CITY LOGISTICS

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CITY LOGISTICS

NETWORK MODELLING AND INTELLIGENT TRANSPORT SYSTEMS

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INVESTOR IN PEOPLE

PREFACE

It is well recognised that urban freight transport plays a vital role in the sustainable development of cities. However, urban freight transport recently faces many challenging problems, including high levels of traffic congestion, negative environmental impacts, high energy consumption and a shortage of labour. Within these difficult conditions freight carriers are also requested to provide higher levels of service with lower costs.

In response to these problems a new area of transport planning has emerged called City Logistics. City Logistics is the process of totally optimising urban logistics activities by considering the social, environmental, economic, financial and energy impacts of urban freight movement.

This book presents the basic concepts and approaches of City Logistics. In particular, it focuses on modelling City Logistics. Modelling is very important, since the estimation and evaluation of the impacts generated by City Logistics measures is required before implementing them. The book mainly deals with network modelling including, vehicle routing and scheduling models with time windows, location models of logistics terminals and impact models of City Logistics measures.

Recent developments in the field of Intelligent Transportation Systems (ITS) can facilitate the implementation of many City Logistics initiatives. Currently, advanced telecommunication systems provide powerful tools for efficiently operating vehicle fleets. Sophisticated logistics systems can now be developed by integrating Global Positioning Systems (GPS) and Geographical Information Systems (GIS) in conjunction with application software. Therefore, ITS based City Logistics has become more realistic in many industrialised countries. In this context, we present a theoretical and practical treatment of modelling City Logistics based on ITS.

City Logistics provides an opportunity for innovative solutions to be developed for improving the quality of life in urban areas. The modelling approaches described in this book are relatively new and are not yet commonly used in city planning. Although, several cities have already implemented some City Logistics initiatives, there currently are a limited number of evaluation tools that have been developed for predicting the consequences of such schemes. However, the models described in this book should provide useful tools for researchers and city planners for evaluating City Logistics policies or measures to help solve urban freight problems.

This book was initially planned to be a textbook for a graduate course on City Logistics.

However, the authors believe that it will be also beneficial for city planners and logistics managers in industry as well as students. The first author of this book initiated a graduate course on City Logistics at Kyoto University, Japan in 1995. He thought that it was necessary to publish a textbook on the subject to disseminate the concepts of City Logistics not only to students but also to city planners.

The four authors have previously conducted collaborative research in the area of City Logistics, much of which is contained in this book. They organised the First International Conference on City Logistics at Cairns, Australia in 1999 and published the proceedings, *City Logistics I*. They are also active members of the Institute for City Logistics (http://www.citylogistics.org), which provides a scientific platform for research and development related to City Logistics and urban freight issues. Therefore, this book is really a collaborative product of the four authors.

This book is composed of nine chapters, with each author making a major contribution to a number of chapters:

E. Taniguchi: Chapters 1, 5, 6 and Section 7.3
R.G. Thompson: Chapters 2, 3, 7 and Section 1.7
T. Yamada: Chapters 4 and 8
J.H.R. van Duin: Chapter 9 and Section 2.7

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August 2000
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1

INTRODUCTION

1.1 BACKGROUND

Recently urban freight transport faces many difficult problems. Freight carriers are expected to provide higher levels of service within the framework of Just-In-Time transport systems with lower costs. Congestion levels on urban roads have been constantly rising due to the increasing levels of traffic demand. The environmental problems caused by traffic have become major issues in many cities. Large trucks produce a substantial amount of air pollution in urban areas by emitting NO_x, SPM (Suspended Particle Material) and other gases. Energy conservation is also an important issue not only because of the limited amount of natural resources available but also for reducing CO_2 emissions to limit global warming. Truck crashes often lead to substantial trauma for the community.

This section describes the background of City Logistics. It highlights the problems associated with the logistics activities by freight carriers as well as social problems including environment, congestion and energy savings in urban areas. The emphasis is on the recent rapid development of ITS (Intelligent Transport Systems) which has the potential to provide effective measures for reducing freight costs as well as solving the social problems. For example, location identification systems for trucks using GPS (Global Positioning Systems) and mobile phone enable freight carriers to dynamically operate vehicle routing and scheduling. This can help minimise freight costs and reduce the total time travelled by vehicles.

There is an ongoing trend towards urbanisation in the world. Cities provide more attractive opportunities for employment, education, cultural and sport activities, etc. The concentration of population in urban areas is observed in most industrialised and developing countries. However, this leads to expanding urban areas and often generates freight transport problems, due to a lack of appropriate urban logistics policies.

