply (68 parking lots inside the 15 building).

7.4.5 Introduction of Cooperative Delivery System

7.4.5.1 Impact of CDS on the number of waiting trucks and waiting time depending on the number of trips covered by CDS

The present form of distribution of goods in the district would meet a lot of problems if trucks are only allowed to use the parking facilities of each building. This means that trucks are not allowed for on-street parking to avoid disrupting the flow of traffic. With that policy adopted in the district, each building in the district would experience long queue of trucks (10.1) with an average waiting time of 27.1 minutes (Figure 7-11 and Table 7-18).

When at least 10% of trips in the district is covered by the CDS, the average number of trucks in queue and their average waiting time could be reduced to 9 and 23 respectively. This result is still far from efficient way of distributing goods and it can be assumed that trucks in queue could hamper the fluidity of traffic since most of the buildings are right beside the streets. CDS is having great influence when at least 70% of all truck trips is under the CDS. Trucks will have an immediate access to the parking lots of each building and the staff of CDS waiting at each building would handle the goods upon the arrival of each truck.

Another freight distribution problem that would arise without CDS is shown in Figure 7-12. A total of 124 trucks could not make their way to the parking are of each building after 5PM. As mentioned, trucks are not allowed to park anywhere except the parking space of each building. All the trucks could only have access to the parking spaces and subsequently delivery their load when at least 50% of trips is under the CDS.

Table 7-18. Comparison of average number of trucks in queue, their waiting time, and total number of trucks in the district with and without CDS

Variables	Without CDS	60% of trips is under CDS	All trips is under CDS
Avg. number of trucks in queue	10	2	0
Avg. waiting time	27	1.1	0
Total number of trucks in the CBD	1078	495	120

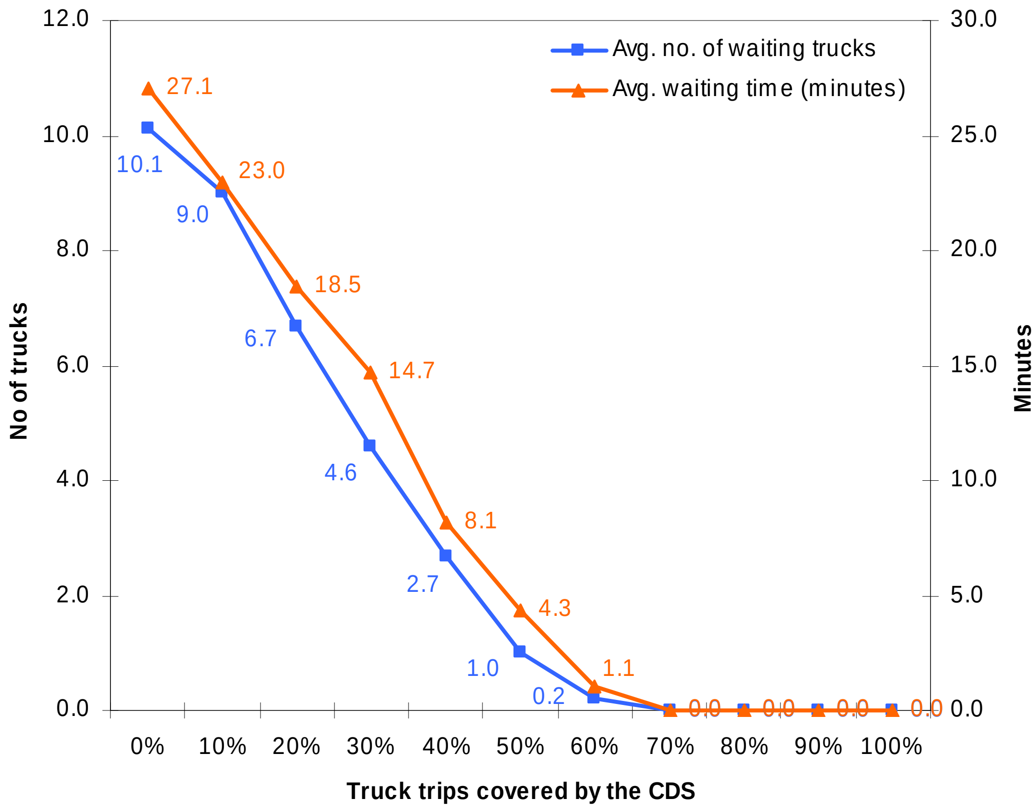


Figure 7-11. Average waiting trucks and average waiting time of trucks in the district depending on the trips covered by the CDS

Adopting a policy is sourced to a particular objective. The simulation result shows that the optimal point where elimination of truck's queue is achieved is at 70%. This result implies that the 68 total parking slots in the district able to accommodate all incoming trips coming both from the 30% trucks who have not taken part to the cooperative delivery and the 70% trucks who have participated the system. If the objective is to eliminate truck's queue and fit the trips to the available spaces, this can be done without complete participations of the carriers. However, if the primary objective of the cooperative system is being pursued, which is to reduce the negative impact of trucks by reducing its number, the system has to cover all the trips.

7.4.5.2 Impact of CDS on the number of waiting trucks and waiting time when the share of retail space increases

As mentioned, the share of retail space (shops and restaurants) in the district is just 2.7% of the total leasable space. In the future, there can be a change of space usage in favor of retail space as the district tries to head towards commercial district. This change to space usage normally have implication to the freight transportation because space which host shops and restaurants has strong trip attraction. It is of interest therefore to find out how the present CDS (the CDS assumed in the simulation model) would absorb such increase of trips.

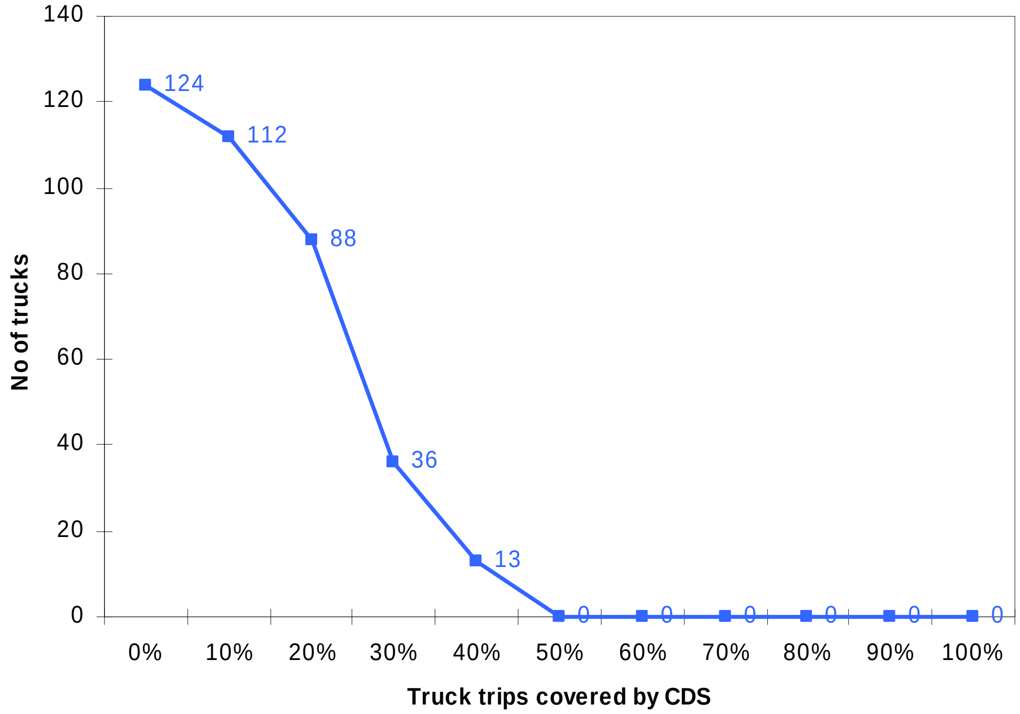


Figure 7-12. Number of trucks did not avail parking space inside the building after 5PM

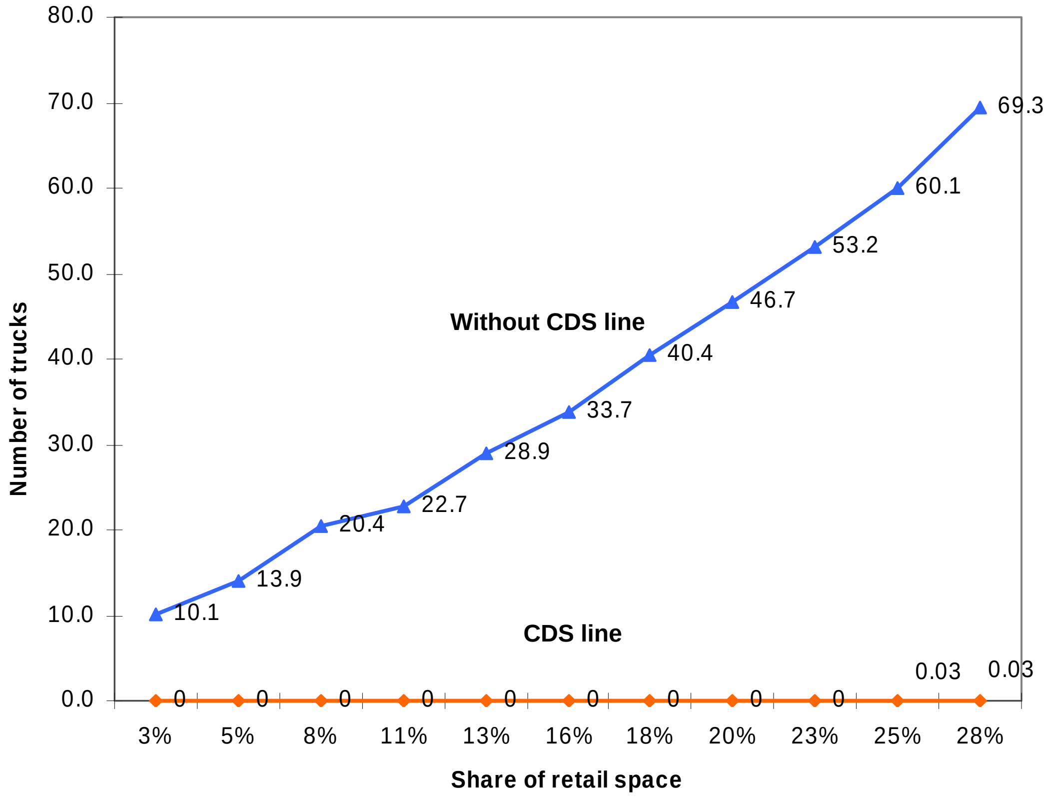


Figure 7-13. Average number of waiting trucks with and without cooperative delivery system as the share of retail space increases

Figure 7-13 illustrates the rise of the number of trucks in queue as the share of retail space increases. The average number of trucks in queue at the present make-up of the district (the 2.7% retail space is rounded off to 3% in the figure) reached 46.7 when the share of retail space totaled to 20%. The limit of the current composition of the CDS is reached when at least 25% of the space in the district would be consumed by shops and restaurants (Figure 7-13). This number translates to 170,000 sq. m. being used for commercial purposes. Under this circumstance, there would be time where some trucks have to wait for a little time before having access to the parking space.

The average waiting time of trucks is shown in Figure 7-14. Unless the share of retail space reached 25% of the total space in the area (GLA), trucks would not have delay before getting a space inside the buildings. It is also of interest to note that at least 2 trucks could not longer get an access to the parking space of the building after 5PM under the 25% of the space is consumed by shops and restaurants. This number increases to 8 when the share of retail space reaches 28%.

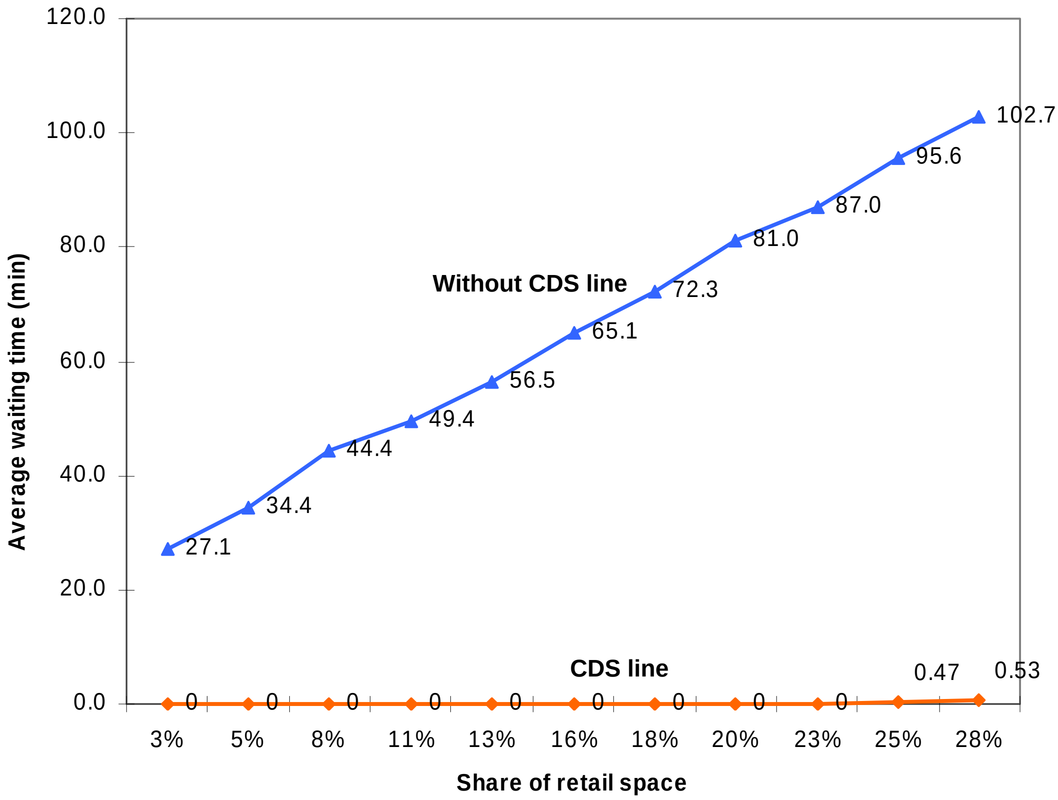


Figure 7-14. Average waiting time of each truck in the district with and without cooperative delivery system as the share of retail space increases

Amendment to the cooperative delivery system in order to meet the future demand in the district can come in many forms such as increasing the number of staff involved in the cooperative work. Increasing the number of parking space for freight vehicles by taking some slot reserved for private cars would also yield positive result to the freight delivery. This can be done in two ways, 1) permanent addition of a parking slot for freight delivery and 2) time sharing of parking slots where the freight vehicles could use the area reserved for private cars during off-peak hours and vice-versa. Allowing the delivery staff to utilize the elevators for passengers during off-peak hour would also increase the delivery pace in view of the shortage of freight elevator. Adding the number of freight elevator by erecting one or two, though difficult due to the current layout of the building, is another option that can also be taken.

7.4.6 Relationship of buildings characteristics and the simulation result

It is imperative to assess what makes some buildings free from queue of freight vehicles or to have shorter queue than other buildings to understand the elements that facilitates the efficiency of freight delivery. Table 7-19 shows that only eight buildings (i.e. buildings 2, 3, 4, 5, 6, 7, 14, 15) were equipped with enough freight facilities (i.e. parking spaces and freight elevators) resulting to having all the trips accommodated without delay. Queues of freight vehicles in varying numbers are observed to the remaining seven buildings which warrant further examination.

Grouping the buildings based on their number of elevator produces some hint that could explain on why some buildings were able to hold all incoming trips. Table 7-20 shows that three groups of building is formed, one is a group of buildings with one freight elevator, two is a group of buildings with two freight elevators, and the last is a group of buildings with five freight elevators. Buildings with one freight elevator and buildings with two freight elevators have almost the same number of floors, number of parking spaces, number of incoming trips, and number of incoming freight. The similarities however ends there as the buildings with one freight elevator were clearly in difficult position to hold incoming trips. On the contrary, those buildings with two freight elevator were had efficient flow of freight movement as indicated by the absent of waiting trucks. This analysis shows that buildings with a floor of 11 or so with one freight elevator is likely to experience queues of vehicles as the demand of delivery staff for the elevator is high.

Table 7-19. Waiting time of truck vehicles to each building without CDS

Bldg code	Building name	No of floor	No of elevator	Parking space	No of trips per day	No of freight per day	No of waiting trucks	Waiting time per trip (min)	Trips did admitted
1	Meiji Seimei	30	5	8	278	1083	48	96	45
2	Kishimoto	11	2	4	63	247	0	0	0
3	Mitsubishi Denki	10	1	4	86	336	0	0	0
4	Syoji	15	1	4	103	403	0	0	0
5	Yusen	15	2	4	96	376	0	0	0
6	Furukawa & Yaesu	9	1	4	102	212	0	0	0
7	Mitsubishi Juko	10	1	4	92	284	0	0	0
8	Mitsubishi Syoji	15	1	4	132	772	16	59	19
9	Mitsubishi	15	1	4	116	456	6	26	0
10	Marunouchi	37	5	8	299	1166	43	93	41
11	Kokusai	9	1	4	218	851	27	83	19
12	Fuji	10	1	4	153	596	9	36	0
13	Shin Kokusai	9	1	4	145	564	3	13	0
14	Shin Nisseki	11	1	4	50	194	0	0	0
15	Shin Tokyo	9	2	4	198	772	0	0	0
	Total	215	26	68	2131	8312	152	406	124

Table 7-20. Comparison of groups of buildings based on available freight elevator

Variables	buildings with 1 elevator	buildings with 2 elevators	buildings with 5 elevators
Avg. no. of floors	11.3	11.7	33.5
Ave. parking spaces	4.0	4.0	8.0
Avg. no. of trips in a day	119.7	119.0	288.5
Avg. no. of freight	466.8	465.0	1124.5
Avg. no. of waiting trucks	6.1	0.0	45.5
Avg. waiting time (min)	21.7	0.0	94.5
Avg. trips did not admitted	3.8	0.0	43.0

7.4.7 Distribution of number of waiting trucks and their waiting time among the buildings

It appears that the degree of problem concerning freight transport vary from one building to another as reflected in Table 7-21. Obviously, the extent of problem seen to the different buildings have close relationship to the building's height, parking space, freight elevator, number of incoming trips and freight. Building 1 and building 10 have many in common – 5 freight elevators and 8 parking slots for freight vehicles – and the number of trips covered by the CDS before they are freed from vehicle's queue are also the same at 60%.

Taking into account all the buildings, a complete elimination of freight vehicle's queue can be completely eliminated when the CDS covered at least 80 percent of trips into each building. Further, number of trips covered by the CDS needs not to be the same – for instance, there are buildings that can be freed from vehicles queue at even lower rate of trips covered by the CDS.

7.4.8 Reduction of trips

Shown Table 7-22 are the number of trips each building is expected to receive with and without cooperative system. Prior survey in the district reported that for every truck, it has an average load of 8 goods to be delivered to two buildings. The same pattern is followed in the simulation where the trucks coming from the stock point have to make a two stop before it return.

The total number of trucks that would enter the district without the CDS is 1078 while 120 for the case of CDS. The difference therefore is 958 trucks which is substantially a high reduction to the total traffic in the area (discussed in the later part). Further, the average load of a CDS truck would be 70 goods and every stop would unload 35 goods.

