

# EFFECTS OF e-BUSINESS ON LOGISTICS AND URBAN FREIGHT TRANSPORTATIONS

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**Abstract:** Information society has been anticipated to have many effects on the demand for transport. The effects of the information society have been assessed to be relatively complicated, indicating on the one hand a generative and addictive effect and on the other hand substitution and modification effects. Information technology and its many applications such as electronic data transfer has accelerated the globalisation and integration of markets and given rise to more complicated and sophisticated supply chain solutions. Many of these tendencies are likely to support longer transport distances, higher delivery frequencies, faster deliveries, and smaller delivery sizes. Electronic business models have strengthened these recent logistics trends although in principle e-business solutions should lead to cost-effective and environment friendly supply chains.

## 1 INTRODUCTION

The importance of electronic commerce is on the increase in almost all areas of trade and industry. The development of information technology has also influenced the work patterns and structures of electronic retailing affecting both travel behaviour and distribution structures. In this research paper the focus is on e-business solutions, supply chain solutions and freight transportation part of the whole research project.

A few decades ago information technology was anticipated to have a mainly substitutive effect on the demand for physical transport. Communications technology was expected to reduce the demand for passenger travel and make distribution transport more effective. At the moment there is relatively little empirical evidence of the substitution effects of information technology. On the other hand the information society and its various ICT applications have been found to have a generating and modifying effect on the demand for physical transport. (Kärnä, 2001) In general, the information age seems to have a more diverse and complicated effect on the demand for physical transport than was suggested at the beginning of the fast development in information and communications technology (ICT). Although

empirical findings are to some extent contradictory, it is very likely that the information society affects travel patterns and distribution structures, as well as land use and regional development.

In this study some recent findings of the effects of the information society on the transport demand have been collected and analysed with reference to both the need for personal travel and urban freight transport. The anticipated changes in travel demand by 2020 have been examined with three different social scenarios in Tampere Region (305000 inhabitants) in Finland with a regional traffic model. The scenarios studied are Virtual Society, Eco-Society and Experience Society. As a baseline scenario the study also included a business-as-usual scenario for a transportation system. These different scenarios have been utilised as input data for the transportation generation model, transport system development and destination choice variables.

From urban freight delivery systems point of view delivery traffic has a major influence on congestion and air quality in central urban areas. Delivery traffic accounts for a relatively small amount of the total vehicle mileage, but it has a significant role in the negative effects of transport. The share of commercial vehicles is on average 10-20 % of the traffic flow. Delivery traffic in the urban areas consists mostly of grocery retail, wholesale

trade and the construction industry. (Ogden, 1992; Ministry of Transport and Communications, 1999) The main rush hours of grocery deliveries are at the same time as the passenger traffic rush hours, between 7 and 9 a.m. (Ministry of Transport and Communications, 1999). An important consequence of the development of logistics, electronic commerce and telecommunications is the consolidation options for deliveries of different suppliers, which can lead to higher load factors and less vehicle mileage. Consolidation entails planning the logistics services to respond to the customer demand and consumers' consumption habits.

The structure of economic life, urban form, and the demand for delivery transports has recently undergone changes which have been anticipated to continue. The changes are partly due to changes in the logistics structure, for example JIT (just-in-time) warehousing and supply chain management strategies, which have decreased warehousing and increased delivery frequencies. Electronic commerce has been anticipated to increase the delivery frequencies and direct them partly to end-users, which implies new challenges for delivery planning. Changes in the operating environment increase the complexity of delivery models and also shorten their lifespan (D'Este, 2000).

The supply chains of products have traditionally been planned to have on direction; the purpose has been to integrate the process from raw materials acquisition to the final product delivered to the end-customer. Several approaches have been developed for this purpose, for example SCM (Supply Chain Management), ECR (Efficient Consumer Response), and the networking strategies attached to these approaches. Nowadays an assessment of environmental effects is part of almost all production processes and many companies have developed environmental management systems to be able to evaluate environmental effects comprehensively. The concept of green logistics includes environmental impact assessment in each part of the supply chain and completes the logistical chain with reverse logistics including recycling and reusing flows of products, by-products and, for example, packaging materials. The purpose is to reduce transport demand with, for example, by planning the packages and distribution channels and taking the market area into account in locating the production facilities. Green logistics is geared towards the development of environmentally friendly products and production methods. (Wu and Dunn, 1995)

The increased use of information technology in logistics and leaner production and warehousing

strategies has increased the customer requirements for time, precision and flexibility of deliveries. Growing accuracy and time requirements may increase the demand for vehicle mileage and lead to customised deliveries, where a small delivery batch is transported directly to the customer. Increased requirements may therefore increase the environmental effects and costs, especially in the distribution chain of the retail grocery trade, where the share of transport-related environmental effects is already relatively high.

IPCC (2007) defined the increasing demand for freight transport as one of the most important target areas in the reduction of carbon dioxide emissions from transport. The energy consumption of transport has been predicted to increase, especially in aviation and shipping. As the globalising markets and logistical trends promote the increase of international freight transport demand, information society applications also affect the energy supply and climate change objectives.

