Greening of Local E-commerce

How to Realise the Environmental Potential of Online Grocery Trade

- A Case Study in the City of Lund

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Abstract

In this thesis, I have compared conventional grocery trade and the emerging online grocery trade, in an attempt to map out the potential environmental implications of local e-commerce. In doing so, the product chain relationships, including business-to-business and business-to-customer, and the grocery store's operations, have been studied and compared. The differences and related environmental implications were explored, with a focus on the changes in transport patterns. A comparison was made between the conventional shopping trips made by customers, and the delivery system offered by online grocery store, in order to analyse the potential environmental implications. In addition to transportation consequences, the changes that local e-commerce could bring about in inventory, warehouse area and design, shop operation, marketing, and shop area, were analysed and discussed. In additions to looking at the promising gains of the online grocery trade, I have also tried to foresee some of the potential constraints and rebound effects that this market form may generate.

With this analysis at hand, I have discussed how different stakeholders could influence the development and design of online grocery trade, so that the potential environmental gains would come true. The small but fast-growing local e-commerce in the city of Lund, and the potential effects on the city's transportation system, have been used as a case study.

Executive Summary

With the development of Internet and e-commerce, online grocery trade, a local application of e-commerce, has entered people's daily life. It brings a brand new concept in grocery shopping: sitting at home, moving the mouse to pick the groceries and waiting for the delivery sent to the door. Online grocery trade is convenient and saves time, hence, and it is believed that the potential of online grocery trade is immense. However, the share of the online grocery trade is still low due to reasons such as the novelty of the concept, conservative shopping habits, limited Internet access, and high prices.

The purpose of this thesis is to map out the possibilities and constraints of online grocery trade on a local level, and to identify and analyse the environmental implications that the shift towards this way of shopping could bring about. Furthermore, different stakeholders' role in adapting online grocery trade in a way that could promote a more sustainable development is discussed.

In order to understand the online grocery shopping, conventional grocery shopping was studied at first. In both types of shopping, the relationships between the actors in the product chain can be divided in two steps:

- *Business to Business* (B2B*)*: from the producer to the wholesaler and from wholesaler to retailer (grocery store), and;
- *Business to Customer* (B2C): from grocery store to customer (including marketing and shopping behaviour).

The online grocery store's operation differs from the conventional grocery store. The realisation of e-commerce in terms of the B2B relationship can contribute to a more efficient operation, therefore saving energy and resources. Potential rationalization gains of e-commerce in the grocery store are mainly cut costs for inventory, warehouse and store operation. Furthermore, e-marketing has advantages to conventional paper-based marketing in information content, paper saving and waste minimisation.

Online shopping may replace some of the B2C shopping trips that today are made by car, as the final transport of grocery is shifted from the customer to the store. Three delivery models have been analysed.

- *Home delivery*: The shop delivers the commodities directly to the customer's home;
- *Office delivery*: The orders are delivered at a workplace, e.g. an office building;
- *Pick-up points*: The orders are delivered to a certain place where customers easily can reach and collect the commodities.

The energy consumption and air emissions have been estimated and compared for the different cases. The outcome from these three models was compared to conventional shopping, and an approximate 'critical delivery distance' was identified, i.e. the distance when online grocery shopping becomes more efficient from an economic and/or environmental perspective.

However, there is always a backside of the coin. Inevitably, beside the promising positive effects of local e-commerce, *rebound effects* are likely to occur. With the environmental perspective in focus, some possible rebound effects have been discussed. The appliances needed for the e-commerce require energy and resources. As today's market share of the online grocery trade is very small, the potentially more efficient store operation is hard to achieve. Other side effect in the B2B transport system could also lead to increased energy consumption and more emissions. Overlapping deliveries and extra transport by the customers could lead to reduce the transport saving. Energy consumption and environmental emissions from delivery will even increase if delivery distances exceed the critical distances. The e-marketing is still used only as a complement to paper-based advertisement and thus does not seem to reduce the paper consumption for marketing purpose.

If we are serious in our attempts to obtain a sustainable development, we need to find ways to tackle these problems. Therefore, different stakeholders' roles in 'greening' local e-commerce has been identified and discussed. Moreover, possible actions for reducing some of the negative impacts and realising the environmental potential of local e-commerce, have been suggested for these stakeholders.