Table 7-21. Distribution of the number of waiting trucks and their waiting time among the buildings

Building code | Variables		Percentage of trips covered by the CDS										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1	No. of waiting trucks	48	45	42	27	2	0	0	0	0	0	0
	Avg. waiting time (m)	96	92	92	69	6	2	0	0	0	0	0
	Trips not admitted	45	42	40	14	0	0	0	0	0	0	0
2	No. of waiting trucks	0	0	0	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	0	0	0	0	0	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
3	No. of waiting trucks	0	0	0	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	0	0	0	0	0	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
4	No. of waiting trucks	0	0	0	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	0	0	0	0	0	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
5	No. of waiting trucks	0	0	0	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	0	0	0	0	0	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
6	No. of waiting trucks	0	0	0	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	0	0	0	0	0	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
7	No. of waiting trucks	0	0	0	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	0	0	0	0	0	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
8	No. of waiting trucks	16	11	4	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	59	44	22	12	1	0	0	0	0	0	0
	Trips not admitted	19	10	4	0	0	0	0	0	0	0	0
9	No. of waiting trucks	6	4	3	2	0	0	0	0	0	0	0
	Avg. waiting time (m)	26	18	14	10	1	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
10	No. of waiting trucks	43	42	28	19	18	8	0	0	0	0	0
	Avg. waiting time (m)	93	87	70	55	51	28	0	0	0	0	0
	Trips not admitted	41	41	26	7	0	0	0	0	0	0	0
11	No. of waiting trucks	27	27	23	21	20	7	3	0	0	0	0
	Avg. waiting time (m)	83	82	78	74	63	35	16	0	0	0	0
	Trips not admitted	19	19	18	15	13	0	0	0	0	0	0
12	No. of waiting trucks	9	4	0	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	36	15	1	1	0	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
13	No. of waiting trucks	3	2	0	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	13	7	0	0	0	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
14	No. of waiting trucks	0	0	0	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	0	0	0	0	0	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
15	No. of waiting trucks	0	0	0	0	0	0	0	0	0	0	0
	Avg. waiting time (m)	0	0	0	0	0	0	0	0	0	0	0
	Trips not admitted	0	0	0	0	0	0	0	0	0	0	0
	Total no. of waiting trucks	152	135	100	69	40	15	3	0	0	0	0
	Total waiting time (min)	406	345	277	221	122	65	16	0	0	0	0
	Total Trips not admitted	124	112	88	36	13	0	0	0	0	0	0

Table 7-22. Trips total with and without CDS

No	Building name	Without CDS	With CDS
1	Meiji Seimei	282	16
2	Kishimoto	64	16
3	Mitsubishi Denki	87	16
4	Syoji	105	16
5	Yusen	98	16
6	Furukawa & Yaesu	102	16
7	Mitsubishi Juko	92	16
8	Mitsubishi Syoji	132	16
9	Mitsubishi	116	16
10	Marunouchi	303	16
11	Kokusai	221	16
12	Fuji	155	16
13	Shin Kokusai	147	16
14	Shin Nisseki	50	16
15	Shin Tokyo	201	16
	Total	2131	240

7.4.9 Effect of the reduced trips to traffic volume in the area

The result of the simulation shows that at least 120 trucks are necessary in order to ship the freights going into the district. Comparing the 120 trucks needed to deliver the goods for the case of CDS is far less than 1078 trucks normally delivering goods in Marunouchi. In short, the horizontal cooperative delivery system could reduce the number of delivery trucks into 12%.

According to a traffic survey in the area, the share of freight vehicles to all traffic is approximately 32 percent. This value was obtained through equation 1:

$$V = V_p + V_t \tag{1}$$

where *V* is the total vehicle volume, *Vp* is the volume of passenger car, and *Vt* is the volume of freight vehicle. The CDS deals only with the delivery of goods and it is therefore important to isolate the number of vehicles collecting goods. In order to quantify the effect of the cooperative delivery to the total traffic, it was assumed that percent of the truck traffic is delivering freights while the remaining half is collecting. Equation 2 would isolate the number of freight vehicle delivering goods from collecting:

$$V' = V_t / 2 \times \alpha \tag{2}$$

where *V'* is the number of freight vehicle delivering freights, *Vt/2* is half the number of total freight vehicle, and a is the reduction rate of freight vehicles due to the implementation of cooperative delivery which is .11. With this assumption, the reduction rate of CDS on the total traffic in the area can be computed by following equation 3:

$$V'' = V_p + V_t / 2 + V' \tag{3}$$

where V is the total number of freight vehicle reduction induced by cooperative delivery system. The final equation that would give the value of the ratio of vehicle reduction as an effect of the cooperative system is given below:

$$R = V''/Vx100 \quad (4)$$

Using the equations above, a 12.48 percent reduction in all total vehicle volume was arrived. This is a significant number that would result in traffic flow improvement since freight vehicles have often been blamed to cause traffic jams due to their unpredictable nature of loading and unloading freights at any given space.

7.4.10 Reduction of environmental emissions

The average length of a trip with two stops is 1.78 km as mentioned in Section 6.3. The district therefore is admitting 216 grams of NOx and 13 grams of PM from delivery trucks alone. Obvious means to decrease these numbers are by ensuring that few numbers of trucks are entering the district. By adopting cooperative delivery, 88% of both NOx and PM can be offset in case of using the same type of trucks while the reduction can be further increase by utilizing CNG trucks that would give a 99% reduction for NOx and eliminating the PM (Table 7-23).

Table 7-23. Environmental emissions

	Existing delivery	Cooperative delivery by existing trucks	Cooperative delivery by CNG trucks
NOx	1078 (trucks) x 1.78 (km) x .118 (g/km) = 226 (g)	120 (truck) x 1.78 (km) x .118 (g/km) = 25 (g)	120 (truck) x 1.78 (km) x .0118 (g/km) = 2.52 (g)
PM	1078 (truck) x 1.78 (km) x 0.007 (g/km) = 13 (g)	120 (truck) x 1.78 (km) x 0.007 (g/km) = 1.49 (g)	120 (truck) x 1.70 (km) x 0 (g/km) = 0 (g)

Note: Emission factors for NOx and PM were based on Technical Methods of Road Environment Assessment

7.4.11 Reduction of working time

Logistics cost is composed of fuel, depreciation, and personal expenses among others. In this study, however, the focus is on personal expenses and working time of both truck drivers and staffs for cooperative delivery. One of the prime gains of the CDS is the reduction of time (85 hours) for delivery vehicles (see Table 7-24). This reduction can be translated to improved quality of the urban environment where trucks run at 20 km/hr.

The recorded average time for trucks is 20 km per hour and the average distance of building from the stock point is .68 km. Similarly, the average distance of building from each other is .42 km. Any delivery route therefore would have to travel an average of 1.78 km for the speed of 20 km/h. This distance has an average travel time of 5.34 minutes which was used to evaluate the running time of trucks in the district.

Table 7-24. Changes derived from CDS

Variables	Existing Delivery (min)	Cooperative Delivery(min)	Time Saved (min)
Delivery time in the area	1078 trucks x 5.34 min = 5756.52	120 trucks x 5.34 min = 640.80	- 5115.75
Unloading time in the building	8333 freight x .33 min = 2,750	8333 freight x .33 min = 2,750	-0
Waiting Time for parking	46475	0	- 46475
Labor time at SP	0	8333	+ 8333
Vertical Cooperative Delivery	8333 freight x 1 min = 8,333	41 staff x 480 min (staff labor time) = 19,680	+ 11441
Total	63,314.52	31403.8	- 31910.72

7.5 Comparison of CDS impact between CBD of Metro Manila and CBD of Tokyo

The traffic and environmental impact of CDS in the Ortigas CBD is rather limited while considerably high in the Marunouchi CBD (Table 7-25). These contrasting results appear to lie to the characteristics of the transportation system where the number of trucks is notably high in Tokyo while incredibly low in Metro Manila.

Although the impact of CDS is greater when applied to high density CBD which mostly located in developed countries, this does not indicate that it is not an intelligent policy solution to the growing problems in a low density CBD mostly located in developing countries. These cities have very limited road infrastructure thus any policy that yield positive effect to the transportation networks should be pursued. Impact of one measure might be limited but if bundled together with other measures might produce a significant result towards realization of efficient urban traffic and healthy environment. Further, in the future, CDS would become important part of any policy set aims to improve freight transportation as the CBD transformed from low to high density. Number of trucks would be expected to increase and load factor would still be low as JIT concept dominates the freight transport management. Normally, when the problems of freight transport escalate, city authorities are becoming notorious by imposing access restriction to protect urban traffic and environment. This scenario can be avoided if CDS is adopted. Aside from pleasing these authorities, adopting cooperative delivery system could also be a boost in the market image of trucking industry as responsible sector which have concern to the well being of the environment.

Table 7-25. Comparison of CDS impact to Manila CBD and Tokyo CBD

Variables	Manila	Tokyo
Traffic impact	0.78%	12%
Environmental impact		
NOx	54% (3274 g to 1517 g)	89% (226g to 25 g)
SMP	54% (359 g to 193 g)	89% (13 g to 1.49 g)
Delivery time in the district	54% (1,099 min to 507 min)	89% (5,756 min to 640 min)
Number of trucks	54% (713 to 329)	89% (1078 to 120)

7.6 Chapter summary

Providing secured (off) loading places for freight vehicles is considerably difficult and required the cooperation of authorities and truck drivers. Among the tasks of the authorities in the district is to ensure that the place is not illegally occupied by private cars which has been often reported in literature – e.g. Best Practice Handbook. Similarly, truck drivers have to make every effort to follow the regulation in place such as observing the allowed duration for parking. This complex issue calls for further research.

The chapter demonstrates that CDS is a very powerful policy tool that could confront several problems of urban freight transport. The substantial number of trucks reduced from the district (12% to the total traffic) is a gain of the environment in the form of improved travel speed and less source of emissions. In addition, few trucks require few parking spaces which have been a real issue to every major city in the world.

The first analysis in Section 7.4.5 reveals that if the interest is to hold the incoming trips in order to avoid the queues of trucks, except the eight buildings (2, 3, 4, 5, 6, 7, 14 and 15) the rest have to adopt cooperative delivery. Level of participation to the CDS however varies from one building to another. This uneven participation rate is a result of several factors such as volume of trips and goods, number of parking spaces, and number of freight elevator.

As the analysis goes deeper, it was learned that although full participation to the CDS could make an 89 percent reduction to the current number of trucks, its effect to the total traffic volume of the district is registered only to 12 percent. This is because truck's share is less than half of the total traffic (32%).

Effect of freight-related-facilities (parking space for trucks and elevator for freight) was also confirmed to be highly important to the fluidity of the delivery chain. Buildings which two freight elevators were having smooth goods delivery process as compared with those buildings having one as confirmed previously.

The highest reduction rate to chemical emissions (NOx and PM) is achieved when CDS is fully adopted and the trucks use to deliver goods are non-polluting vehicles. With these two policies adopted, 99 percent of NOx is reduced while a CNG truck does not emit PM. Assuming the regular trucks would continue to deliver goods under the CDS, 88% of both chemicals could still be reduced.

The reduced number of trucks when converted to time is 5115 minutes while the total time saves from the CDS is 31910 minutes. Cooperative delivery therefore thus not necessarily increased the operation cost of the companies as shown by the study. Regarding the comparison of the traffic impact of CDS between Ortigas CBD of Metro Manila and Marunouchi district of Tokyo, it was found out that the CDS's traffic impact to the former is rather limited while notably high to the latter. These contrasting results appear to lie in the difference of transportation characteristics where share of trucks in Ortigas is substantially low (1.7%). Moreover, the transportation network appears to be saturated that even if the number of trucks is withdrawn, the network is still holding large number of vehicles.

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CHAPTER **8**

Application of Cooperative Delivery System to a High Density Central Business District: Case of Developed Country

8.1 Introduction

Intra-city goods movement is profoundly affected by the facilities and services available for pickups and deliveries (Morris *et el*, 2001). Insufficient numbers of parking space and lack of (off) loading places are some of the common problems that delivery trucks have to deal with. Increasing the utilization rate of the limited parking facilities by ensuring limited parking time for each truck is an important measure in view of the shortage in parking space in the CBD. Attaining this brief parking time, however, requires a shift from the traditional way of moving goods to policy-driven methods. Traditional way presents an image where a driver has to leave his truck and make his way to the floor of the building to make freight delivery. Although this method remains to be popular due to its simplicity, there exist methods that when carefully enforce would present economic and financial benefits to the urban goods movement in general. One of these policies is by assigning staff members inside a building to facilitate the (un) loading activities to free the driver immediately. This chapter discusses implementation of CDS in high-density CBD characterized by high-rise buildings. Further, it tries to produce guidelines regarding what CDS design is suitable depending on the characteristics of the CBD. Moreover, it provides a hint when to adopt any of the CDS design which would useful for planners around the world.

In the analysis, the height of the buildings in the district is extended to anticipate future development. Any redevelopment of buildings in the area would have enormous impact to the distribution of goods in the area. The flow of discussions begins by introducing the unloading process once the truck entered the building. Typical problems that hampered the efficiency of delivery are made known before available measures are enumerated. The main discussion of the chapter, which is the application of vertical cooperative delivery system and the simulation analysis, are presented and summarized in the end of the chapter.

This Chapter begins by reviewing related papers in management of the delivery system inside a building. Section 8.2, Section 8.3, Section 8.4 are devoted to the review of significant papers in the delivery of goods. Along the review process, common problems in urban centers of moving goods were noted such as the difficulty of driver locating available parking space. Some important data from Chapter 7 were re-used and presented in Section 8.5. The method to obtain the data is presented in detail in Section 8.6. These data are important information that be used for simulation modeling in the later part of the chapter. Simulation modeling is discussed in detail in Section 8.7. This discussion includes the process of selecting distribution arrival that could replicate the actual arrival of trucks as recorded in the survey. Section 8.9 tried to produce a guidelines when and what CDS design is adopted based on the characteristics of the CBD. The chapter is concluded in Section 8.10 which highlighted the issues given a thorough assessment.

As mentioned, the main premise of making the delivery process inside the building efficient is that delivery vehicles that cannot access the docking area normally use any available space near the delivery establishment to (un)load their freight. Accelerating the turnaround of the delivery vehicles at the docking area would also reduce the number of vehicles in queue that sometimes long enough to occupy portion of the street hence obstruct the fluidity of the traffic.

8.2 Urban Goods (Off) Loading Process

Iwao *et al* (2001) produces the most notable illustration of delivery process inside (unloading activity) the building (see Figure 8-1). The chain of this process is composed of six steps which start as soon as the delivery truck arrives. In the figure, the truck is parked in an on street (off) loading area which has the longest time of loading/unloading activity as compared to truck parked in a parking space located inside the building or beside the building (off-street) (Park et al, 1998). The obvious reason is its distance from the freight elevator located inside the building.

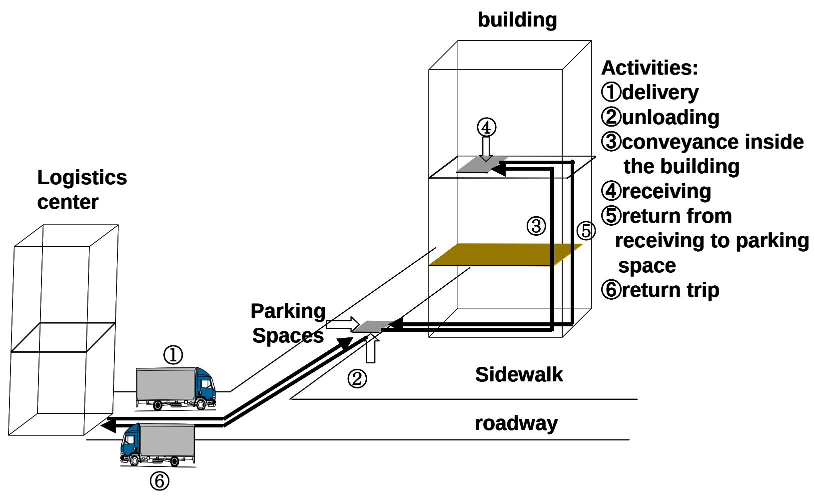

Figure 8-1. Delivery and unloading activities (source: Iwao et al, 2001)

8.3 Common problems related to unloading activities

Problems of (off) loading activity range from lack of sufficient number of parking space to lack of freight elevator. In New York for instance, inadequate freight-handling facilities in the CBD were identified as the major barriers to freight mobility. Inadequate docks or receiving areas and insufficient freight elevators did not support the increasing number of freight deliveries, resulting in a significant amount of off-loading on the streets (Morris *et el*, 2001).

Further, it is more difficult to deliver goods in the buildings in ancient cities where freight elevator usually does not exist. In this condition, the goods carriers have to utilize the stair which naturally resulted to longer delivery time.

Parking spaces and freight elevators are two important elements that could determine the smoothness of the delivery activity. As the number of parking space increases, the probability that the waiting time of vehicle is short also increases. Parking time of vehicle on the other can be influenced by the availability of enough number of freight elevators. Truck drivers that do the delivery would find it fast to return to their truck if elevator is right waiting near the parking area.

Table 8-1. Problems and countermeasures of (off) loading activity

	Problems	Countermeasures
Trucks trip	Delayed delivery	Cooperative delivery, regulation of delivery time
	Reduction of travel speed	Provision of priority lanes for goods vehicle
	Mixing of passenger cars and freight vehicles	Traffic regulation, traffic imposition
Parking of goods vehicles	Parking congestion of passenger cars and freight vehicles at on-street parking facility	Time and spatial separation of vehicles at on-street parking facility
	Increase of illegal parking	Conduction of off-street parking facility (on-street parking facility regulation, parking charge discount)
		The reinforcement of the criterion on the planning of inside parking facility for goods vehicle
Loading/unloading	Competing people and goods	Spatial separation of people and goods
	Lack of conveyance paths	Design standards for conveyance path
	Lack of elevator for exclusive use of goods inside the building	Design standards of elevators for goods

Source: Park *et al*, 1998

Park *et al* (1998) has summarized the frequent encountered problems during the delivery of goods and its countermeasures (see Table 8-1). Congestion reduced the speed of trucks thus delay the delivery (see Chapter 2 for in-dept discussion). This problem is compounded by the increasing number of vans used for delivery which propelled by the Just-in-time (JIT). It is argued that using vans instead of trucks will increase total traffic thus congestion.

The lack of parking spaces and (off) loading spaces for goods vehicles resulted to the rampant practice of occupying the spaces not intended for goods delivery. Although sometimes there are reserved spaces for vehicles delivering goods, it has been reported that in most cases, these are occupied by private cars and hence double parking occur. Protection of reserved places for goods vehicles therefore is necessary to ensure that right type of vehicles occupied the places.

Exclusive elevator for delivery is often inexistence or short in number affecting the entire chain of delivery – this means truck has to spend longer time in the (off) loading area.