A high proportion of total goods movement occurs within cities. For example, in Tokyo and surrounding areas, about 67% of total goods movement in terms of tonnage have both the origin and destination within the 23 wards (central area) according to a survey conducted in

1994. It indicates the importance of goods movement within urban areas.

There is a high cost in terms of money and time incurred as a result of the movement of goods within cities. Trucks carry most goods within cities, and road transport has become expensive due to the decreasing load factors of trucks. This reduction in load factors of trucks has been caused by the recent trend towards smaller loads being frequently transported to meet a wider range of consumers needs.

Cities are now facing the global competition for investment and trade with an efficient transport system essential for sustained economic prosperity. Therefore, the efficient and environment friendly logistics systems help cities become more competitive in terms of economic development.

The recent development of e-commerce (electronic commerce) also makes City Logistics more important. There are two points to discuss the impacts on City Logistics by the development of e-commerce.

(a) E-commerce changes the logistics activities by giving a high priority to the demands of customers or consumers.
(b) Logistics activities themselves incorporate e-commerce for matching the demand and supply of goods movement.

The e-commerce provides a good opportunity for a quick, individual and direct commerce in the business to business (B2B) and the business to consumer (B2C) cases at low price. As a result, manufacturers need to change their logistics systems to faster, more reliable systems with lower costs for meeting with the higher level of individual demand of consumers. The platform for matching the supply and demand for goods movement through the Internet makes it possible to rationalise the logistics systems by increasing the load factors of trucks. These changes may or may not contribute to alleviating traffic congestion and improve the environment. Therefore, the application of City Logistics initiatives will become more essential for reducing freight costs and solving social problems.

1.2 Fundamental Concepts

The concept of "City Logistics" (e.g. Ruske, 1994; Kohler, 1997; Taniguchi and van der Heijden, 2000a) has the potential for solving many of these difficult and complicated problems. Taniguchi *et al.* (1999a) defined City Logistics as "the process for totally optimising the logistics and transport activities by private companies in urban areas while considering the traffic environment, the traffic congestion and energy consumption within the framework of a

market economy." The aim of City Logistics is to globally optimise logistics systems within an urban area by considering the costs and benefits of schemes to the public as well as the private sector. Private shippers and freight carriers aim to reduce their freight costs while the public sector tries to alleviate traffic congestion and environmental problems.

1.3 STAKEHOLDERS

There are four key stakeholders involved in urban freight transport; (a) shippers, (b) freight carriers, (c) residents and (d) administrators. Each of the key stakeholders in urban freight transport has their own specific objectives and tends to behave in a different manner. City Logistics models need to recognise these factors.

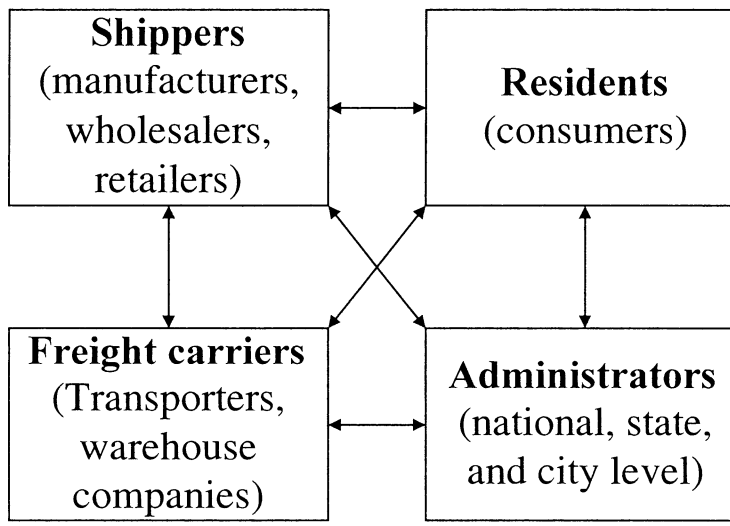

Figure 1.1 Key stakeholders in City Logistics

Shippers are the customers of freight carriers who either send goods to other companies or persons or receive goods from them. Shippers generally tend to maximise their levels of service, which includes the cost, the time for picking up or delivering, and the reliability of transport as well as trailing information. Recently the requirement for carriers to arrive at customers within specified time windows for pickup/delivery has become popular. A recent survey in Osaka and Kobe in Japan, found that freight carriers were required operate with designated arrival times or time windows for 52% of goods delivered and for 45% of goods