The local e-commerce of grocery trade has started and is likely to grow in the city of Lund. The local government of Lund should be aware of e-commerce's possibilities, but not take them for granted. Rebound effects may reduce the gains and even lead to negative environmental impacts. One of the most important challenges for the local government of Lund is to influence the development of local e-commerce as an integrated step towards achieving a more sustainable transportation system.

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1. Introduction

Online grocery trade is one of the many applications of E-commerce. It is currently developing rapidly in Sweden as well as in the rest of the world. Online grocery stores have their advantages in terms of efficient management and operation, which could eliminate some of the environmental impact that conventional grocery stores give rise to. The local online grocery shopping could also adopt an integrative home delivery system. This system could replace the multi-individual grocery shopping and have the potential of reducing the overall transportation and hence, reduce the corresponding energy consumption and environmental impact. This kind of integrative transportation might contribute to a more sustainable transportation system, which is the core target of LundaMaTs project in Lund. How to facilitate online grocery shopping for a more sustainable environment will be explored in this thesis.

1.1 Background

We are now experiencing a dramatic societal shift and entering something we tend to call the *Information Society*. A key factor in this development has been the penetration of Internet, something that has happened at an amazing speed. The speed of the development of the Internet world is so fast that it is hard to follow and analyse. However, it is important to make an effort to understand the current situation, see trends and also to make predictions in order to influence the planning and design of local E-commerce. We can not take the positive environmental potential of the Information technology (IT) development for granted. We need to actively work to make better use of the technology to create a better environment in the Information Society. This was also the main incentive for me to choose this topic for this thesis.

The accelerating growth of Internet triggers the companies to adopt Internet as new channel for their business. The Internet allows the conventional businesses to go online: business to business (B2B) and business to customer (B2C), such as retailing, banking, marketplace auctions etc. It is extending to virtually all aspects in people's daily life. All of these applications are fitted within the concept of E-commerce.

1.1.1 E-commerce

Internet is the prerequisite for the development of E-commerce. The accelerating growth of Internet forces many companies to adopt the Internet as a new channel for their business. This is what we today call E-commerce we.

OECD has defined E-commerce as follows:

"Electronic Commerce refers generally to all forms of transactions relating to commercial activities, involving both organisations and individuals, that are based upon the processing and transmission of digitised data, including text, sound and visual images. It also refers to the effects that the electronic exchange of commercial information may have on the institutions and processes that support and govern commercial activities" (OECD, 1997).

The Internet is the media used for both information exchange and sales channels for business. Because of the facts that this exchange is fast and convenience, the growth of E-commerce is rapid. This is obvious in the example of the United States. Currently, 44 % of US business sell goods or service over the Internet, with an additional 36 % expected to be online by the end of 2000. In 1999, combined revenues from Business-to-Consumer (B2C) and Business-to-Business (B2B) E-commerce were $ US171.5 billion, a growth rate of 72 % from 1998. B2C E-commerce is primarily retail sales and is expected to grow from $ US 25 billion in 1999 to

$ US 37 billion in 2000, representing a positive consumer attitude toward shopping online (International Technology and Trade Associates (ITTA) Inc., 2000).

According to the survey by International Data Corporation (IDC), sales generated by online transactions should grow strongly world-wide from $ US 32 billion in 1998 to $ US 130 billion in 2000 and then $ US 425 billion in 2002, definitely passing the $ US 1000 billion mark in 2003. (NetValue, 2000).

Sweden is a leading country in E-commerce. Sweden has high an Internet penetration of 51%. The online market penetration in Sweden is the second highest in the world (The Boston Consulting Group, 2000).

1.1.2 Online grocery commerce

E-commerce has affected many industries. The grocery trade is no exception. Grocery stores have started selling food and other daily household commodities via Internet in the United Stated since 1996. Although online grocery commerce is still in its rudimental stage, the expectation is rather optimistic. Andersen Consulting, in conjunction with 29 other companies, has released a study which stated that grocery shopping and the purchase of general household items on the Internet will escalate from a value of $ US100 million in 1997 to $ US85 billion in 2007 in US (Nua Internet Surveys, 2000).