8.4 Improvement measures for urban goods

There are measures that can be applied to realize efficient delivery of goods in view of the difficulty faced by the sector (see Table 8-2). Although most of the measures listed are rather familiar, there are quite unusual measures that have not been widely reported in literature such as time-sharing of both parking spaces and elevators, and consolidated delivery inside the building. Time-sharing is referring to allow the use of facilities intended for private cars (parking space) and passengers (elevator) to goods delivery during the determined off-peak periods in a day. This policy would increase the capacity of freight-handling facilities hence increase the fluidity of goods. Similarly, consolidating the goods intended for the same receiver would decrease the utilization of elevator. This scheme however might require some staff members permanently station at the (off) loading area to perform the consolidation.

Table 8-2. Improvement policy for urban goods movement

Type of Measures	Hard	Establishment of depot in the inner city Increase of lane capacity Signal control improvement Provision of (off) loading and parking places Automatic conveyance material system inside the building
	Soft	Consolidated delivery Efficient checking and sorting inside the building Cooperative delivery Time-sharing of parking spaces Time sharing of elevators Coordinated delivery inside the building

Source: Iwao *et al*, 2001

Measures in Table 8-2 that are not very familiar are discussed further to make the Chapter more accessible. As mentioned, protection to the city center of old towns by restraining access of delivery trucks is one of common reasons to erect a depot. Cities that were built even before the start of motorization were simply not suited to accommodate heavy vehicles and therefore were in need of other method to deliver the goods. This case has been witnessed in some European cities as described in Chapter 3. The depot then serves as consolidation area for goods that will be distributed to the final receivers by a truck that suits the environment of old town. In some cases, a staff in the depot would inform the recipient that a package has arrived and it can be delivered or be pick-up by the recipient.

Signal control improvement has also been proven as an effective measure to improve the flow of traffic. This measure can be done by optimizing traffic signal timing plans, coordinating traffic signal control, and implementing adaptive signal control. Normally, results that can be attained for improving the signal control includes improvement of travel time, reduction of delays and stops of vehicles in the network.

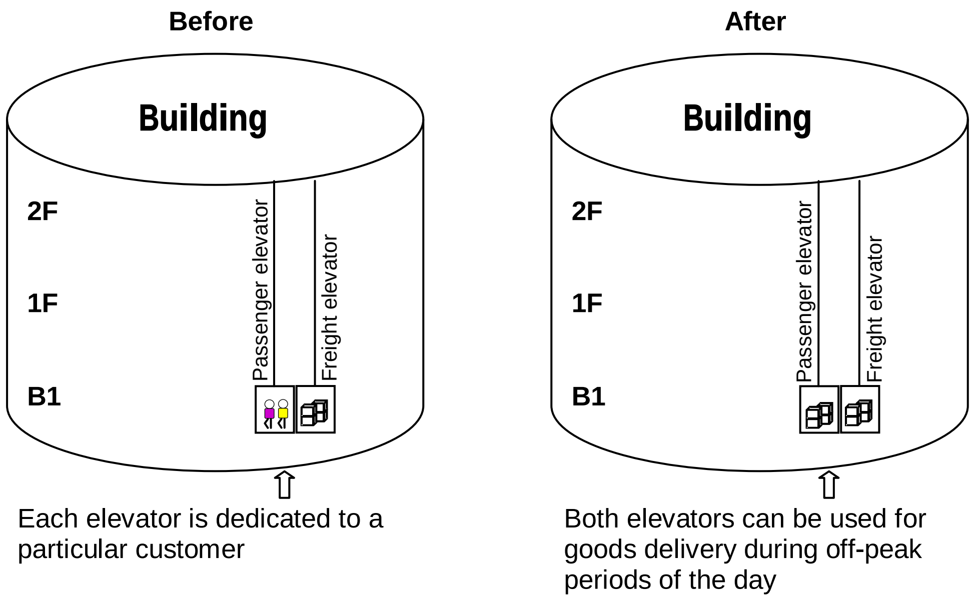

Figure 8-2. Time-sharing of elevators

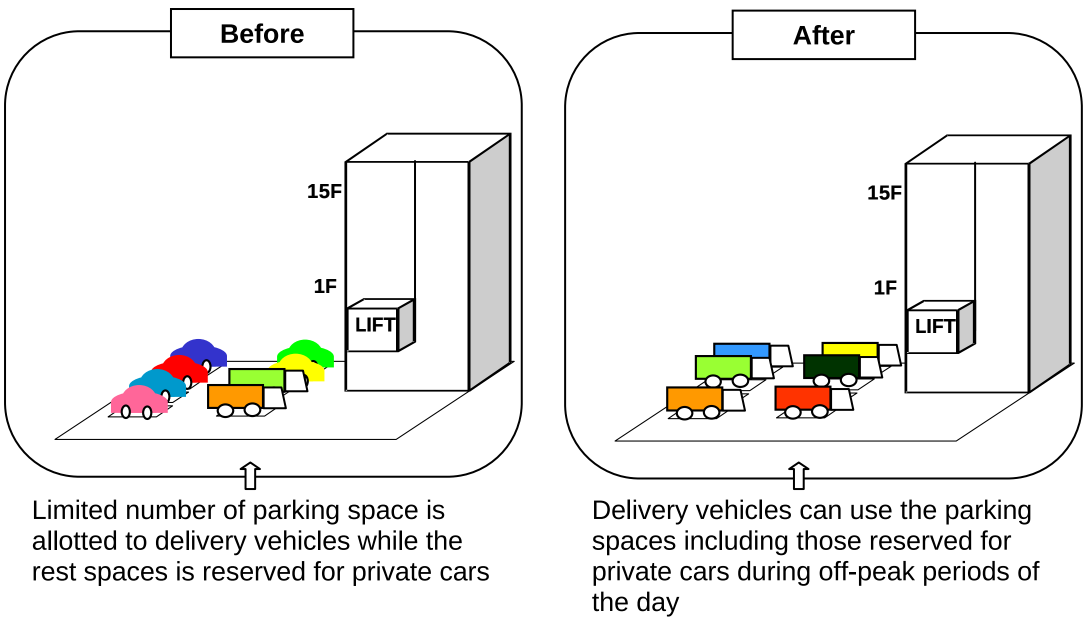

Figure 8-3. Time-sharing of parking spaces

It appears obvious that there is a need to distinguish the difference between consolidated delivery and cooperative delivery. Literature tends to suggest that consolidation takes place when a cooperative delivery among companies is formed (Castro, 2002, Visser *et al*, 1999). Cooperative delivery change the form of urban delivery from independent private transport to consolidated transport that resulted to higher load factor and reduction of the number of trucks. It is worth to note thought that consolidated delivery can also be done by a single transport company having a multiple customers in an area.

Allowing freight carriers to use the passenger elevator during off-peak periods would increase their mobility (Figure 8-2). In Japan, there was a reported case where 70% of trucks in a day arrived to a store before it opens (Iwao *et al*, 2001).

Parking management is a powerful too to control the flow of traffic. This measure includes provision, control, regulation or restriction of parking space. Parking management can consist of actions that fall into six categories: on-street parking, off-street parking, fringe and corridor parking, pricing, enforcement and adjudication, and marketing.

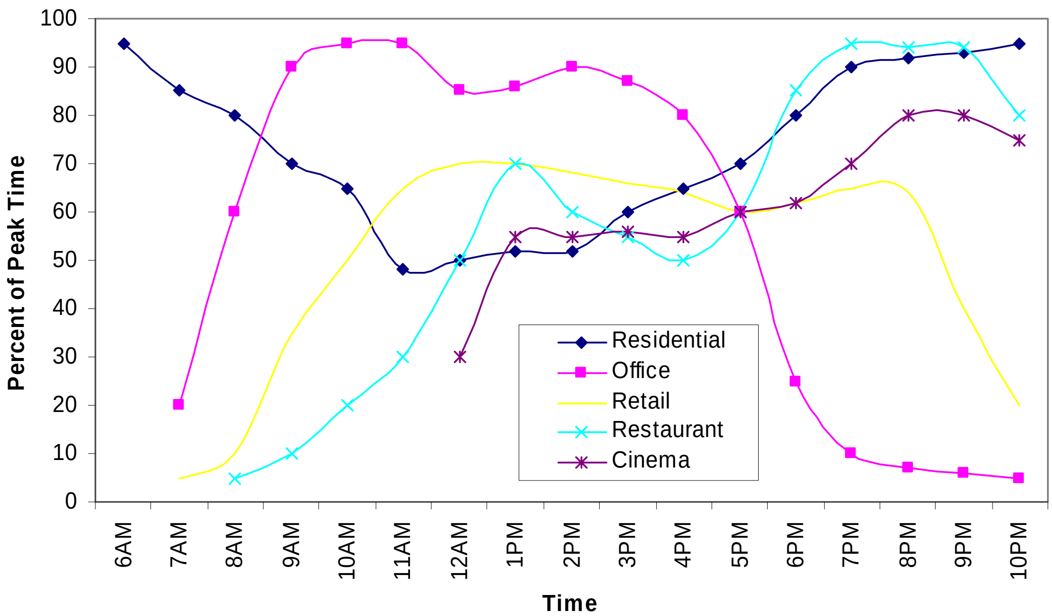

Figure 8-4. Parking Accumulation by Land Use by Time of the Day
Source: Meyer, M.D. (1997). A Toolbox for Alleviating Traffic Congestion and Enhancing Mobility, Institute of Transportation Engineers.

Another parking management strategy that is being considers in many communities is the concept of shared parking. Shared parking in essence means that two or more land uses controlled by one or may owners can share the same parking space over the course of a day, week, or month. The basic premise for this strategy is shown in Figure 8-4 which indicates that different activities generate different temporal demands for parking which provide good opportunities for more efficient parking provisions.

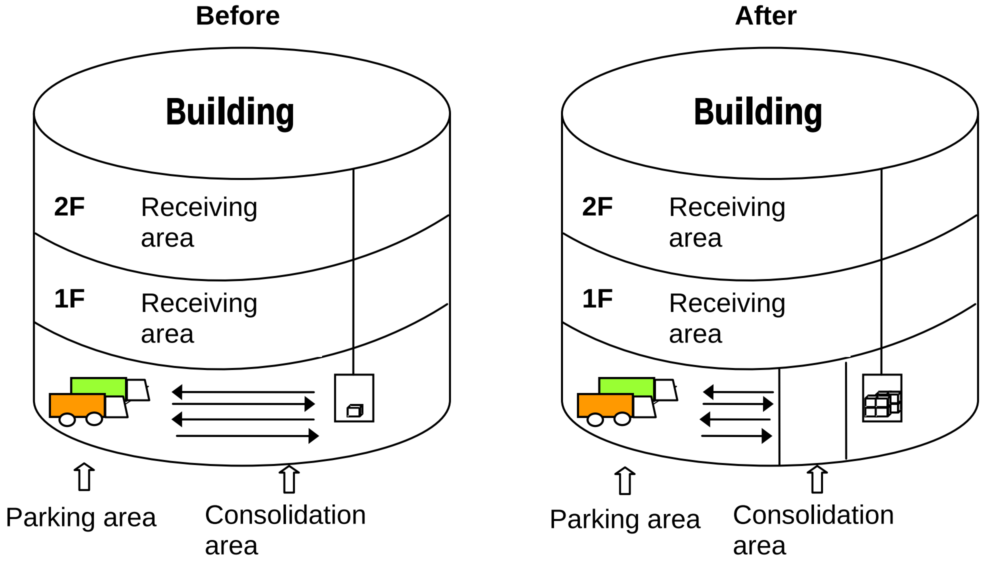

Figure 8-5. Coordinated delivery inside the building

Organizing the goods after it was unloaded from the trucks would also bring some benefits such as utilization to the freight elevator would become more rationalize. This would remove unnecessary waiting time for staff delivering the goods since the elevator is hardly use.

8.5 Application of measures to improve goods delivery

Four policies from Table 8-2 were seen adopted in the social experiment in the Marunouchi, Tokyo – establishment of depot, provision of (off) loading and parking places, cooperative delivery, and consolidated delivery inside the building. The social experiment is discussed in length in Chapter 4 while the analyses for the effect of the adopted policies are available from this Chapter onwards. This Chapter in particular analyzes the (off) loading activity inside the building.

Freight elevator supports all the building covered by the experiment and designated parking spaces for delivery vehicles are also available (see Table 8-3). The number of trips and goods found in the table is recorded prior to experiment. This was done to observe the natural process of performing delivery activity and to determine the severity of truck's traffic.

At the (un)loading area inside the four (4) buildings joined the social experiment, two staff members are permanently station to assist the drivers of delivery trucks. After unloading the goods, the truck would leave and move to the next building and the same process is perform there. This arrangement, however, is not available to those who did not participate to the social experiment (see Chapter 4 for more discussion).

The effect of this scheme reduced the parking time of each truck from 15 minutes to 2.35 minutes. This reduction to the parking time of trucks was mainly credited to the presence of two staff which handles the goods once the truck entered the docking area.

The usual responsibility of the driver, that is to deliver the goods to the final recipients, has been passed to the staff. This arrangement allows the driver to bring out the truck to the next delivery destinations.

Table 8-3. Properties of the four buildings

Building		Furukawa & Yaesu	Mitsubishi Jyukou	Mitsubishi Shouji	Mitsubishi
No of floor		9	10	15	15
No of freight elevator		1	1	1	1
No of staff member at unloading area		2	2	2	2
No of parking space		4	4	4	4
Gross floor (m^2)		70016	45985	55259	62906
Leasable space (LS) (m^2)		43628	31861	37829	40484
Percentage of LS		62%	69%	68%	64%
Office space (OS) (m^2)		41080	30477	37829	40248
Percentage (OS)		94%	96%	100%	99%
Shops & Restaurants (SR) (m^2)		2547	1414	0	236
Percentage (SR)		6%	4%	0%	1%
Trips per day	Office	84	74	132	93
	Shops & Restaurants	18	18	0	23
	Total	102	92	132	116
No of freight per day	Office	144	184	772	271
	Shops & Restaurants	68	100	0	185
	Total	212	284	772	456

8.6 Method of Data Collection

8.6.1 Data of freight vehicles' arrival

Although data of the four buildings are available, presentation and in-dept discussion were only performed to the Mitsubishi building since it has the most complete set of data. The data obtained from trucks delivering goods during the three (3) day experiment to the Mitsubishi building are available in Table 8-4 (data of trucks who did not participate the experiment were not included). Observations suggest that time interval from each trip in the early morning delivery is very short - for instance is the interval between the first trip and second trip on the fist day of the experiment. The first delivery truck arrived at 8:48 carrying 14 goods and followed shortly by another vehicle transporting 16 goods at 8:52 resulting to 4 minutes time interval between the trips. It is believed that in this part of the day, most business establishments and offices are storing goods supplies that could at least serve the whole day. This might be the primary reason that could explain why there is a big amount of goods to each trip having very short time interval.

The relatively small number of carriers participated is visible to the few number of trips observed - seven (7) trips on February 19, eleven (11) trips on Feb 21 and seven (7) trips on Feb 21 (18 carriers participated out of 232 operating in the area). Number of goods was also considerable few as compared to the actual number of goods observed in Table 8-3. In the table, 456 goods were reported while recorded number of goods in the experiment is only 108 on the first day, 106 on the second day and 108 again on the last day.

Table 8-4. No. of truck trips and goods delivered

Date	Arrival time	No of goods
2/19	8:48	14
2/19	8:52	16
2/19	8:53	32
2/19	9:04	39
2/19	9:22	4
2/19	9:39	1
2/19	14:56	2
2/20	8:37	13
2/20	8:46	30
2/20	8:47	2
2/20	9:07	6
2/20	9:10	36
2/20	9:24	12
2/20	10:08	1
2/20	10:48	2
2/20	11:11	2
2/20	13:09	1
2/20	14:04	1
2/21	8:36	11
2/21	8:46	31
2/21	8:46	2
2/21	9:09	9
2/21	9:17	35
2/21	9:47	8
2/21	13:09	12

8.6.2 Description of the surveillance system

All the staff members assigned at the (off) loading places of the buildings was equipped with a surveillance device called PEAMON (Personal Activity Monitor). This device records the location positioning data through its built in PHS (Personal Handy phone System) function. The location of the staffs in a particular time is located through these data.

Asakura *et al* (2001) describe it as a pocket-size travel data collection equipped with PHS (Personal Handy phone System) receiver, three-dimensional acceleration sensor, CPU, compact flash memory card and powered by lithium ion battery (Figure 8-6). The unit's size is 120 mm in height, 12 mm in thickness, and has a weight of 125 gram. The location positioning data (longitude, latitude, and time) is generated every 15 seconds via its built-in PHS function. This travel-monitoring unit uses the signal strength and the ID number of 3 to 7 base stations of PHS communication system capable of monitoring activities for 48 hours. Although PEAMON could collect data on the staffs' detailed activities, a weak and disturb signal could lead to a missing data. In that case, this is substituted by the daily reports recorded by the staffs.

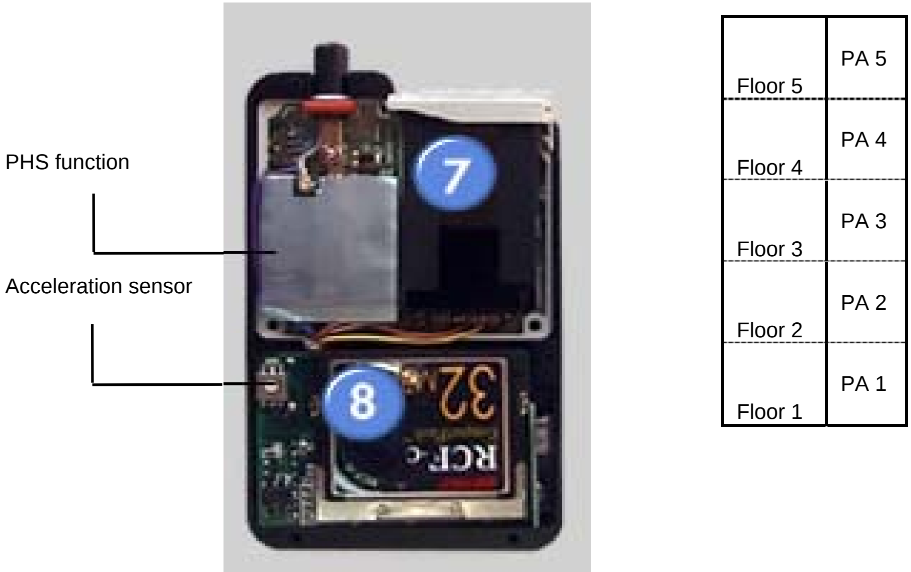

Figure 8-6. PEAMON model and sequential installations of power antenna

8.6.3 How does it work to trace the delivery floor of goods

PEAMON's signal is relying to the power of base station and therefore cannot record with the absence of signal. In order to mitigate this difficulty, a Power Antenna (PA) with range of 300 meters was installed to each floor of the building totaling to 19. These PAs, which solely developed to support PEAMON function, were installed sequentially in order to have a sequential base station ID. PEAMON will record the ID of each station and its corresponding signal strength to distinguish it from one floor to another.

The installation of PAs is illustrated in Figure 8-6 while example of base station ID is shown in Table 8-5. As can be seen from the table, each base station has a unique identification number making it simple to trace which floor the unit holder located. Interpreting the table would state that the unit holder was in Floor 1 from 9:10:00 until 9:10:15 and moves to Floor 5 at 9:10:30 and arrived to Floor 4 at 9:11.