## 2 FINDINGS

Changes in the business environment and production structure affect the demand for goods transports. Manufacturing industries are mostly transport intensive business areas, where a cost-effective and reliable transport system is one of the most important requirements. Electronic data transfer and the fast development of information technology have markedly affected the business environment in the last ten years. This development offered an opportunity to use and improve increasingly effective business control systems and increased the amount of real-time information and therefore more dynamic business processes.

As the markets and operations of companies are becoming more global, production and logistics structures are planned on a new basis. Production processes have also become more focused as companies retain the same number of plants but increase the degree of plant specialisation.

At the moment there are several potential business models in e-commerce. Usually companies use Internet-based services as electronic shops. E-commerce solutions are used increasingly as effective marketing channels. Business-to-customer solutions have attracted a lot of attention in recent years, but they still have a relatively small, although increasing, role in the market. The use of business-to-business solutions are more advanced and trading between companies has partly moved to the Internet.

Although long term contracts are mostly made in a traditional way, the physical orders and planning of supply chains have been transferred into electronic form. This trend has increased real-time operations and made business processes more dynamic in enterprise networks.

Electronic business models have strengthened the recent logistic trends for smaller delivery entities, higher delivery frequencies, and more demanding requirements of punctuality and reliability in transport chains. Transport distances have a tendency to increase, partly because e-business does not usually need as multi-level a delivery structure as traditional distribution channels. In principle, e-business solutions should lead to cost effective supply chains, but usually, due to the focus on service level by fast deliveries, e-commerce is increasing the demand for fast freight transports. If e-commerce is to be a more common way of shopping among consumers, it may also have various effects on delivery systems and freight transport demand in urban areas.

The introduction and growth of e-commerce has also been seen to increase demand for land use due to the establishment of new transshipment points in the form of distribution centres. The information society also partly supports a shift towards road and air freight transport modes due to the requirements for fast delivery times and the extension of the geographic areas of supply and distribution. Therefore e-commerce can be anticipated to reinforce longstanding trends for transport growth.

### 3 CONCLUSIONS AND FUTURE RESEARCH

In this study the transport demand effects of the information society were studied with a scenario approach and a regional four-step model in the case area of Tampere Region in Finland. The changes in the urban form and travel demand were studied by using three different social scenarios defined in a earlier study Changes in urban form and transport demand in Finnish cities by the year 2020 (Heinonen et al., 2000). The scenarios applied describe the possible social conditions and the development leading to it during the period 2000-2020.

The three scenarios studied were virtual society, eco-society and experience society. Virtual society is a scenario for virtual mobility and satellite urban form. Eco-society is a scenario for environmental awareness and dense urban form and experience

society is a scenario for car dependence and fragmented urban form. As a baseline scenario the study also included a business-as-usual scenario for travel behaviour, land use and transportation systems. Demand forecasts were made for 2020.

Consumer preferences also have a leading role in the demand for deliveries. To some extent ICT can help manage growth in urban deliveries. In virtual society the demand for delivery transports is at the same level as in the baseline scenario due to increased lorry mileage.

In eco-society distribution structure changes and demand for delivery transport decreases. In eco-society business solutions are changing relatively a lot compared to the other scenarios. Delivery mileage per inhabitant is smaller than at present and the energy consumption of deliveries is down by 3.4 % compared to the baseline scenario in 2020.

In experience society delivery demand increase remarkably, by 25 % compared to the baseline scenario in 2020. Delivery generation in the information society can be managed better than in experience society, where the increase of delivery demand leads to unsustainable delivery transport amounts. Increased delivery mileage in this scenario leads to 9 % greater energy consumption. The increase in delivery transport demand increases the congestion on the main street network and thus also affects the delivery schedules and punctuality. A marked increase in delivery demand in this scenario would require considerable infrastructure investments.

The energy consumption of transport in virtual society and eco-society is smaller than in the baseline scenario in 2020. In virtual society reduced travel and only slightly increased delivery transport demand lead to 1 % lower energy consumption than in the baseline scenario. In eco-society substantial investments in public transport supply and changes in the delivery structures lead to 2 % lower energy consumption than in the baseline scenario.

The development in experience society is quite different, as energy consumption as well as the amount of transport-related exhaust gases is approximately 10 % greater than in the baseline scenario. Thus both virtual society and eco-society comprehend more sustainable development from the perspective of climate change and energy issues in the transport sector.

This research indicate that e-business solutions may have significant effects on freight transport demand and also supply chain system-wide planning. E-business solutions contain a lot of information for effective planning of supply chain

including delivery systems, but the e-business operators and portals have to just focus on supply chain operation in addition to advanced ICT system development.

The next phase of the research process is to focus more detailed in supply chain planning and delivery systems in e-business services and solutions. One basic approach is also to clarify real customer needs and expectations for deliveries of e-business and e-commerce, which form the basis for supply chain management in this business area.

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