Similarly, the current market share of online grocery commerce is also low in Sweden (0.1%). However, it is predicted to be 6% by 2005, and the growth will be further after. (Forrester Research, 2000)

The latest Environmental Report by the Swedish Ministry of Environment shows their optimistic on the E-commerce: "*E-shopping could help the environment… A report from the Swedish Environmental Protection Agency shows that Internet shopping for groceries can benefit the environmental by cutting emissions and saving energy…*" (Swedish Ministry of the Environment, 2000).

1.1.3 Why study grocery trade?

In 1998, about 20% of total household expenditures were spent on groceries in Sweden. (Forsebäck, 1998). The private transportation for grocery shopping is huge. Every year, Swedes drive 2.6 billion km to buy groceries (Statistics Sweden, 1999). The energy consumption is estimated to be 3.1 TWh, which is approximately the same amount of energy consumed by domestic grocery transport by truck, train and boat (Orremo & Wallin, 1999). If E-commerce could lead to a reduction of such driving behaviour, it would naturally lead to great energy and emission reduction.

Traditional Grocery Shopping Characteristics:

1. Short: The grocery shopping distance is usually not more than 5 km.
2. Many: All of the households need to shop for food and other household groceries.
3. Frequent: Most households go grocery shopping at least once a week.

Most households drive their cars to the stores (Orremo & Wallin, 1999). It accounts for approximately 6% of the private car use (SCB, 1999). Even these trips are short; their frequency affects our environment because of fuel consumption and fume emissions.

1.1.4 Why study E-commerce on a local level?

The major concern regarding E-commerce and the environment has up until now been focused on international E-commerce. It is easier to learn that purchase commodities from faraway will tend to increase the overall

energy intensity of the transportation system (Romm, 1999). However, due to the properties of the commodities (foods should be kept fresh) sold by grocery stores, online grocery trade has to happen on a local level since some groceries would otherwise spoil during longer transportation distance. The size of the local grocery trade and the potential impact a shift from conventional to online grocery shopping could lead to, makes it interesting to investigate the environmental implication that such a shift could bring about.

1.1.5 Why in Lund?

As other cities in Sweden, Lund is facing the emerging of local E-commerce. It is helpful for the local government to realise what kind of possibilities and constraints the online grocery trade might bring, hence to promote the utilisation of this kind of trade mode for a more sustainable society.

Moreover, the local government of Lund is endeavouring in achieving sustainable transportation for Lund through the LundaMaTs project (LundaMaTs: Sustainable Transportation System for Lund). The local government of Lund and LundaMaTs have taken on a very interesting and unique challenge in trying to harmonise the development of local E-commerce with the efforts to create a more sustainable environment in Lund.

1.2 Objective

The main objective of this thesis is to find the possibilities and constraints of online grocery trade on a local level, and to evaluate the possibility for the local government to influence the environmental implications from such local online grocery trade. In order to fulfil this objective, a study based on the following research questions has been made:

- What are the major differences between traditional grocers and online grocers with respect to business to business (B2B), store operation, customer behaviour and business to customer (B2C) relationship?
- What environmental implication could these differences lead to?
- What kinds of environmental benefits can online grocery shopping contribute?
- What are the factors affecting the environmental implications?
- What actors could influence these factors?
- What realistic measurements could Lund Municipality take to optimise the positive environmental implications of the emerging online grocery shopping?

1.3 Methodology

The research approaches used in this paper were several. One approach was literature review. Literature studies were carried out in the related area of E-commerce, consumer behaviour, home delivery, transport study etc. The second approach was the case study of LundaMaTs (Sustainable transportation system in Lund). The third approach was interviews. Interviews were carried out with the respondents from online grocery stores and conventional grocery stores. These include Matomera (a pure internet-based online grocery store), ICA Anderssons in Södra Sandby (a conventional grocery store, which is going to carry its online grocery trade from 2001) and Malmborgs (a conventional grocery store situated in Lund centre with online grocery trade and home delivery service). Interviews were also carried out with the grocery store customers, including five persons with online grocery shopping experience volunteered to share their shopping experience. The interviews include face-to-face interviews, questionnaires by email and telephone interviews.