Table 8-5. Example of station ID and signal strength

Time	PA1 (ID, SS)	PA2 (ID, SS)	PA3 (ID, SS)	PA4 (ID, SS)	PA5 (ID, SS)
9:10:00	1, 12				
9:10:15	1, 20				
9:10:30					5, 40
9:10:45					5, 25
9:11:00				4, 16	

The monitoring of the activities of the two staffs inside the building assigned to transport the goods work in this way: they will write to the logbook their destination floors, number of offices intended for delivery and the number of goods going to deliver every time they leave the docking area located at the basement (B3) floor of the building. The PEAMON cannot record data while the holder is inside the elevator due to the absence of signal. However, PEAMON monitoring will resume as soon as the elevator opened up to the destination floor. Data will be recorded continuously every 15-seconds until they return again to the elevator.

8.6.4 Results of PEAMON monitoring

The result of PEAMON monitoring is presented in two ways. The first one is in the form of graph showing the routes of both staffs starting from their first delivery in the morning until their last delivery at the end of the day. The second one is in the form of tables which clarify the individual route of the staffs shown in the graph. Every single graph is composed of two supplemental tables.

The monitoring result of PEAMON on the first day (Feb 19) of experiment is shown in Figure 8-7. The delivery activity started by Staff1 at 9 o'clock in the morning and followed shortly by Staff2 at 9:15. The first delivery stop of Staff1 was on Floor 1 and his last delivery was as early as 10:40 - brings three (3) pieces of goods to Floor 2. On the other hand, Staff2's first stop was on Floor 5 and ends his delivery after sending goods to Floors 4 and 1 at 2:55. The detail of the routes of Staff1 and Staff 2 is shown in Table 8-6 and 4-14 respectively.

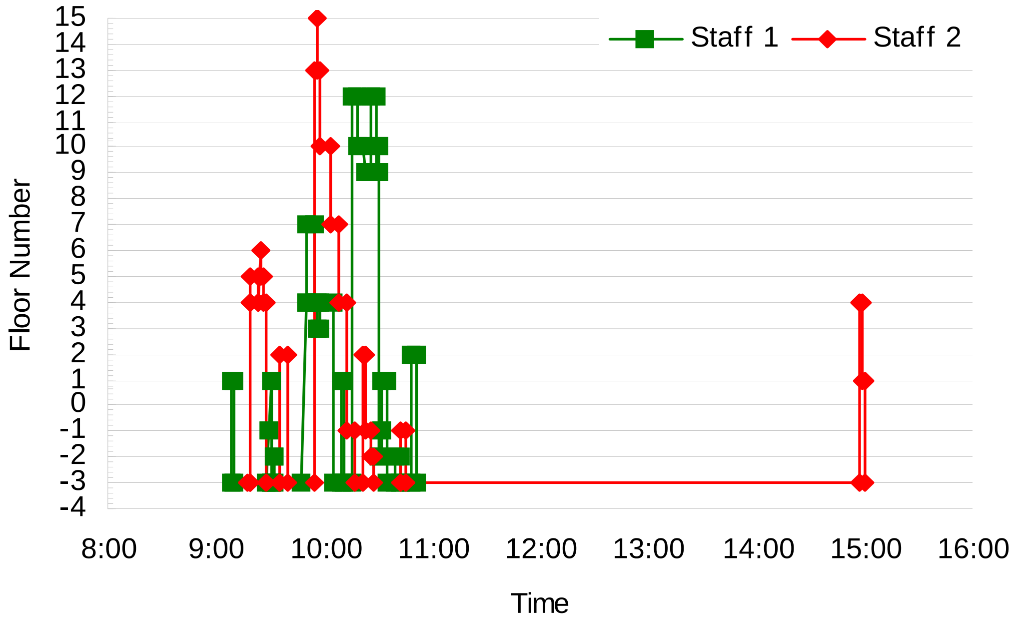

Figure 8-7. 2/19 PEAMON monitoring result

Table 8-6. Staff1's route

Time (Feb 19)	Route	Floor Location	No of office	No of delivery items	Destination	Time
9:00	B3⇒F1⇒B3				B3⇒F1	0:00:09
		1Floor	1	10	F1	0:01:51
					F1⇒B3	0:00:09
9:25	B3⇒B1⇒F1⇒B3				B3⇒B1	0:00:08
		B1	1	19	B1	0:01:25
					B1⇒F1	0:00:05
		1Floor	2	5	F1	0:00:21
					F1⇒B3	0:00:09
9:50	B3⇒F7⇒F4⇒F3⇒B3				B3⇒F7	0:02:43
		7Floor	2	9	F7	0:03:51
					F7⇒F4	0:00:09
		4Floor	1	2	F4	0:01:55
					F4⇒F3	0:00:05
		3Floor	1	8	F3	0:00:25
					F3⇒B3	0:07:50
10:15	B3⇒F12⇒F10⇒B3				B3⇒F12	0:00:25
		12Floor	1	1	F12	0:02:52
					F12⇒F10	0:00:08
		10Floor	1	2	F10	0:02:30
					F10⇒B3	0:13:15
10:40	B3⇒F2⇒B3				B3⇒F2	0:00:11
		2Floor	1	3	F2	0:02:19
					F2⇒B3	0:00:11

Table 8-7. Staff2's route

Time (Feb 19)	Route	Floor Location	No of office	No of delivery items	Destination	Time
9:15	B3⇒F5⇒B3				B3⇒F5	0:01:13
		5Floor	1	12	F5	0:03:45
					F5⇒B3	0:04:15
9:35	B3⇒F2⇒B3				B3⇒F2	0:00:11
		2Floor	1	7	F2	0:04:49
					F2⇒B3	0:00:11
9:50	B3⇒F15⇒F10⇒F7⇒B1⇒B3				B3⇒F15	0:01:57
		15Floor	1	1	F15	0:00:23
					F15⇒F10	0:00:37
		10Floor	1	3	F10	0:06:21
					F10⇒F7	0:00:09
		7Floor	1	4	F7	0:04:53
					F7⇒B1	0:04:37
		B1	1	2	B1	0:03:38
					B1⇒B3	0:00:07
10:20	B3⇒F2⇒B2⇒B3				B3⇒F2	0:00:11
		2Floor	2	6	F2	0:01:53
					F2⇒B2	0:03:07
		B2	1	1	B2	0:00:55
					b2⇒B3	0:00:05
10:40	B3⇒B1⇒B3				B3⇒B1	0:00:07
		B1	1	11	B1	0:01:53
					B1⇒B3	0:00:07
14:55	B3⇒F4⇒F1⇒B3				B3⇒F4	0:00:49
		4Floor	1	1	F4	0:00:51
					F4⇒F1	0:00:09
		1Floor	1	1	F1	0:00:51
					F1⇒B3	0:00:09

The second day of PEAMON monitoring result is depicted in Figure 8-8. The route network of Staff1 started at 9:35 delivering goods to Basements 1, 2, and ends as early as around 11:54 after completing to deliver the goods for Basement 4. For the case of Staff2, his route network started at 9:45 and terminated at around 2:07 in the afternoon after having delivered the last goods to Floor 7. Although there were several rising of both networks of the two (2) staffs as shown in the graph, it does not suggest that all the trips were made to deliver goods. The staffs made several trips to other floors which did not match when verified with the logbook.

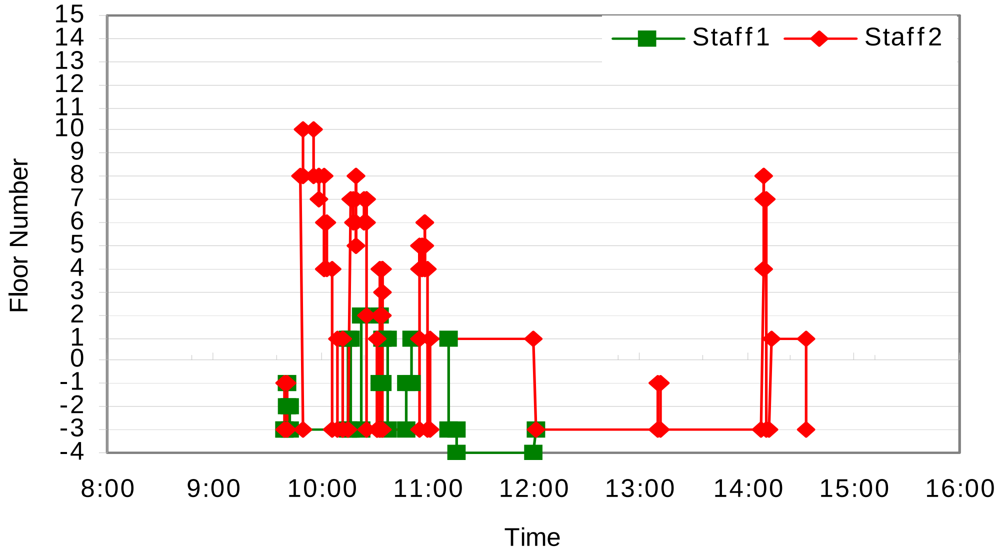

Figure 8-8. 2/20 PEAMON Monitoring result

Table 8-8. Staff1's route

Time (Feb 20)	Route	Floor Location	No of office	No of delivery items	Destination	Time
9:35	B3⇒B1⇒B2⇒B3				B3⇒B1	0:00:07
		B1	1	24	B1	0:00:56
					B1⇒B2	0:00:05
		B2	1	1	B2	0:00:55
					B2⇒B3	0:00:05
9:55	B3⇒F1⇒B3				B3⇒F1	0:00:09
		1Floor	2	18	F1	0:01:21
					F1⇒B3	0:00:09
10:20	B3⇒F2⇒F1⇒B3				B3⇒F2	0:00:11
		2Floor	1	2	F2	0:10:37
					F2⇒F1	0:01:53
		1Floor	1	5	F1	0:02:06
					F1⇒B3	0:00:09
10:50	B3⇒B1⇒B3				B3⇒B1	0:00:08
		B1	1	7	B1	0:02:55
					B1⇒B3	0:20:20
11:10	B3⇒B4⇒B3				B3⇒B4	0:00:05
		B4	1	2	B4	0:44:25
					B4⇒B3	0:00:05

Table 8-9. Staff2's route

Time (Feb 20)	Route	Floor Location	No of office	No of delivery items	Destination	Time
9:45	B3⇒F10⇒F8⇒F6⇒F4⇒B3				B3⇒F10	0:00:49
		10Floor	1	1	F10	0:06:23
					F10⇒F8	0:00:07
		8Floor	1	4	F8	0:02:55
					F8⇒F6	0:03:35
		6Floor	1	1	F6	0:00:23
					F6⇒F4	0:00:07
		4Floor	2	5	F4	0:02:47
					F4⇒B3	0:00:13
10:15	B3⇒F7⇒B3				B3⇒F7	0:00:19
		7Floor	4	14	F7	0:02:25
					F7⇒B3	0:07:35
10:30	B3⇒F4⇒B3				B3⇒F4	0:00:41
		4Floor	1	1	F4	0:01:22
					F4⇒B3	0:00:38
13:10	B3⇒B1⇒B3				B3⇒B1	0:00:08
		B1	1	1	B1	0:01:52
					B1⇒B3	0:00:08
14:05	B3⇒F7⇒B3				B3⇒F7	0:01:13
		7Floor	1	1	F7	0:01:12
					F7⇒B3	0:00:18

The two tables complementing the routes shown in Figure 8-8 are Table 8-8 and Table 8-9. Table 8-8 explains the route network of Staff1 on the second day of the survey while Table 8-9 details the route of Staff2. As can be observed from Table 8-8 there are three (3) recorded time appear to be long enough to warrant further clarification. First is the 10 minute and 37 second time spent in delivering goods at the 10:20 trip. A look at PEAMON data, however, shows that staff spends this whole time in Floor 2 without moving to other floors. This gives the impression that the staff was made to wait for some time before the receiver was available. The second case needs to be clarify because of the unusual longer time spend in delivering goods is the 10:50 trip. Data recorded by PEAMON shows that the staff after having delivered the goods for Basement 1, went to Floor 1 without carrying goods before finally returning to docking area. The third case, which raises concern due to spending more time than thought to be required, is the 11:10 trip. As shown in the PEAMON data, this staff spend the whole 44 minutes and 25 second in Basement 4. There must be unusual interruption which cause him to spend more time in facilitating this particular delivery.

Staff2's first trip chain as reflected in Table 8-9 revealed that he delivered goods continuously to Floor 10, Floor 8, Floor 6, and Floor 4. The longest delivery time was observed in the 10th floor, where one (1) piece of goods delivering took 6 min and 32 sec.

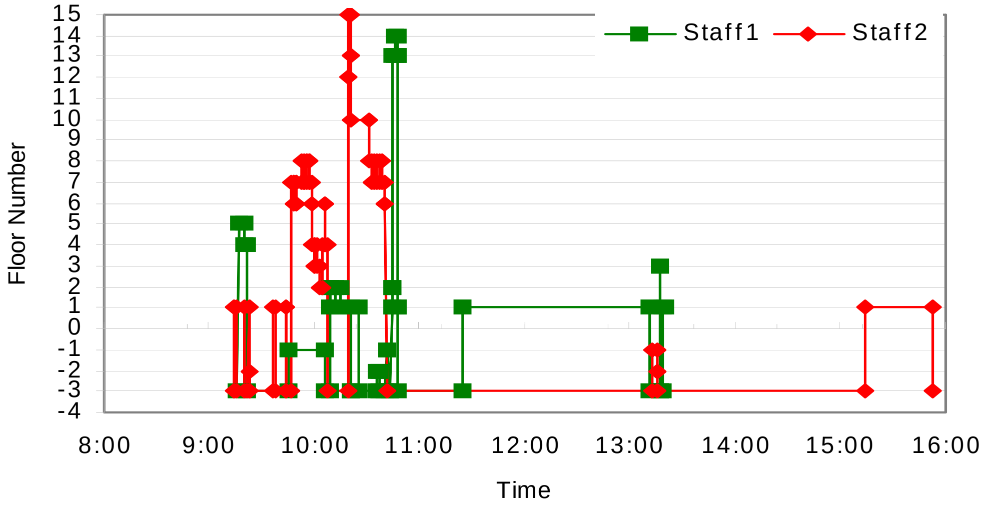

Figure 8-9. 2/21 PEAMON monitoring result

On the third day of experiment, PEAMON recorded data is illustrated in Figure 8-9. Staff1 made his first delivery to Floor 5 at 9:15 while Staff2 had delivered nine (9) pieces of goods to Floor 1 ten (10) minutes earlier. Both staffs have their last departure from the docking area at 1:10 sharing the freight elevator. Although the same figure suggested that Staff2 still made one more departure at around 3 o'clock in the afternoon, records in the logbook shows that this trip was not related in transporting goods.

Table 8-10. Staff1's route

Time (Feb 21)	Route	Floor Location	No of office	No of delivery items	Destination	Time
					B3⇒F5	0:00:30
9:15	B3⇒F5⇒B3	5Floor	1	10	F5	0:03:40
					F5⇒B3	0:00:50
					B3⇒F2	0:00:11
		2Floor	1	4	F2	0:00:25
					F2⇒F1	0:00:05
		1Floor	1	2	F1	0:02:10
10:00	B3⇒F2⇒F1⇒F2⇒F1⇒B3				F1⇒F2	0:00:05
		2Floor	1	4	F2	0:03:55
					F2⇒F1	0:00:05
		1Floor	1	6	F1	0:05:06
					F1⇒B3	0:00:09
					F3⇒B1	0:00:08
10:40	B3⇒B1⇒B3	B1	1	2	B1	0:01:22
					B1⇒B3	0:00:08
					B3⇒F3	0:00:12
13:10	B3⇒F3⇒B3	3Floor	1	1	F3	0:00:48
					F3⇒B3	0:00:12

The details of each trip chain by the two staffs graphed in Figure 8-9 are shown in Table 8-10 and Table 8-11. Staff1 actually visited and made delivery to seven (7) floors of which he spent the longest stay at Floor 6. On the other hand, Staff2 made delivery to eleven (11) floors visited 15 offices scattered to the floors building.

Table 8-11. Staff2's route

Time (Feb 21)	Route	Floor Location	No of office	No of delivery items	Destination	Time
9:10	B3⇒F1⇒B3				B3⇒F1	0:00:09
		1Floor	1	9	F1	0:00:51
					F1⇒B3	0:00:09
9:45	B3⇒F7⇒F6⇒F4⇒B3				B3⇒F 7	0:00:18
		7Floor	4	17	F7	0:00:25
					F7⇒F6	0:00:05
		6Floor	1	2	F6	0:00:25
					F6⇒F4	0:11:05
		4Floor	2	6	F4	0:00:25
					F4⇒B3	0:08:05
10:15	B3⇒F15⇒F10⇒F8⇒F7⇒F6 ⇒B3		1	1	B3⇒F15	0:00:55
		15Floor	1	1	F15	0:00:52
					F15⇒F10	0:00:38
		10Floor	1	3	F10	0:09:22
					F10⇒F8	0:00:08
		8Floor	1	1	F8	0:01:25
					F8⇒F7	0:00:05
		7Floor	1	1	F7	0:01:55
					F7⇒F6	0:05:35
		6Floor	1	1	F6	0:00:43
					F6⇒B3	0:00:17
13:10	B3⇒B1⇒B3				B3⇒B1	0:00:08
		B1	1	11	B1	0:02:25
					B1⇒B3	0:00:35

8.6.5 Survey summary

The survey reveals several insights that can be useful in understanding the complexity of goods offloading chain. The arrived data averages and properties of elevator are shown in Table 8-12. Opening and closing time of elevator is 3.5 sec and 4.9 sec respectively. Furthermore, the elevator time for movement from one floor to next immediate floor (either up or down) is 5 sec. However, when the desired location is higher than that – say from first floor going to 5th floor – the elevator time from first floor to second floor is 5 seconds, while from second floor to 3rd floor is 2 seconds (Table 8-12).

The processing time for 13 goods (average per trip) in the docking are (B3) is 8 minutes. This time refers to the moment the two staffs work on the goods from the vehicle, sort out, divide the amount and identify each other's route up to their departure by the elevator. For instance, if the delivery is to be made at Floor 15, the computed time will look like this: 8 minutes (processing time) plus 30 sec (elevator time) plus 8.4 sec (opening and closing time of elevator) plus 37 sec (average delivery time on that floor). This case assumes that the elevator is uninterrupted to the other floor and the first stop is the 15 floor.

Table 8-12. Averages observed from the survey

Floor	Elevator time	Ave time	Ave no of office	Ave no of goods	No of trip
F15	30.0	0:00:37	1.0	1.0	2
F14	28.5				
F13	27.0				
F12	25.5	0:02:52	1.0	1.0	1
F11	24.0				
F10	22.5	0:06:09	1.0	2.3	4
F9	21.0				
F8	19.5	0:02:10	1.0	2.5	2
F7	18.0	0:02:27	2.2	7.7	6
F6	16.5	0:00:30	1.0	1.3	3
F5	15.0	0:03:43	1.0	11.0	2
F4	13.5	0:01:28	1.4	3.0	5
F3	12.0	0:00:36	1.0	5.0	2
F2	10.5	0:04:00	1.2	4.3	6
F1	9.0	0:01:50	1.3	7.0	8
B1	7.0	0:02:03	1.0	9.6	8
B2	5.0	0:00:55	1.0	1.0	2
B3	0.0	DOCKING AREA			
B4	5.0	0:44:25	1.0	2.0	1

The lack of available data concerning the sizes and weights of goods and the distance of offices from elevator make it difficult to explain the real cause on why some delivery time takes longer than the others do. Although logic might state that the amount of goods delivered and number of offices visited is directly proportional to the amount of time spent for delivery, it is also important to consider the distance of offices from the elevator. For instance, it would be difficult to explain why the average delivery time to Floor 5 is shorter than say Floor 10 given that Floor 5 has more number of goods to be delivered. One possible explanation is perhaps the office visited in Floor 5 is closer to elevator than that of Floor 10.