1.4 Scope and limitation

The E-commerce discussed in this thesis refers to the local E-commerce regarding of grocery trade and online grocery trade. Grocery shopping refers to the shopping for food and necessary daily goods by households. The discussion in the thesis regarding online grocery trade will focus on the online grocery store and the customers, i.e. Business to Customer (B2C) and their environmental implications.

The thesis will discuss the difference in environmental implications between the traditional and online grocery trade regarding store operation, and transportation. The discussion will however focus on transportation and consequences of adopting a home delivery system when shifting to online grocery trade. The environmental implications refer to the impacts on the natural environment and not human health.

Due to the fact that not many online grocery stores exist, gathering of information is limited to a few companies. Furthermore, due to a lack of studies and statistics on local grocery commerce, studies on the Swedish national level will be used.

Questionnaires on shopping habits were distributed to 56 people in Lund. There were 24 respondents, giving an answer rate of 43%. The respondents in the survey were from local government of Lund, Lund University (students and teachers), Trivector Company etc. Although the author of this thesis has tried to cover different categories of people within Lund, the results can self-evidently not be interpreted as to represent the inhabitants in Lund. However, the investigation results could be seen as a coarse indication on the current E-commerce trend in Lund, and be used to compare to the available literature in the field.

2. Grocery shopping goes digital

Shopping for groceries is indispensable for everybody's daily life. We are used to going to a supermarket to purchase groceries. Since a few years ago, a new grocery shopping channel was introduced, shopping via Internet. We call this online grocery shopping or E-shopping.

2.1 Conventional shopping

In order to understand whether and how online grocery shopping can replace or partly replace conventional grocery shopping, it is essential to understand conventional grocery shopping first. There are three main factors involved in deciding people's grocery shopping behaviour: '*How much to buy?'*, '*Where to buy?'* and '*How to buy'?* They affect each other as described in figure 2-1.

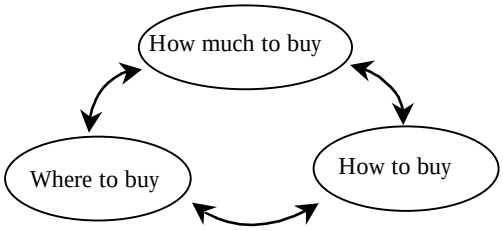


Figure 2-1: *Model of the Three inter-connected factors in grocery shopping*

The amount of groceries a customer wants to buy can affect which grocery store they go to: a big supermarket or a small grocery store. The amount of commodities purchased can determine which kind of transportation the customers will use: driving by car, public transport, bicycling or walking. The location of the grocery store can also be a factor in determining the customer's means of transportation. Also how often they shop close-often, far-seldome. Hence, the three factors affect each other. The factors and their relationships will be explained below.

2.1.1 How much to buy: purpose and amount

Grocery shopping can be classified according to purpose: *stockpiling shopping* or *supplemental shopping*. The stockpiling shopping is mostly for groceries for the whole household for a certain period of time. Usually, this kind of stock shopping will be carried out at least once a week in a big supermarket. The supplemental shopping is for items that are omitted in the stock shopping or for impulsive needs. This might occur two or more times per week. The terms of 'stockpiling shopping' and 'supplemental shopping' can be derived from a classification by Dahlén, who divides grocery shopping into stockpiling, supplementary purchases and single items purchases (Dahlén, 1999). However, both supplementary purchases and single items purchases are for items that were omitted from stockpiling. The characteristics, especially the transportation properties of supplementary purchases and single item purchases are similar: they are of much smaller amounts comparing to the stockpiling shopping, and car is not necessary for transporting such items. Therefore, supplemental purchases and single items purchases can be combined and called supplemental shopping.

Grocery shopping can be classified according to amounts: *big shopping* or *small shopping*. Big shopping refers to a large amount of groceries bought at one time, which can not be transported by a single bicycle. Big shopping is usually done by households with no less than two persons and with the purpose of stockpiling shopping. Small shopping on the other hand refers to a smaller amount of commodities, which can be transported on a bicycle. Small shopping can be supplemental shopping for bigger households. It can also be stockpiling shopping of smaller households or singles (see table 2-1).

Household	**Household >= 2**	**Household <=2**
Stockpiling	Big amount	Small amount
Supplemental shopping	Small amount	Small amount

Table 2-1: *Classifying shopping amount and purpose*

Example in Lund

There were 21 respondent who answered questions regarding their grocery shopping. The results are presented in table 2-2. Of the respondents, 100% stated that they go grocery shopping at least once a week. The transportation means for shopping are various. Most of the people use more than one transportation mean. The amount of commodities purchased differs when using different transportation means. The amount of commodities was smallest when go shopping by foot. The amount of commodities purchased when go by bicycle is higher, which is 240 SEK in average. The amount of commodities purchased when go shopping by car is much higher than the previous two transportation means. All of the respondents will do one stockpiling shopping and at least another one supplemental shopping each week. The amount of stockpiling differs due to different size of households.

Means of Transport	**Percentage of respondents who use the various means of transport***	**Times/week (Average)**	**Amount SEK (Average)**
By foot	57%	2.9	133
By bicycle	71%	1.6	240
By car	38%	1.2	730

* Respondents use different means of transport on the different occasions when they shop, which explains why the total is not 100%

Table 2-2: *Conventional shopping behaviour in Lund with regard to transport, frequency and amount*

2.1.2 Where to buy: the different kinds of conventional stores

The conventional grocery stores can be divided by the size of their scales as smaller grocery store, such as ICA Nära, and bigger supermarkets, such as ICA Kvantum (ICA, 2000).

The smaller grocery stores can be called neighbourhood stores, which are often located close to their customers and used for their daily shopping. The sales area of such stores is usually about 150 to 400 m^2. Since the sales area is limited, the selection of items is also limited. The selection in such store is limited by the lack of non-food groceries (Source: ICA, 2000). These stores usually do not have large car parking spaces, if any parking space at all. The customers usually come by bicycle or by foot for small shopping.

The big supermarkets have large sales areas of about 1500 to 3000 m^2, or even larger. They provide a large amount of articles including food and non-food groceries for customers' stockpiling purchases. They are usually located at town outskirts and have large car parking area (ICA, 2000). Many customers drive to these supermarkets and do stockpiling shopping.

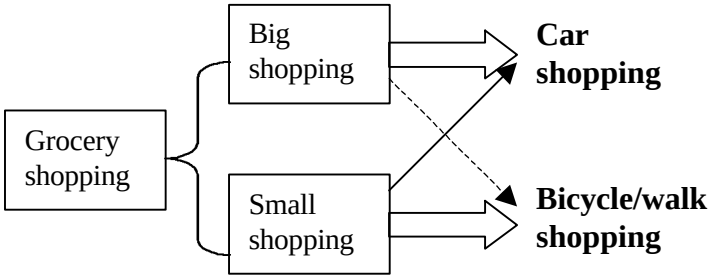
The choices of grocery store are diverse and free for the customers. People can choose either neighbourhood stores for impulsive shopping or choose big supermarkets for stockpiling shopping.

2.1.3 How to buy: means of transport to and from the store

The transport that customers choose to take to the store differs. It includes car driving, bicycling, walking, and public transport. In Sweden, according to statistics, about 60% of such trips to the store are done by car, 36% by walking and cycling, and 4% by public transport (Orremo & Mallin, 1999).

People, who go shopping by bicycle and/or walking, carry on average a relatively small amount of commodities. People who go shopping by public transport, such as bus or commuter train, will not be able to carry a large amount of commodities due to the limitation of physical strength and the space limitation on the bus or train. Those shopping by public transport can be treated similar to those shopping by walking. Purchases of large amounts of commodities, which can not be transported by bicycle or hands, are most often transported by car. However, some households still use a car to transport a small number of commodities. Some people use a cart connected to their bicycle when they purchase large amounts but the proportion of such people is very small. Therefore, the transportation of groceries can be described as in figure 2-2.

Figure 2-2: *Model of conventional grocery shopping trips regarding amount of commodities and means of transport*



People go shopping at various times of the week; during weekdays after work or during the weekend. People travel for grocery shopping only or combine shopping with other non-shopping related trips. The distance travelled for grocery shopping various with different circumstance. The distance for the neighbour grocery stores is short. While the driving for the grocery shopping in the supermarket at the outskirts of the city is long.