The data of Basement 4 is considered irregular and was taken out during the computation for average delivery time to each floor which used as input data for simulation. There was a strong indication that there were interferences during the delivery to B4 and the time recorded did not reflect the actual delivery time.

8.7 Simulation modeling

Simulation approach is becoming more popular than any other analytical tools due to its increasing reliability and user-friendliness. One advantage of this approach is its ability in illustrating in graphical form the condition under observation as well as its effectiveness for quantifying benefits and limitations of the different possible alternatives. This presentation in graphical form enables to identify elements of the system that requires attention due to the likely occurrence of instabilities – for instance is inability of staff members to hold incoming goods.

The identified instabilities can then be treated by manipulating the input data or increasing the capacity of some elements of the simulation – e.g. parking space, elevator.

8.7.1 Process of building simulation model

Shown in Figure 8-10 is the process of building a simulation model in ProModel. This simulation software has five important elements to describe either existing or planned facility – location, entity, routes, processing rule, and arrival. Locations represent places where raw materials arrived or process. Raw material is anything that moves – for this study, the entity is goods. After having the two elements, the next step is to develop the routes used by entity at the same time connects one location to another. Processing rule is set to define what the modelers want the entity to do while at a location. Processing time and other ready commands can be issued in processing rule. The last element is the setting of arrival time and interarrival of raw materials. Several arrival distributions are available in the software. If the arrival or interarrival time does not follow a pattern, StatFit statistical software included in the ProModel can be used to identify appropriate distribution.

8.7.2 Description of ProModel

The simulation models built were done using ProModel Version 4.1, a commercially available discrete event simulation package used for simulating logistical activities. The entire process involved in transporting the goods is modeled as a manufacturing network where each floor of the building, (off) loading area, stock point is considered as location (Figure 8-10). The goods coming in to the building is assigned as entity and the two staff members and the trucks considered as resources. Elevator was not represented through resources due to perceived difficulty of handling it in the

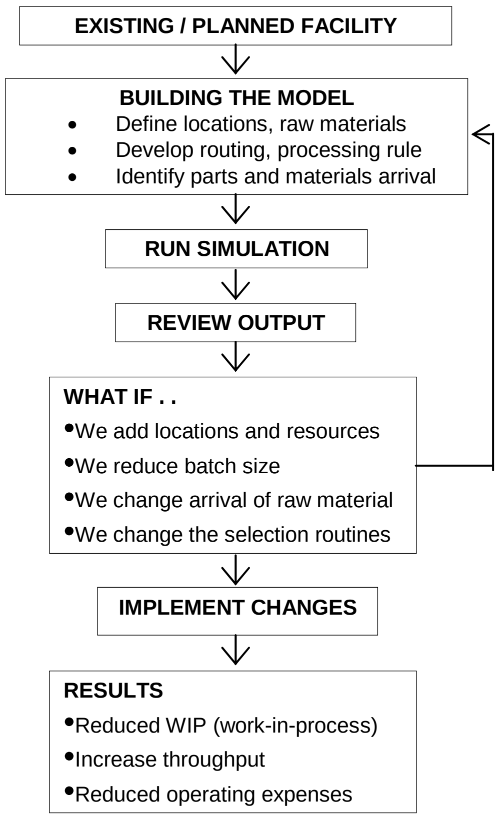

Figure 8-10. Process of building simulation model

software since a resource (elevator for instance) cannot transport another resource (staff members). However, the network on which the staff travels models the same function as the elevator.

For modeling convenience, certain assumptions were set:

- No distinction is made between types, sizes, and weights of cargo.
- From the floor where the delivery is to be made, it took 2 minutes and 24 seconds for staffs to return to the elevator disregarding the number of offices and goods (this is obtained by getting the average of all floors' averages monitored by PEAMON).

8.7.3 Data fitting

Since the surveyed data do not follow any particular pattern, for instance every 15 minutes, it is not possible to input a fix interarrival. To mitigate this difficulty, the perceived appropriate way to determine the best distribution that could represent the interarrival is the use of StatFit. The collected data for arrival times of trucks in three-days were worked in Excel spreadsheet and plugged into the statistical software. After running the software, however, only the second day-data generated distributions fit and the two other arrival data were rejected due to insufficient of data point.

The suggested distributions to represent the interarrival times are shown in Table 8-13. Several distributions fitted the data which could be applied to interarrival of trucks trips. Normally, chi-square test is applied to see if the data came from a specific distribution. However, lack of adequate number of data points prevented from performing this test. Two other useful tests are Kolmogorov-Smirnov test (K-S test) and Anderson-Darling test (A-D test). Like the chi-square test, these tests are used to decide if the sample comes from a specific distribution. The A-D test is a modification of K-S test and gives more weight to the tails than does the K-S test.

Table 8-13. Distributions Fit

Distribution	Rank	Acceptance	K-S test	A-D test
Inverse Gaussian (-3.35, 23.6, 40.1)	100	accept	Do not reject	Do not reject
Lognormal (-0.483, 2.93, 1.3)	99.9	accept	Do not reject	Do not reject
Pearson 5 (-7.7, 1.75, 39.4)	99.4	accept	Do not reject	Do not reject
Weibull (1, 0.682, 28.8)	98	accept	Do not reject	Do not reject
Exponential (1, 35.7)	96.2	accept	Do not reject	Do not reject
Erlang (1, 1, 35.7)	96.2	accept	Do not reject	Do not reject
Gamma (1, 1, 35.7)	96.2	accept	Do not reject	Do not reject
Pearson 6 (1, 102, 1.27, 4.23)	91.9	accept	Do not reject	Do not reject
Log-Logistic (1, 1.51, 23.4)	87	accept	Do not reject	Do not reject
Beta (1, 4.95e+6, 0.984, 1.23e+05)	73.4	accept	Do not reject	Do not reject
Pareto (1, 0.35)	7.37	accept	No fit	No fit
Triangular (0.951, 177, 0.986)	0.898	accept	Do not reject	reject
Uniform (1, 158)	0.0027	reject	reject	reject

Result of K-S test, at .05 significance level, shows that only the Uniform distribution was rejected. On the other hand, the A-D test aside from rejecting the Uniform distribution also rejected the Triangular distribution. Both tests did not give value to the Pareto distribution. The lack of adequate data is seen as the main reason for the vague results of the tests.

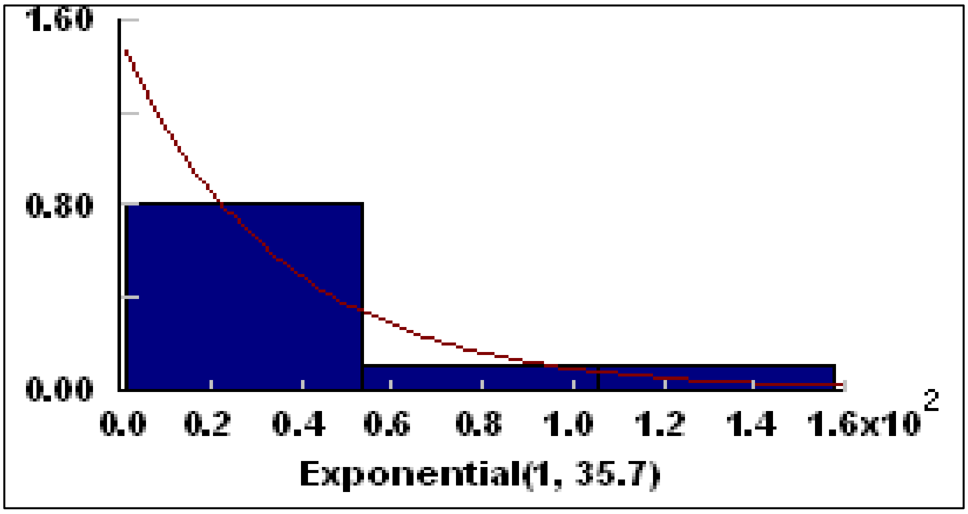

Figure 8-11. Fitted arrival distribution

Statistically, any of the remaining ten distributions could be applied for time intervals between trips. However, it is important to determine which distribution could provide an output that would reflect the real behavior of the system. Aside from applying all the accepted distribution to the simulation, another method is by plotting the input data against the selected distribution as reflected in Figure 8-11. As shown in the figure, the shape of the data is the same as the plot of exponential distribution.

8.7.4 Computation of working time

Equation 1 shows the computation process of staff's working time (utilization percentage of the staff). This is defined as the percentage of time the resource spent traveling or to be used, transporting or processing an entity, or servicing a location or other resource. Utilization percentage shows the total time of the staff members involve in processing the goods. This value is the reflection of real time the staff members involved in activities related to the delivery of goods excluding idle time and rest. The three (3) variables composing the equation are defined below:

$$\textbf{Working time} = \frac{\text{Total Travel to Use Time + Total Time In Usage x 100}}{\text{Total Scheduled Time}} \qquad (1)$$

Total Travel to Use Time (TTUT) is the time where the resource (staff members) spent traveling to a location (floors, docking are, etc) to transport or process an entity (goods), or to service a location or other resource. It does not include any pick up time, but does include any blocked time.

Total Time in Usage (TTU) is the total time the resource spent transporting or processing and entity (goods), or servicing a location or other resource.

Total Schedule Time is the total number of hours scheduled or made available for the resources (staff members).

The ***100*** multiplier in the equation is a decimal conversion multiplier to make the percentage figure a whole number rather than a pure decimal value.

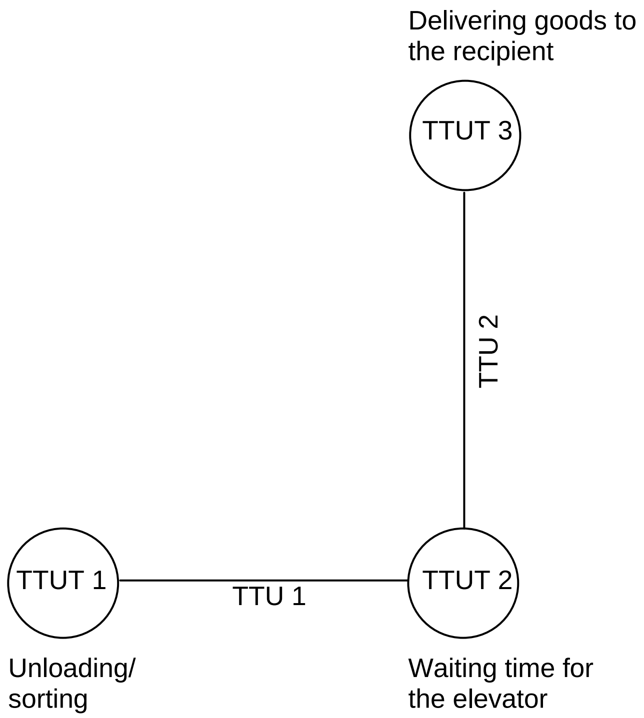

Figure 8-12. Diagram of different time calculated to attain working time

As explained, working time of the staff comes from their different activities related to transport the goods across the building. As can be seen in Figure 8-12, TTUT is the sum of time spent by the staff in unloading and sorting the goods, while waiting for the elevator, and delivery time to the recipient. On the other hand, TTU can be described as combined travel time of the staff from the docking area to the elevator and from the origin of the elevator to the final floor where the delivery is to be made (Figure 8-12).

8.7.5 Properties of the simulation model

The properties of the 15-story building were replicated for the simulation to analyze the impact of frequency of trips and number of goods to the capacity of the two staffs. Ocular inspections to the building show that the total time for the elevator to close and open is 8.4 seconds while its speed is 2.5 seconds from one floor to another (Table 8-14).

The total time in a day of the staff in delivering all the incoming goods were processed to arrive 36.92 seconds which is the average time a staff spent to unload a piece of goods from the truck up to the elevator. Obviously, the configuration of the data is worked to fit it to the simulation. With regard to the amount of time spend by the staff to deliver goods to each floor, the average time arrived is 2.24 minutes for each piece of goods. If the staff were delivering two parcels, the delivery time to the floor alone where the shop is located would be 4.48 minutes.

Table 8-14. Input data of the simulation

Buildings	No of elevator	Speed from one floor to next	Opening and closing	Unloading / goods up to elevator	Goods per floor trip
15-story	2	2.5 sec	8.4 sec	36.92 sec	2.24 min
20-story	2	2.5 sec	8.4 sec	36.92 sec	2.24 min
30-story	2	2.5 sec	8.4 sec	36.92 sec	2.24 min
40-story	2	2.5 sec	8.4 sec	36.92 sec	2.24 min

The simulation tried to assess the impact of two variables to the capacity of the staff – first variable considered was the frequency of trucks and the second variable was the number of goods loaded on each arriving truck. The obvious reason is to find a balance between the variables and the staff's capacity to realize efficient delivery of goods.

The survey found that every arriving truck has an average load of 13 goods and the average trips to the building is eight. This data was used as the base case for the simulation for the following reasons:

1) To validate the accuracy of the simulation in replicating the real operation of goods delivery
2) To distinguish the working time and rest time of the staff given the amount of goods arriving
3) To estimate the number of goods that the staff able to deliver in a day
4) To determine the 'right circumstances' to increase the number of staff

There are three time interval and three differrent number of goods per trip as shown in Table 8-15. The 13 goods which is the base case was taken from the average number of goods carried by delivery vehicles from the survey. The number of arriving goods was then doubled and tripled since it is difficult to predict the exact number of goods that would arise in the future. In this case, a series of choices are available which could be used as reference.

Table 8-15. Variations of number of goods and time interval between trips

No of goods per arrival	Time between arrivals	No of trips	Total no of goods arriving	Scheduled time (hr)
	exponential			
	15 min	32	416	8
13	30 min	16	208	8
	60 min	8	104	8
	exponential			
	15 min	32	862	8
26	30 min	16	416	8
	60 min	8	208	8
	exponential			
	15 min	32	1248	8
39	30 min	16	624	8
	60 min	8	312	8

Regardless of which interval and goods number is used as input data, the simulation is scheduled to run for 8 hours. This system assumes that all the staff members start working at 8 in the morning and end at 5 in the afternoon for 8 hours service. Taking into account the variations in number of arriving goods and time between arrivals, there are twenty seven (27) simulation cases.

8.7.6 Properties of the buildings

As discussed in Chapter 4, the district is currently experiencing renewal of its buildings to create a CBD that caters business, cultural and commercial functions. Data obtained suggest that at present, the share of shops and restaurant is merely 3 percent while 97 percent is devoted to office space. Effort to raise the share of commercial establishments would also increase the number of goods and truck's trips into the district.

In order to make the area of simulation analysis broad and general, it is important to produce different models that depict different buildings with different heights to predict to what extent the buildings in the district will be extended in height. Further, the output is aim to serve as decision support not only for Marunouchi district but also to other central business districts in Japan and other countries.

With that aim, the first simulation studied a 15-story building which was taken as a base case. Since this is the building which has real data recorded through survey, the simulation's result can be compared for validation. After the validation, the building's floor is increased to 20, then 30, and 40.

8.7.7 Results

(i) Case of the 15-story building

The number inside the boxes in Figure 8-13 reflects the amount of goods left at the docking area after the eight-hour run of the simulation. These numbers imply the inability of the two staffs to handle the quantity of goods delivered in the building in a day.

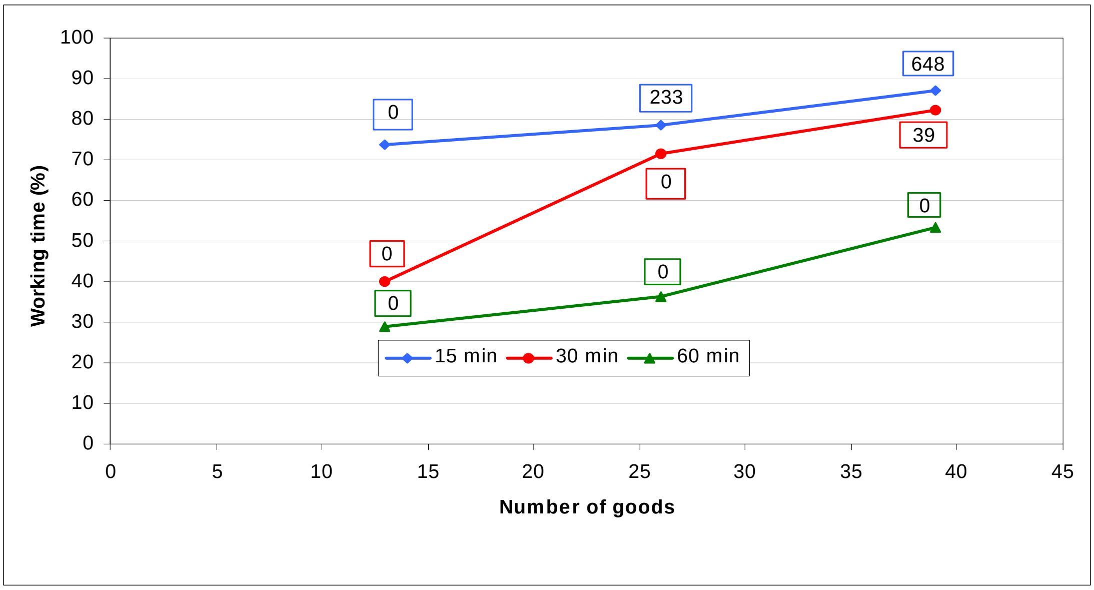

Figure 8-13. Case of a 15-story building

A careful look at the same figure would reveal that with every arriving truck has a load of 13 goods the two staff managed to deliver all the goods to the recipients within the building. In addition, the staffs' working time are placed well below the 100% mark which could be interpreted that they are getting a break in between trips. A 100% working time means that the staffs have spent the 480-minute working hour. The highest working time number of the staffs is 74% while the lowest is 29%. The 74% working time is equal to 354-minute. This suggests that the staffs have almost a four-minute break between trips (126 minutes divided by 32 trips is equal to 3.9 minutes). With regard to the 29% working time, this implies that the two staff is under utilized with a rest between trips of 43 minutes.

As the load of arriving trucks increases to 26, the 15-minute interval is too short that the staffs were not able to deliver 233 goods. Increasing further the amount of goods to each arriving truck would further limit the ability of the two staffs as shown by the increasing number left at the docking area after the 8-hour run of the simulation.

(ii) Case of the 20-story building

The one-hour interval between trips is enough time for the two staffs to deliver all the goods as shown in Figure 8-14. With every arriving truck's load of 39, the average working time of staff stands at 78% implying that the staffs could afford to have rest of 13 minutes between trips (106 minutes divided by 8 trips is equal to 13.25 minutes). This large amount of time suggests that the volume of goods could still be increased from it present number of 39.

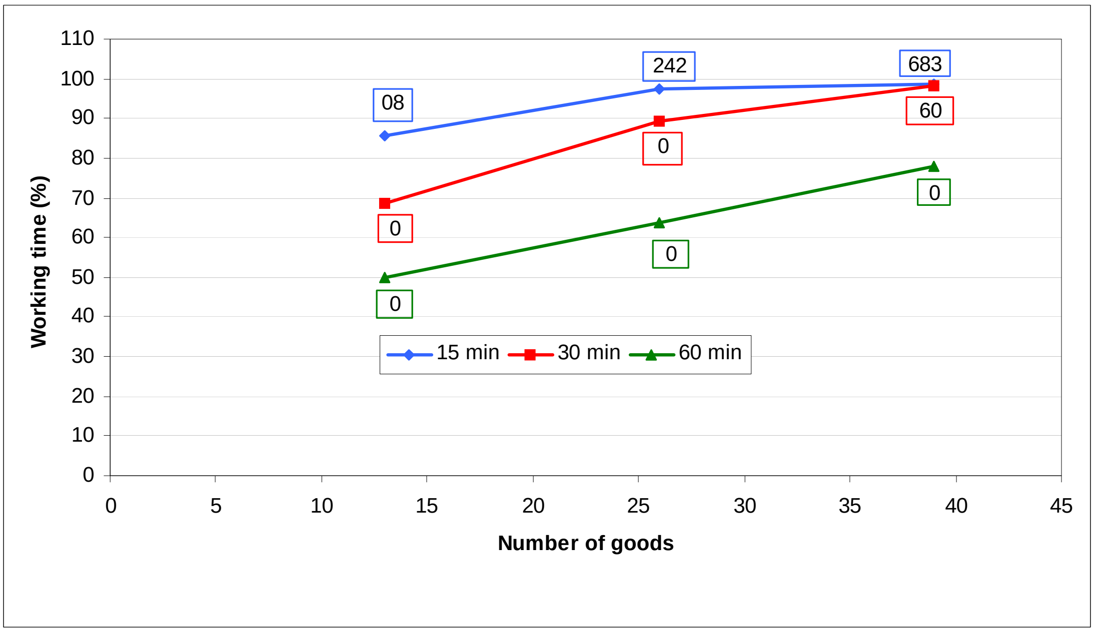

Figure 8-14. Case of a 20-story building

When the interval between trips was set to 30-minutes, the two staffs can still manage to deliver goods as much as 26 but have shown limitation at 39. Reading the working time rate of the staff at 26 goods per arrival stick to 89 % that has an equivalent of working for 429 minutes out of 480-minutes scheduled working hours. This ratio would allow the staffs to have rest of roughly 3 minutes between trips (51 minutes divided by 16 trips is equal to 3.18 minutes). On the other hand, it is notable in the same figure that under the 15-minute time interval between trips, the staffs could not deliver all the goods carried by trucks.

(iv) Case of 30-story building

As the floor of the building reaches 30, the two staffs have hard time to deliver the coming goods especially when the interval between trips is 15-minutes (Figure 8-15). At 15-minute interval, the staffs working hour is notably high that almost reach the maximum working time which is 100%. Increasing the length of time interval between trips from 15-minutes to 30-minutes ensures that the staffs were able to send out all the goods to the recipients provided that the load of every coming truck is lesser than 26. As shown in the same figure, at 26 goods per arriving truck, there were at least 47 goods left at the docking area after the 8-hour run of the simulation. While the staffs have difficulty of shipping out all the goods under the 15-minute and 30-minute interval between trips, this is not the case when the length of trips interval reached 60-minutes. Even if the load of every incoming truck reached 39, all the goods are shipped out before the end of the day's working hour. Under this condition, the staffs working time stands at 84% implying that they have spend 403 minutes out of 480-minutes working time. It can be said that they have an almost 10-minute rest between trips assuming that their delivery time of every trip is equal (77 minutes divided by 8 trips is equal to 9.6 minutes).

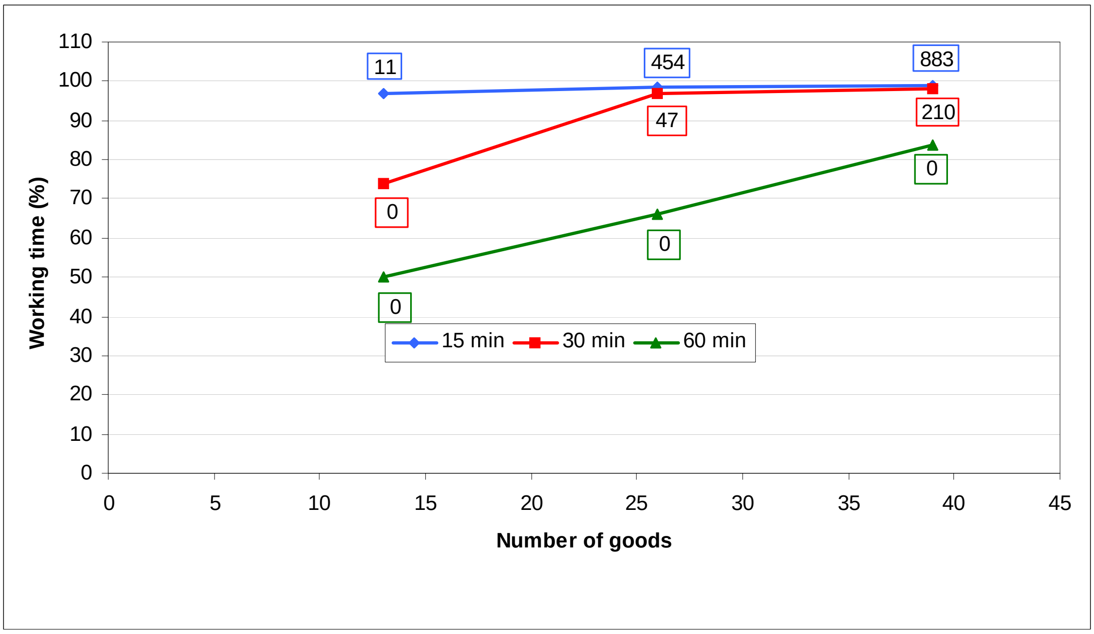

Figure 8-15. Case of a 30-story building

(v)Case of 40-story building

The working time of two staffs reached 100% on several occasions as shown in Figure 8-16 indicating that their whole attention is dedicated to the delivery of goods. The 60-minute interval between trips is sufficient time for the staffs to fulfill the delivery with 91% being the highest working time rate which was attained when every arriving truck has a load of 39 goods.

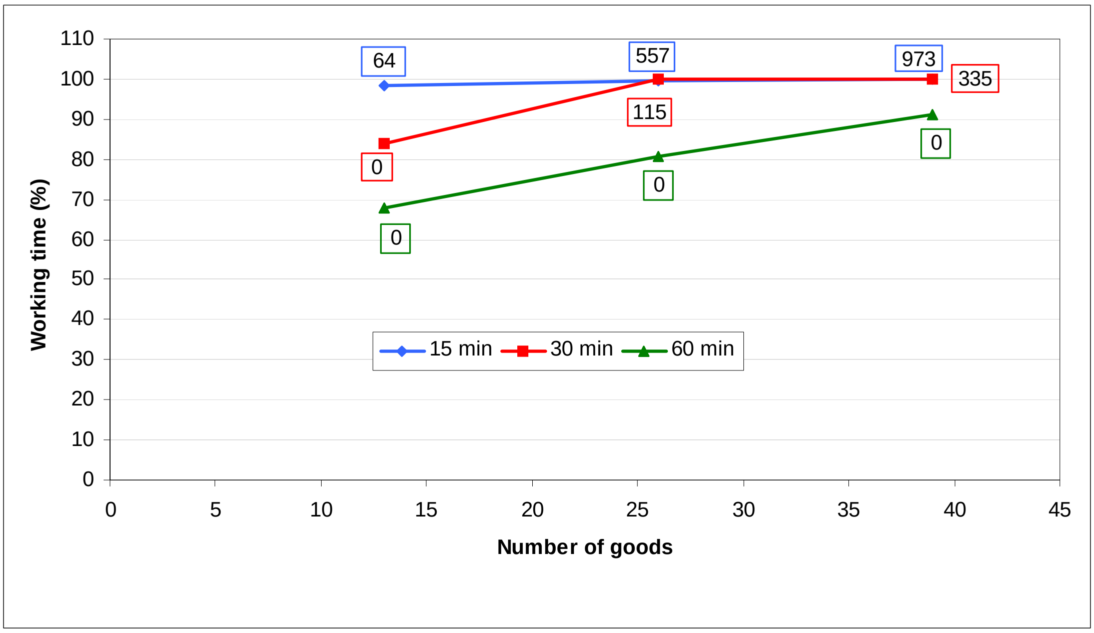

Figure 8-16. Case of a 40-story building

8.7.8 Model validation

In order to check if the simulation presented before was able to replicate the real operation inside the building, a simulation count to a 15-story building and the recorded data from the survey is compared as shown in Table 8-16. Trips refers to the number of times the staffs visit a floor to deliver freight. The number of goods delivered by the staffs, which generates 52 trips to both counts, is 103.

Table 8-16. Comparison of surveyed data and Simulation count

Floor	No of trips	
	Surveyed data	Simulation count
15	2	2
14	0	4
13	0	3
12	1	2
11	0	2
10	4	4
9	0	3
8	2	3
7	6	1
6	3	3
5	2	3
4	5	4
3	2	4
2	6	1
1	8	2
B1	8	4
B2	2	2
B3	0	3
B4	1	2
Total	52	52

Another useful test to validate the accuracy of the simulation model is by comparing the real time recorded during the survey and the simulation-generated time. As reflected in Table 8-17, the recorded time to deliver 103 goods across the 15-floor building is 16.13 minutes while the simulation time is 17.41. The difference therefore is merely 6%.

Table 8-17. Comparison of surveyed time and simulation-generated time

Variables	Delivery time for 1 truck trip	Time (8 hours)	No of goods
Surveyed data	16.12 min	128.96 min	103
Simulation result	17.41 min	139.28 min	103

8.8 Discussion of results

Adopting cooperative delivery system requires advance knowledge not only to the number of companies intended to join, number of goods covered but also to the small components of the system such as correct delivery schedule and right number of staff. Employing excessive number of staff is detrimental to all parties concern such as the shippers and carriers since this will increase the cost involved. On one hand, assigning staff that could not fulfill the delivery the way the system was designed would weaken its merit and may miss its objectives.

Table 8-18. Perceived suitable number of goods per truck based on the capability of the two staffs

Building	No. of goods per trip (1- hour interval)	No. of goods per trip (30-min interval)	No. of goods per trip (15-min interval)
15-story	39 - 45	26 - 30	13 -20
20-story	39 - 45	26 - 30	Less than 13
30-story	26 - 35	Less than 26	Less than 13
40-story	39	Less than 26	Too short interval

The series of simulation models built could support in resolving the above dilemma (Table 8-18). The capability of the two staff with regard to the delivery of goods was determined in relation to the amount of goods, time interval between trips and the height of the building. The results of the two tests affirmed the reliability of the models

8.9 Comparison of time saved from Vertical CDS, Horizontal CDS and the combination of Horizontal and Vertical CDS

In order to evaluate which CDS design is to be applied as a management measure for freight transport in the CBD, a new simulation analysis is conducted to the Marunouchi district. At first, all the 15-buildings were assumed to have the same number of story which is 15. The number of story is then increased to 20, 30, and 40. The simulation and analysis process is the same of that in Chapter 7 where average waiting time of trucks is compared between with and without CDS schemes. Further, the same simulation software, Simul8, is used. The idea here is to determine which

CDS design is most suitable depending on the average height of the buildings in the CBD.

In this section of the study, four cases is compared; 1) without CDS, 2) Vertical CDS, 3) Horizontal CD, 3) combination of Vertical and Horizontal CDS. Definition of each CDS is available in Chapter 4.

8.9.1 Data requirements

The Marunouchi building (Building number 10 in Chapter 7) was taken as model to estimate the likely GLA of the building area when it reaches 40-story. At present, no building exceeded 40-story. Marunouchi building being the tallest has 37-story. With that consideration, the likely configuration of the building in the area is shown in Table 8-19. As mentioned, the area is more of an office-oriented CBD where around 97% of building space is dedicated for office use.

Table 8-19. Properties of the buildings

Building story	GLA (sq. m.)	Parking space	Freight elevator	Space usage		Trip attraction per 1,000 sq. m.	
				Office	Shops and Restaurants	Office	Shops and Restaurants
15 story	42,162	4	2	97	3	2.6	14.1
20 story	56,216	5	3	97	3	2.6	14.1
30 story	84,324	6	4	97	3	2.6	14.1
40 story	112,432	8	5	97	3	2.6	14.1

Note: Trip attraction is based on the survey in Marunouchi district.

The estimated number of trips based on the trip attraction in Table 8-19 is available in Table 8-20. The number shown is total delivery trips but since each truck would make two deliveries, the total number of trucks entering the district is therefore half of the total trips. For instance, the total number of trucks that would enter the CBD when all the buildings are 15-story is 900 trucks.

Without CDS scheme and Vertical CDS scheme have the same pattern of truck trips. As mentioned in Chapter 4, the only difference between them is that under the Vertical CDS, there are staff inside the building that would help the driver unloads the goods. In essence, there is no depot and goods consolidation under the Vertical CDS.

Table 8-20. Number of trips without CDS and under Vertical CDS

	Number of trips				
Building story	8:00 - 9:30	9:30 - 12:00	12:00 - 17:00	Total	Total trips to 15-bldgs
15 story	29	42	49	120	1800
20 story	38	56	65	160	2400
30 story	58	84	98	240	3600
40 story	77	112	131	320	4800

Note: Average goods per delivery to one building is 4. Survey results show that every truck had made two stops for each delivery, the total number of goods per truck therefore is 8.

Horizontal CDS scheme and the combination of Horizontal and Vertical CDS scheme have the same pattern of truck trips (Table 8-21). The only component that separates them is the availability of staff inside the building for the combination of Horizontal and Vertical CDS. Horizontal CDS relies to the ability of the driver to unload all the consolidated goods. Further, there is a depot where goods are consolidated under these two schemes as discussed in Chapter 4 and Chapter 7.

Table 8-21. Number of trips and goods under Horizontal CDS and combination of Horizontal and Vertical CDS

Building story	Number of trips				Number of goods			
	8:00 - 9:30	9:30 - 12:00	12:00 - 17:00	Total	8:00 - 9:30	9:30 - 12:00	12:00 - 17:00	Total
15 story	6 (19)	5 (34)	5 (39)	16	115	168	196	479
20 story	6 (26)	5 (45)	5 (52)	16	153	224	262	639
30 story	6 (38)	5 (67)	5 (79)	16	230	336	393	959
40 story	6 (51)	5 (90)	6 (87)	18	307	448	524	1279

Note: Figures in the parenthesis are number of goods per delivery to one building. Since CDS truck would make two stops for each delivery, the total number of goods per truck is therefore double of that number.

8.9.1 Simulation Results

The average waiting time of trucks is considerably low when the building has 15-story to all the schemes. Even without any form of CDS, the average waiting time is merely 2.27 minutes. There was also a small waiting time under the Vertical CDS at 0.7 minute. This can be attributed to the high number of trucks in the morning and limited number of space where trucks could park while waiting for the assistance of the staff inside the building.

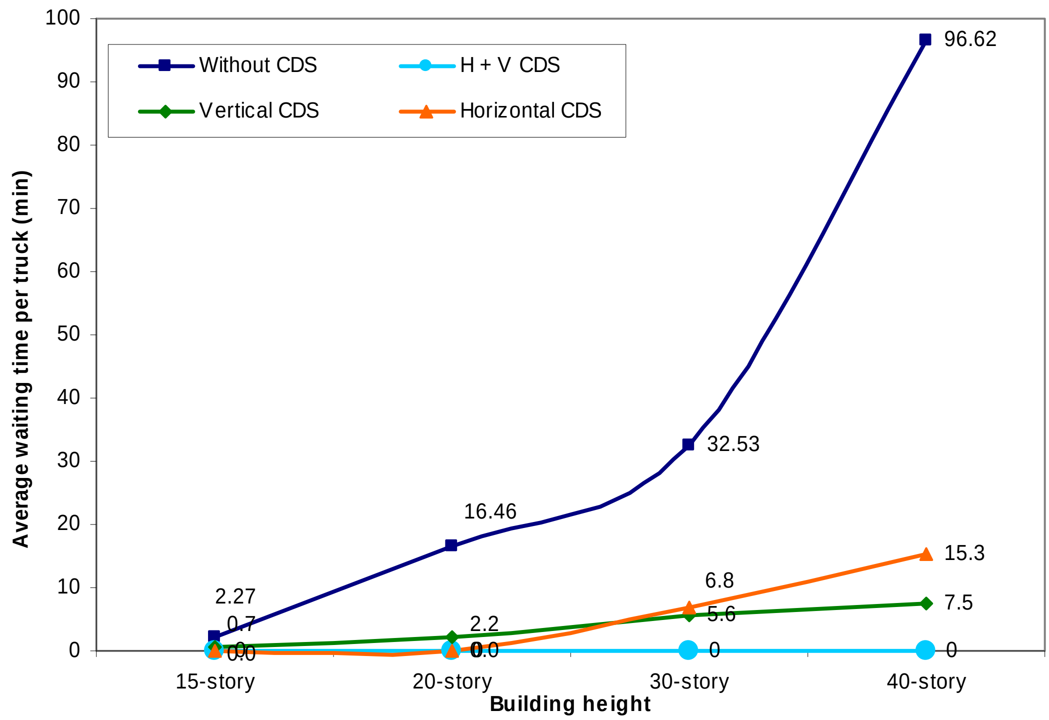

Figure 8-17. Average waiting time of trucks based on which CDS is adopted

It can be observed that there is no waiting time of trucks even after the building reaches 40-story under the combination of Horizontal and Vertical CDS while there is a steady increase of waiting time under the Horizontal CDS scheme. This result underscores the necessity to assign CDS staff inside the high rise buildings. The performance of Vertical CDS based on truck's waiting time is getting better as compared with the Horizontal CDS as the building's height increases. The reason is that as the building gets tall, it takes some time for the driver to deliver the consolidated goods and therefore the truck has to occupy the parking space longer. There were events that other CDS trucks have to wait until the parking space is emptied by another CDS which causes delay for the delivery.

Table 8-22. Comparison of Without CDS scheme and combination of Horizontal and Vertical CDS scheme

a. 15-story

Variables	Computation process	Without CDS	Computation process	H + V CDS	Difference
Delivery time	898 trucks x 5.34 min	4,796	120 trucks x 5.34 min	641	4155
Unloading time	7185 goods x 0.33 min	2,371	7185 goods x 0.33	2,371	0
Waiting time for parking	1796 trucks X 2.27 min	4,077	240 trucks X 0 min	-	4077
Labor time at SP	No SP	-	1 min/goods X 7192 goods	7,192	-7192
Vertical Delivery time	7185 goods x 1 min	7,185	45 staff x 421 min	18,945	-11760
Total		18,430		29,148	-10719

Note: 5.34 minutes of delivery time are derived from Chapter 7 while 0.33 minute and 1 minute (for labor time at SP and vertical delivery) are derived from survey data that was discussed in the same chapter. The number of staff is equal to total number of freight elevator plus one additional staff while waiting time of trucks and staff's working time (vertical delivery) are derived from simulation result.

b. 20-story

Variables	Computation process	Without CDS	Computation process	H + V CDS	Difference
Delivery time	1198 trucks x 5.34 min	6,398	120 trucks x 5.34 min	641	5757
Unloading time	9585 goods x 0.33	3,163	9585 goods x 0.33	3,163	0
Waiting time for parking	2396 trucks X 16.46 min	39,442	240 trucks X 0 min	-	39442
Labor time at SP	No SP	-	1 min/goods X 9589 goods	9,589	-9589
Vertical Delivery time	9585 goods x 1 min	9,585	60 staff x 437 min	26,220	-16635
Total		58,588		39,613	18976

c. 30-story

Variables	Computation process	Without CDS	Computation process	H + V CDS	Difference
Delivery time	1798 trucks x 5.34 min	9,602	120 trucks x 5.34 min	641	8961
Unloading time	14385 goods x 0.33	4,747	14385 goods x 0.33	4,747	0
Waiting time for parking	3596 trucks X 32.53 min	116,986	240 trucks X 0 min	-	116986
Labor time at SP	No SP	-	1 min/goods X 14383 goods	14,383	-14383
Vertical Delivery time	14385 goods x 1 min	14,385	75 staff x 437 min	32,775	-18390
Total		145,720		52,546	93174

d. 40-story

Variables	Computation process	Without CDS	Computation process	H + V CDS	Difference
Delivery time	2398 trucks x 5.34 min	12,806	135 trucks x 5.34 min	721	12085
Unloading time	19185 goods x 0.33	6,331	19185 goods x 0.33	6,331	0
Waiting time for parking	4796 trucks X 96.62 min	463,414	270 trucks X 0 min	-	463414
Labor time at SP	No SP	-	1 min/goods X 9589 goods	19,178	-19178
Vertical Delivery time	19185 goods x 1 min	19,185	90 staff x 443 min	39,870	-20685
Total		501,736		66,100	435636

Table 8-23. Comparison of Without CDS scheme and Vertical CDS scheme

a. 15-story

Variables	Computation process	Without CDS	Computation process	Vertical CDS	Difference
Delivery time	898 trucks x 5.34 min	4,796	898 trucks x 5.34 min	4,796	
Unloading time	7185 goods x 0.33 min	2,371	7185 goods x 0.33 min	2,371	0
Waiting time for parking	1796 trucks X 2.27 min	4,077	1796 trucks X 0.7 min	1,257.38	2820
Labor time at SP	No SP	-	No SP	0	0
Vertical Delivery time	7185 goods x 1 min	7,185	45 staff x 432 min	17,280	-10095
Total		18,430		25,704	-7,275

b. 20-story

Variables	Computation process	Without CDS	Computation process	Vertical CDS	Difference
Delivery time	1198 trucks x 5.34 min	6,398	1198 trucks x 5.34 min	6,397	1
Unloading time	9585 goods x 0.33	3,163	9585 goods x 0.33	3,163	0
Waiting time for parking	2396 trucks X 16.46 min	39,442	2396 trucks X 2.2 min	5,271.75	34171
Labor time at SP	No SP	-	No SP	0	0
Vertical Delivery time	9585 goods x 1 min	9,585	60 staff x 475 min	28,500	-18915
Total		58,588		43,332	15,256

c. 30-story

Variables	Computation process	Without CDS	Computation process	Vertical CDS	Difference
Delivery time	1798 trucks x 5.34 min	9,602	1798 trucks x 5.34 min	9,602	0
Unloading time	14385 goods x 0.33	4,747	14385 goods x 0.33	4,747	0
Waiting time for parking	3596 trucks X 32.53 min	116,986	1798 trucks X 5.6 min	20,139.00	10642
Labor time at SP	No SP	-	No SP	0	0
Vertical Delivery time	14385 goods x 1 min	14,385	75 staff x 470 min	35,250	0
Total		145,720		69,738	75,982

d. 40-story

Variables	Computation process	Without CDS	Computation process	Vertical CDS	Difference
Delivery time	2398 trucks x 5.34 min	12,806	2398 trucks x 5.34 min	26,408	0
Unloading time	19185 goods x 0.33	6,331	19185 goods x 0.33	6,527.80	0
Waiting time for parking	4796 trucks X 21 min	463,414	2398 trucks X 7.5 min	35,971.88	10642
Labor time at SP	No SP	-	No SP	0	0
Vertical Delivery time	19185 goods x 1 min	19,185	90 staff x 470 min	42,300	0
Total		501,736		111,208	390,528

Table 8-24. Comparison of Without CDS scheme and Horizontal CDS scheme

a. 15-story

Variables	Computation process	Without CDS	Computation process	Horizontal CDS	Difference
Delivery time	898 trucks x 5.34 min	4,796	120 trucks x 5.34 min	641	4155
Unloading time	7185 goods x 0.33 min	2,371	7185 goods x 0.33	2,371	0
Waiting time for parking	1796 trucks X 2.27 min	4,077	240 trucks X 0 min	-	4077
Labor time at SP	No SP	-	1 min/goods X 7192 goods	7,192	-7192
Vertical Delivery time	7185 goods x 1 min	7,185	7185 goods x 1 min	7,185	0
Total		18,430		17,388	1041

b. 20-story

Variables	Computation process	Without CDS	Computation process	Horizontal CDS	Difference
Delivery time	1198 trucks x 5.34 min	6,398	120 trucks x 5.34 min	641	5757
Unloading time	9585 goods x 0.33	3,163	9585 goods x 0.33	3,163	0
Waiting time for parking	2396 trucks X 16.46 min	39,442	240 trucks X 6.8 min	-	39442
Labor time at SP	No SP	-	1 min/goods X 9589 goods	9,589	-9589
Vertical Delivery time	9585 goods x 1 min	9,585	9585 goods x 1 min	9,585	0
Total		58,588		22,978	35611

c. 30-story

Variables	Computation process	Without CDS	Computation process	Horizontal CDS	Difference
Delivery time	1798 trucks x 5.34 min	9,602	120 trucks x 5.34 min	641	8961
Unloading time	14385 goods x 0.33	4,747	14385 goods x 0.33	4,747	0
Waiting time for parking	3596 trucks X 32.53 min	116,986	240 trucks X 6.8 min	1,632	115354
Labor time at SP	No SP		1 min/goods X 14383g oods	14,383	-14383
Vertical Delivery time	14385 goods x 1 min	14,385	14385 goods x 1 min	14,385	0
Total		145,720		35,788	109932

d. 40-story

Variables	Computation process	Without CDS	Computation process	Horizontal CDS	Difference
Delivery time	2398 trucks x 5.34 min	12,806	135 trucks x 5.34 min	721	12085
Unloading time	19185 goods x 0.33	6,331	19185 goods x 0.33	6,331	0
Waiting time for parking	4796 trucks X 96.62 min	463,414	270 trucks X 15.3 min	4,131	459283
Labor time at SP	No SP	-	1 min/goods X 9589 goods	19,178	-19178
Vertical Delivery time	19185 goods x 1 min	19,185	19185 goods x 1 min	19,185	0
Total		501,736		49,546	452190

In this section of the study, the term "distribution time" will be used to describe time derived from delivery, unloading, waiting time for parking, labor time at stock point (SP), and vertical delivery (Table 8-23). The summary of distribution time from Table 8-22, Table 8-23, and Table 8-24 is shown in Table 8-25. For a district which has an average height of 15-story buildings, Horizontal CDS has the lowest delivery time followed by without CDS scheme. The reason that the combination of Horizontal and Vertical CDS have high distribution time is because of the substantial time by staff inside the building. This is a large time that can not be easily offset through reduction of delivery time and waiting time.

For a CBD with an average of 20-story buildings, Horizontal CDS still has the lowest delivery time. This is followed by the combination of Horizontal and Vertical CDS and Vertical CDS comes third. One notable observation is that all the CDS design have lower distribution time as compared to the present scheme (without CDS).

For a high density CBD with an average building height of 30-story, still the Horizontal CDS produces the smallest distribution time. Although it has the lowest distribution, it should also be noted that it has the highest waiting time of trucks among the 3 CDS schemes at 6.8 minutes (Figure 8-17). The order of distribution time remain the same even after the height of the buildings in the CBD is increased to 40-story – Horizontal CDS being the scheme having the lowest distribution time. Waiting time of this CDS design however increases to 15.3 while Vertical CDS increases to 7.5 minutes (Figure 8-17). The combination of Horizontal and Vertical CDS did not recorded any waiting time from different CBD densities.

Table 8-25. Total delivery time from each scheme

Building story	TOTAL TIME (min)			
	Without CDS	H + V CDS	Horizontal CDS	Vertical CDS
15-story	(2) 18,430	(4) 29,148	(1) 17,388	(3) 25,704
20-story	(4) 58,588	(2) 39,613	(1) 22,978	(3) 43,332
30-story	(4) 145,720	(2) 52,546	(1) 35,788	(3) 69,738
40-story	(4) 501,736	(2) 66,100	(1) 49,546	(3) 111,208

Note: Figure in the parenthesis is rank of each scheme, 1 being the scheme having the lowest distribution time

8.9.2 Selecting which of CDS design is adopted based on CBD's building density and building use

From the social point of view, i.e. reduction of environmental emissions and other negative impact of trucks, any CDS scheme is desirable. Reduced number of trucks would mean few sources of emissions, vibration, accident and other negative externalities born out of truck's presence. There is no change to the number of trucks under Vertical CDS since there is no consolidation of goods however there is benefits in the form of reduced waiting time.

However, when other components of distribution system are considered such as labor time at depot and unloading time, each CDS has its own strength. For instance, when a CBD is low density, i.e.15-story buildings, Horizontal CDS is the most suitable owing to the 6% time saved (Figure 8-18). Adopting any of the other two CDS would increase distribution time which can be interpreted as increase to distribution cost as shown by the negative position of the curve.

The positive effect of all the CDS begins when the building height reaches 20-story. This means that the building administration has more options of which CDS to adopt knowing that this would not necessarily increase the distribution cost. The time saves from the combination of Horizontal and Vertical CDS is notable since under the CBD with 15-story buildings, it has the largest loss.

It must be noted that the analysis is performed to an office-oriented CBD and therefore there might be changes to the pattern of time saves from the different CBD designs. Based on this result however, it can be theorized that significant changes of building use from office to commercial (i.e. shops and restaurants) would put the combination of Horizontal and Vertical CDS into strong position as the most effective measure. This theory have two grounds; 1) there would be substantial increase to the number of trucks and gained from delivery time alone would be tremendous and 2) there would be a long waiting time of trucks which could be removed when Horizontal and Vertical CDS is adopted. Of course adopting the Horizontal CDS would have also bring tremendous reduction of truck trips however the without the assistant of staff inside the building, it would be difficult for the driver alone to deliver the consolidated goods. This situation would significantly increase delays to other CDS trucks.

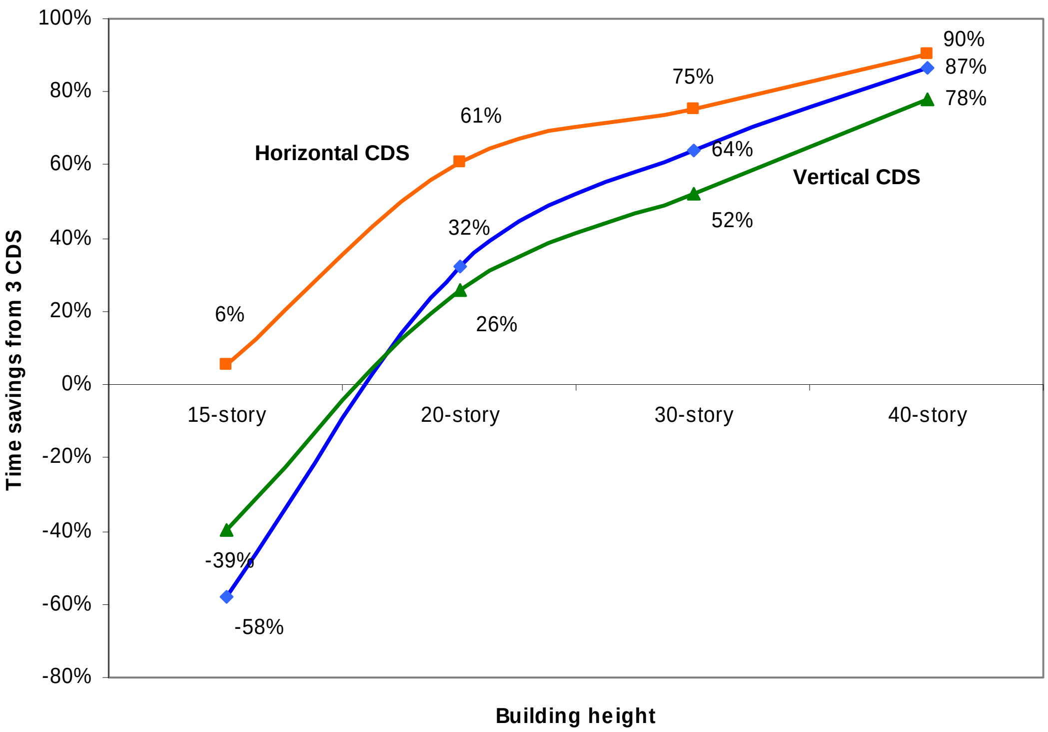

Figure 8-18. Time saved from three types of CDS for an office-oriented CBD

8.10 Chapter summary

Ensuring efficient delivery of goods – i.e. safe and on time – lies to many segments of the delivery chain. Congestion may delay the truck, lack of parking space for truck may prolong the delay, and lack of sufficient number of freight elevator may further extend the delay. Facilities related to delivery of goods inside the building therefore require serious examination in the same manner as that of traffic congestion outside the building.

This chapter at the beginning brought to light activities that are often receiving less attention from both transportation and urban planning. The complexity of delivery process is discussed thoroughly by integrating past studies that has notable discussion to the sector in the early part. The papers of Park *et al* (1998) and Iwao *et al* (2001) in particular were able to demonstrate what is happening inside the building after the delivery trucks docked.

The highlight of the chapter is the identification of suitable CDS design depending on the building density of the CBD. It was found out that Horizontal CDS is the only design suitable for low density CBD in view of distribution time. Adopting any of the two other CDS designs, i.e. the combination of Horizontal and Vertical CDS and Vertical CDS, would bring increase to the distribution time and therefore would increase the distribution cost. However, when the building density increases and each building reaches 20-story, all the 3 CDS designs bring enormous benefits in the form of time saved. These findings would be useful guidelines in selecting which CDS design is adopted when it is adopted based on the characteristics of the CBD.

It appears that the general trend is that as the building density increases, the greater it needs of the CDS. It is because the number of trucks followed the same trend and as its numbers increases the more problems it generates. This problem can be in the form of traffic congestion which can cause delay to the goods and other vehicles, truck’s queue at the (un) loading area of the buildings, and tremendous environmental pollutions.

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CHAPTER 9

Conclusions, Recommendations and Future Research Directions

9.1 Introduction

The two parallel goals of the study defined earlier in Section 1.2 of Chapter 1 had been achieved. These goals, which were elaborated in five objectives, are 1) to evaluate the applicability of CDS to different types of central business district, and 2) to evaluate quantitatively traffic and environmental impacts of CDS in the CBD using empirical data. The application of CDS to different types of central business districts was carried out to evaluate its traffic and environmental impact. The effect of CDS from social view point tends to be large in a high density CBD where the number of trucks is high. On the other hand, the effect of CDS to a low density CBD which is mostly found in developing country appears to be limited due to the very low share of trucks and saturated transportation network. Despite this minimal impact, CDS however should be given serious consideration as a policy option in view of rapid economic development in these countries that would eventually increase the number of trucks in the road network.

After conducting series of analysis, this chapter concludes the study. After Section 1.1, further four sections follow. The highlights of each chapter are presented in Section 9.2 while Section 9.3 enumerates important findings of the study. Section 9.4 provides short recommendations for urban freight transport stakeholders (i.e. shippers, carriers, residents, and authorities) and other interest groups based on the result of analyses while Section 9.5 sets the direction for future studies to strengthen knowledge on the role of CDS in managing freight transport.

9.2 Summary

Chapter 1 presented the overview, goals and objectives, problem definition, significance, scope and the structure of the dissertation. The five objectives of the study are: to review the current development and practices of cooperative delivery system and the factors for the implementation of such measure; 1)to review the current development and practices of cooperative delivery system and the factors for the implementation of such measure; 2) to clarify transportation conditions in urban areas and review the urban freight transport policies in selected developed and developing countries; 3) to provide guidelines of which, CDS design is suitable for applications based on the CBD’s characteristics and right timing of measure application; 4) to assess the roles of CDS as the CBD transform from low density to high-density structure; and 5) to evaluate the impacts of cooperative delivery system to the traffic flow in CBD road networks and also to the improvement of urban environment.

Chapter 2 enumerates the problems currently faced by urban freight transport and drivers due to the emergence of logistical challenges. Highlights of this chapter include the imbalance growth of freight transport (vkm) among the different modes where road freight is continuing to rise while the others are declining. This trend which is common to almost every country drew policy reaction in the form of promotion of modal shift by the government as has been seen in EU and Japan. The expansion of market through IT which resulted to the sophistication of customers was also reviewed. This customer attitude is believed to greatly contribute to the increase number of trucks in the road with few load. After the review to these current developments impacting urban freight transport, the main problems confronting the industry were presented. These are increasing traffic congestion and air pollution, increased cost of goods movement, and the slide down of truck's load factor.

Chapter 3 reviews the fundamental policy of the governments towards the realization of efficient freight transport in the urban areas. This review exposed the disparity in policy formulation between countries in developed and developing countries. Aside from the preparedness of freight facilities, most countries in developed regions found to have a dedicated government institution which manages policies and programs relating to freight transport. Developing countries, on the other hand, are still focused on passenger transport. Concerning the TDM examples, it appears that CDS is a product of several access restrictions. For instance, access restriction of trucks by different means (e.g. ban of night deliveries, total truck ban, time window, etc.) is imposed in some cities in Europe to preserve historic sites and decrease negative impact of truck on the environment. It was also noted, however, that there were cases that due to efforts of companies to cope-up with financial loss, CDS is formed.

Chapter 4 presented policy goals that a measure in freight transport in urban areas can be aimed. Means to achieve these goals can be in the form of infrastructure-based measure (hard) and TDM-based measure (soft). Hard measures such as further development of road and construction of freight terminal require huge financial resources and they are achieved in a long period of time. On the other hand, soft measures require less financial investment and can be adopted for a short period of time. The highlight of this chapter is the rationalization of CDS as one of the most powerful measures to address the problems brought by trucks in the CBD. CDS meets the objective of reducing traffic congestion, reducing transportation cost, reducing negative impact of trucks into the environment, and improving safety. The idea of CDS is that different logistics operators are surrendering part of management of their goods so it can be consolidated with other cargoes before bringing in into the city center. In essence, less number of trucks is bringing the same amount of goods to the city. Expected benefits that can be derived from CDS are: 1) reduction of vehicle-kilometers, 2) reduction of delivery time, 3) reduction of the number of trucks, 3) reduction of environmental emissions, and 4) reduction of transport cost.

Chapter 5 isolated the study area of the study and came up with groups of central business district. It was observed that most CDBs in developing countries are low density while those in developed countries are high density. Share of trucks to the total vehicles is considerably low also to the CBDs in developing country. One plausible explanation to the low number of vehicles is that people are very much dependent on car as the public transportation is unreliable which resulted to a very high traffic volume. In Metro Manila, apart from the survey conducted for this study, other surveys also found out that more half of the vehicles in the road network are cars. The CBDs from the perspective of freight transport planning can be grouped into four: 1) low density CBD in developing country, 2) high density CBD in developing country, 3) low density CBD in developed country, and 4) high density CBD in developed CBD.

Chapter 6 presented the first application of CDS in a low density CBD in developing country. Ortigas CBD in Metro Manila is taken as case study. Impact of CDS to traffic was observed to be limited at 0.76% due to the high number of cars. Meaning, even if the number of trucks is withdrawn, there are still substantial number of vehicles left in the network. With regard to environmental impact of the CDS, NOx coming from trucks can be reduced by 54% (just 1.6% if emission from other vehicles is included) while SPM to 54% (2.15% if emission from other vehicles is included). In the future, the proportion of vehicles might change as the development of the central business district intensifies and turns the CBD into high density. Share of trucks can be expected to increase that would further aggravate traffic congestion and pollutant emissions. When CDS is applied in this situation, i.e. share of truck is to the total traffic is 20%, its impact is far larger at around 9.12%. This reduced number of trucks resulted to improved travel speed. With regard to environmental impact, NOx can be reduced by 19.20% and 20.63 for NOx. In essence, CDS becomes more important as the development of the CBD intensify. The limited capacity of infrastructure necessitates a management based measure that would limit the number of trucks while serving the same amount of goods.

Chapter 7 evaluated the impact of CDS to a low density CBD in a developed country. Impact of CDS to traffic is observed to be high at 12% of the total traffic. Reduction of both NOx and SPM emissions is as high as 89%. This chapter also tried to estimate the necessary number of trucks that must be cover by the CDS in order to avoid queues of trucks at the (un)loading area. It was found that at least 70% of the truck trips should be cover to meet this objective. Modifications to the CBD however should be made when the proportion of retail space (i.e. shops and restaurants) reached 23% due to tremendous increase of truck trips (presently, share of retail space is 2.7%). These changes can be done in the form of increasing the number of CDS staff and/or increasing the number of freight facilities (i.e. parking space and freight elevator). Regarding the working time (i.e. labor, delivery time), a 50.4% reduction (from 63,314 min to 31,403 min) can be achieved by the CDS. Comparison of CDS results between Manila and Tokyo is also presented which highlights the notable high traffic and environmental reduction in Tokyo while very limited for the case in Manila.

Chapter 8 focuses on the logistical activities inside the building when the district turns to high density CBD. Height of the building is increased from 15 floors to 20, 30 and 40 story. The newly renovated Marunouchi building which is the highest building in the district has a total floor of 37. Thus, it appears reasonable to limit the simulation analysis to 40-story. After determining this building height limit, the study assessed the relationship of the number of staff working in the CDS inside the building, height of the building, frequency of trips, and amount of goods for each delivery. For instance, the maximum number of goods per trip under 15-minutes trip interval is 28 goods for a 15-story building. This maximum number of goods could be increased to 37 when the interval of trips is 30-minutes and can be as high as 50 goods per trip if the interval of trips is 60-minutes. These results can be a guide to determine the number of staff necessary depending on the height of the building and attracted number of goods. The highlight however of the chapter is the identification to the suitable CDS design depending on the building density of the CBD. It was found out that Horizontal CDS is the only design suitable for low density CBD in view of distribution time. Adopting any of the two other CDS designs, i.e. the 1) combination of Horizontal and Vertical CDS, and 2) Vertical CDS, would bring increase to the distribution time and therefore would increase the distribution cost. However, when the building density increases and each building reaches 20-story, all the 3 CDS designs bring enormous benefits in the form of time saved. These findings would be useful guidelines in selecting which CDS design is adopted and when it is adopted based on the characteristics of the CBD.

9.3 Conclusions

Based on the review of many policies in the world concerning urban freight transport and simulation analysis of different cases, the following can be concluded:

a) CDS is adopted mostly in developed countries like Japan and some countries in Europe and there are several reasons for its implementation such as difficulty of delivering goods into the city centre due to access restriction, effort of the companies to cope-up with loss and also enhance their social standing as matured and responsible companies (Chapter 3).

b) Access restriction is a common measure among the cities however; motivations for implementation are quite different. For instance, developed countries applied access restriction not only to mitigate serious traffic congestion but also for great concern to protect the urban environment and to some cases to protect historic centre. For the case of developing countries, access restriction is often adopted to push out trucks from public transport's key avenues (e.g. EDSA of Metro Manila) to limit the competition of buses and other public transport modes to the limited road space. Cities in these countries rely heavily on road-based public transport due to the lack of an efficient rail-based public transport system (Chapter 3).

c) The study confirmed that CDS is among the most powerful measures to improve urban traffic and environment and meets every objective of TDM measures for freight in the CBD (Chapter 4).

d) From the perspective of application of CDS, central business district can be classified into four categories: 1) low density CBD in developing countries, 2) high density CBD in developing countries, 3) low density CBD in developed countries, and 4) high density CBD in developed countries (Chapter 5).

e) Traffic and environmental impact of CDS appears to be limited on low density CBD in developing countries because of the small share of trucks to the total

f) In the future, if the share of trucks increases due to loosen regulation and development of the CBD, CDS can be a more effective measure to improve the traffic flow and the environment as general. In essence, the impact of CDS increases as the share of trucks in the road network also increases (Chapter 6).

g) Traffic and environmental problems in the CBD of developing countries can not be mitigated by simply adopting CDS. This is because much of the problems are sourced from private and public transport vehicles. For instance, 76% of NOx comes from cars and only 2% from trucks. Thus, addressing traffic and environmental problems requires forming a bundle of policy that involves both trucks and other vehicles (Chapter 6).

h) CDS has high impact in terms of traffic and environment even in low density central business district in developed countries due to the high share of trucks in the network (Chapter 7).

i) Aside from reduction of traffic and pollutant emissions, CDS can also be a tool to address the problem of shortage of parking space in the CBD. If the objective is to eliminate waiting time of trucks to parking, this can be achieved even without total participation of carriers to the CDS (Chapter 7).

j) Horizontal CDS is the only CDS design that brought reduction to the distribution time in a low density office-oriented CBD (15-story) and therefore the most suitable measure. Vertical CDS and the combination of Horizontal and Vertical CDS increases the distribution time to a low density CBD and therefore would increase the distribution cost. Distribution time refers to time derived from delivery (vehicle’s running time), unloading, waiting time for parking, labor time at stock point (SP), and vertical delivery (Chapter 8).

k) When the height of each building in the CBD reaches 20-story, all of the CDS produces remarkable reduction of distribution time. Horizontal CDS has the lowest distribution time followed by the combination of Horizontal and Vertical CDS and followed by Vertical CDS. The trend is the same when the buildings in the CBD are 30-story and 40-story (Chapter 8).

9.4 Recommendations

i) Applicability of CDS to different types of CBD

It is difficult to assert whether CDS is a suitable measure for freight transport management to a low density CBD in developing countries in view of limited benefits achieved from the scheme. On one hand, it is interesting to argue that any policy that yields positive effect to the transportation network should be pursued in view of limited infrastructure. Impact of one measure might be limited but if bundled together with other measures might produce significant result towards the realization of efficient urban traffic and healthy environment. On the other hand, there would be difficulty of persuading the companies to abandon their current operation to participate in a scheme where social benefits are limited and economic rewards are uncertain. It should be noted that willingness of companies to join the CDS is to some extent because of their consciousness to project a matured and responsible company which could enhance their image in the market.

In essence, social benefits of CDS are low in a congested and car-dominated CBD which could describe those CBDs in developing countries and notably high in the CBDs of industry-oriented cities (i.e. CBD with high share of trucks in the road network). Despite this limited benefits, CDS should not be left out as freight management tool. Recent trend suggests that there is a need for transport providers to organize themselves as the city authorities are becoming notorious in imposing access restriction to protect urban traffic and environment. Trucks have always been an easy target when these two issues are addressed out of belief that they are the main source of such problems.

ii) Selecting which CDS design is adopted based on the building density of the CBD

Low density CBD both in developed and developing countries would gain benefits from Horizontal CDS both from economic and social point of view. The reduced number of trucks would improve the environment even in a small way while the freed road space could be utilized by other transport modes. Developing countries are in difficult position of finding source of finance for its transport infrastructure and would greatly benefits when few numbers of trucks could be used to deliver the same volume of goods. The analysis performed shows that adopting CDS in a low density CBD would not necessary increase the distribution time which can be basis for distribution cost. Perhaps this CDS can be best applied in the CBD of London, Paris, Metro Manila and other CBDs of Asian cities where building height is not very high.

In a commercially oriented high density CBD, the combination of Horizontal and Vertical CDS would be effective. This is followed by Vertical CDS. CBD of New York, Hong Kong, Singapore, and some high density CBDs of Tokyo like Shinjuku would greatly benefits from this measure.

Although residential areas were not covered by the analysis, there are some residential areas which do not welcome the presence of trucks as has been seen in some quarters of Paris (see Chapter 3 for the discussion of some TDM in Paris). It is believed that Horizontal CDS could also serve this area without financial loss (without increasing the distribution time) and greatly benefits the residents from the reduced number of trucks. This would bring calm and increase the livability of the area.

iii) Combination of policy measures for freight and passenger transport

Efforts of the government in the developing countries should be directed on how to enhance the services of public transportation and to propose mechanism that would discourage use of cars and encourage use of public transportation. The road capacity of cities from these countries is extremely limited and there is a difficulty to expand this capacity through provision of infrastructure in view of limited financial resources.

Demand therefore could hardly be met through construction of roads and demand management measures should be initiated.

Concerning trucks, as much as possible, they should not be denied access but instead there should be an initiative on how to assess them. Providing platform for discussion like the FQP model of UK (see Chapter 3 for FQP discussion) is a good example on how to engage trucking industry into public forum in search of sustainable freight transport.

9.5 Future Research Direction

There are many issues identified in the course of this study that require further research to strengthen implementation mechanisms for CDS. These issues are listed below.

i) Integration of pick-up of goods into the CDS

Ideally, all goods going in and coming out should be covered by CDS. However, it is difficult to compel participation in the CDS due to unwillingness of companies to surrender part of operation of their business. The adopted CDS to both central business districts did not cover this part of freight transport and it would be interesting to see how effective CDS in reducing traffic and improving urban environment should both pick-up and delivery is covered.

ii) Simultaneous application of CDS and other TDM measures for passenger cars and public transportation

CDS is not an all-around solution to the complex problems of freight transportation in the central business district. It would of interest to measure the degree of improvement in the urban traffic and environment if CDS is pair with other TDM measures.

iii) Identifying suitable number of stock point

A stock point is crucial elements of CDS as it serves as platform to consolidate the goods carried by different carriers before sending it to the central business district. The study just consider one stock point to every CDS and it would be of great interest to see a study which could produce a guidelines regarding correct number of stock point based on its influence area.

iv) Method to avail land to host the stock point

Aside from difficulty of persuading companies to form CDS, to minimize the negative impacts of trucks distributing freight, it is also difficult to locate suitable area to host the depot for cargo consolidation. It is of interest therefore to have a kind of study that could identify successful practices in locating stock point.

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Appendices

SCHOOL OF URBAN AND REGIONAL PLANNING
U N I V E R S I T Y O F T H E P H I L I P P I N E S
E. Jacinto Street, Diliman, Quezon City 1101

March 14, 2005

MR. JOSE RAYOS III
Complex Administration Manager
Robinsons Galleria
Edsa, Ortigas, Mandaluyong City

Dear **Mr. Rayos**:

The Tokyo University of Marine Science and Technology (TUMST) is currently undertaking a comparative study of freight delivery operations and practices in malls at urban centers in Asia. The study aims to look at the possibility of organizing freight distribution through cooperative delivery between freight forwarders and assess the efficiency of the use of available resources and facilities. Your establishment is considered as one of the malls to be part of the comparative study and the only mall one identified for the Philippines.

The TUMST study team has requested our assistance in making the necessary arrangement and coordination with your establishment in carrying out the data collection and surveys for their study. Among the vital information that we would like to obtain includes the following:

- Total lot area, total building area, total floor area, gross leasable space and total number of floors.
- Tenancy – percentage of office space, shops, restaurants and others.
- Total parking space (slots) for private cars and trucks, total number of passenger elevators and freight elevators.

These information, we believe are readily available from building plans and specifications and will also be verified and validated by manual inventory. In addition, we would like to collect information on physical distribution and daily delivery operation through the conduct of a one day survey. This survey aims to determine the frequency of delivery arrivals, type and number of goods delivered, average delivery time, parking time of truck while unloading, number delivery service staff, and delivery truck details. We would also like to count the number of vehicles entering and exiting or just passing by your establishment. Please find the attached document for further information regarding the survey. Should it be fine with your company, we would like to conduct the survey on March 18 or 19, 2005.

Mr. Jim Joel Madrigal will be the person that would directly coordinate with you in the arrangement of the data collection and survey in your establishment. You can contact him at Tel. no. 929-0495 loc 217, Telefax: 928-8305.

Rest assured that the mall's regular operation would not be hampered in anyway. The data and other pertinent information acquired will be handled with strict confidentiality and that only summaries will be reported. Likewise, the study team would be more than grateful to furnish your management a copy of data and pertinent report arising from the study.

Thank you very much and we sincerely hope for your favorable response.

Very sincerely yours,

HUSSEIN S. LIDASAN, Ph.D.
Associate Professor

Appendix 1. Robinson's Galleria survey communication letter

SCHOOL OF URBAN AND REGIONAL PLANNING
UNIVERSITY OF THE PHILIPPINES
E. Jacinto Street, Diliman, Quezon City 1101

February 17, 2005

MS. LIZA SILERIO
Regional Operations Manager
SM Megamall
Ortigas, Mandaluyong City

Dear **Ms. Silerio**:

The Tokyo University of Marine Science and Technology (TUMST) is currently undertaking a comparative study of freight delivery operations and practices in malls at urban centers in Asia. The study aims to look at the possibility of organizing freight distribution through cooperative delivery between freight forwarders and assess the efficiency of the use of available resources and facilities. Your establishment is considered as one of the malls to be part of the comparative study and the only mall one identified for the Philippines.

The TUMST study team has requested our assistance in making the necessary arrangement and coordination with your establishment in carrying out the data collection and surveys for their study. Among the vital information that we would like to obtain includes the following:

- Total lot area, total building area, total floor area, gross leasable space and total number of floors.
- Tenancy – percentage of office space, shops, restaurants and others.
- Total parking space (slots) for private cars and trucks, total number of passenger elevators and freight elevators.

These information, we believe are readily available from building plans and specifications and will also be verified and validated by manual inventory. In addition, we would like to collect information on physical distribution and daily delivery operation through the conduct of a one day survey. This survey aims to determine the frequency of delivery arrivals, type and number of goods delivered, average delivery time, parking time of truck while unloading, number delivery service staff, and delivery truck details. Should it be fine with your company, we would like to conduct the survey at the end of March, after the Holy Week.

Mr. Jim Joel Madrigal will be the person that would directly coordinate with you in the arrangement of the data collection and survey in your establishment.

Rest assured that the mall's regular operation would not be hampered in anyway. The data and other pertinent information acquired will be handled with strict confidentiality and that only summaries will be reported. Likewise, the study team would be more than grateful to furnish your management a copy of data and pertinent report arising from the study.

Thank you very much and we sincerely hope for your favorable response.

Very sincerely yours,

HUSSEIN S. LIDASAN, Ph.D.
Associate Professor

Appendix 2. SM Megamall survey communication letter

National University Corporation
TOKYO UNIVERSITY OF MARINE SCIENCE AND TECHNOLOGY — SCHOOL OF URBAN AND REGIONAL PLANNING
UNIVERSITY OF THE PHILIPPINES
E. Jacinto Street, Diliman, Quezon City 1101

Survey on goods movement in the Shopping Centers in Metro Manila

Transit Survey

Location	Time Started
Date	Time Ended
Weather	Code
Recorder	Sheet of

TIME (15 min Interval)	Vehicle No.	Vehicle Type	Arrival Time	Departure Time	Queue Length

VEHICLE TYPE:
B - Bus **M** - MegaTaxi / FX **J** - Jeep **O** - Others (Specify)
C - Private Car/Van **T** - Taxi **V** - Delivery Van

Appendix 3. Transit survey form

National University Corporation
TOKYO UNIVERSITY OF MARINE SCIENCE AND TECHNOLOGY
and
SCHOOL OF URBAN AND REGIONAL PLANNING
UNIVERSITY OF THE PHILIPPINES
E. Jacinto Street, Diliman, Quezon City 1101

Survey on goods movement in the Shopping Centers in Metro Manila

Code: ____________

VOLUME COUNT		Date:
Location		Weather:
From: (Aproach)	Sketch of the area	Surveyor:

Direction																
Veh Type / Time	*Private Cars*	*Motorcycle*	*Taxi*	*FX*	*Delivery Vans*	*Trucks*	*Jeepney*	*Bus*	*Private Cars*	*Motorcycle*	*Taxi*	*FX*	*Delivery Vans*	*Trucks*	*Jeepney*	*Bus*

Appendix 4. Classified traffic volume survey form

National University Corporation
TOKYO UNIVERSITY OF MARINE SCIENCE AND TECHNOLOGY

SCHOOL OF URBAN AND REGIONAL PLANNING
UNIVERSITY OF THE PHILIPPINES
E. Jacinto Street, Diliman, Quezon City 1101

Survey on goods movement in the Shopping Centers in Metro Manila

GOODS DELIVERY SURVEY (Form A)			Code:
			Sheet: of:
Location:		Weather:	
Date:		Time Started:	
Recorder:		Time Ended:	

Time (15 min Interval)	Delivery No.	Plate No.	Trucking/Forwarding Company	Arrival Time	Docking Time	Departure Time	Maximum Queue (per 15 mins only)

REGIONAL PLANNING LABORATORY
Tokyo University of Marine Science and Technology
Etchujima, Tokyo, Japan

Appendix 5a. Goods delivery survey form (A)

TOKYO UNIVERSITY OF MARINE SCIENCE AND TECHNOLOGY
and
SCHOOL OF URBAN AND REGIONAL PLANNING
UNIVERSITY OF THE PHILIPPINES
E. Jacinto Street, Diliman, Quezon City 1101

Survey on goods movement in the Shopping Centers in Metro Manila

GOODS DELIVERY SURVEY (Form B)			Code:
			Sheet: of:
Location:		Weather:	
Date:		Time Started:	
Recorder:		Time Ended:	

Delivery No.	Plate No.	Goods Delivered				Other Delivery Destinations
		Description	Quantity	Unit	Destination	

REGIONAL PLANNING LABORATORY
Tokyo University of Marine Science and Technology
Etchujima, Tokyo, Japan

Appendix 5b. Goods delivery survey form (B)