2.1.4 Conclusion

The main trend in conventional shopping is that more people use car to shop at bigger supermarkets for big shopping. Supplemental shopping is made in nearby stores, which are convenient to reach by bicycle or walking.

However, there are also exceptions. Some people drive for a small amount of commodities. There are also other exceptions. Small shopping can also be carried out in bigger supermarkets by bicycle or walking when such supermarkets are closer to people's residence. But these factors have a rather smaller effect on the overall impact of transportation on the environment.

2.2 E-shopping –online grocery shopping

With the emerging of E-commerce, "the web is becoming the average consumer's shop window on the world" (May, 2000). Since retailers first appeared on the Web in 1995, Web-based retail has become an established and substantial sector (May, 2000). The grocery stores accepted this channel. One of the earliest and typical examples of online grocery stores is Peapod in the United States. In Sweden, NK-Hallen in Stockholm was the first grocery store to sell groceries via Internet as of September 1996 (Segerlund, 1998).

Online grocery trade refers to the business carried out by grocery stores based on Internet. In stead of going to the supermarket, the customers could sit in front of the computer to browse and choose the commodities via the store's homepage on Internet. The store's personnel select the commodities for their customers and send the orders to their home.

2.2.1 Why do grocery stores go online

What has stimulated grocery stores to sell online? A primary incentive is revenue. For example, the grocery consumption in Sweden in 1999 was about SEK 175 billion (ICA, 2000). Even just one percent of such a grocery market is about SEK 1.8 billion. The second incentive can be described as competition between stores. Many stores go online because other stores already have gone online, such as ICA Andersson in S. Sandby, Lund (Frelin, 2000). Grocery stores also wish to establish new channels: advertising channels and sales channels for promoting their existing grocery trade. There is also the incentive of reducing their operation cost via online trade.

2.2.2 Who goes shopping online?

Online grocery shopping is convenient for their customers. People are used to spending time on travelling to the supermarket, walking and searching for items in the big supermarket and waiting in the checkout lines. With online shopping, the customer only needs to click on the needed item. The groceries are then delivered to the home. Online grocery stores can be accessed 24 hours a day rather than during the limited opening hours of conventional stores. It saves time and is convenient. The Internet also offers the customers the opportunities to compare the prices of same brand in different stores without visiting several stores. Online grocery shopping benefits people who want to save time and those with difficulty in mobility.

Customers who shop groceries online could be called online grocery customers or E-customers. The current E-customers and potential E-customers can be categorised as below.

Internet users and technology people

The Internet is the channel for online grocery shopping, and hence, Internet experience is a prerequisite. E-customers were found on average to have used the Internet for a longer period of time than non-E-customers (Dahlén, 1999). Also, E-customers are presumed to be younger, and they have grown up with more advanced technologies (Carins, 1996). It is therefore easier for them to accept new technology and a new life style, and hence, easier to accept a new shopping experience – grocery shopping online.

People dislike grocery shopping

There is a group of people who see shopping as a necessary but unpleasant chore to be dealt with as painlessly as possible. Dahlén (1999) found that 17-35% of the customers has such an attitude. In his study, 80.1% of the online grocery shoppers expressed apathy to grocery shopping.

Busy people, lack of time

Many people, such as busy professionals and working couples with young children, are willing to pay for the time they can save. "Time starved" people are not as sensitive to price and are willing to pay extra to free up time in their schedules (Cude, 2000).

People with mobility problems

The elderly and disabled people might welcome online grocery shopping. Home delivery service can resolve their difficulty in accessing the conventional stores. The information on the commodities is more detailed and

abundant than with their original system of telephone or fax home shopping. However, the elderly people might have difficulties regarding computer and Internet knowledge.

2.2.3 What to buy?

E-customers can choose almost all the groceries from Internet as in the conventional stores. However, there are some exceptions. Matomera does not sell flowers or fresh fish (Johnsson, 2000).

According to Dahlén's investigation, it was found that stockpiling is more common when shopping on the Internet (Dahlén, 1999). The size of the orders averaged 850 SEK at Matomera (Johnsson, 2000). If customers purchase the same amount of commodities in a conventional store, the most likely means of transport is by car. If the cost of an order is less than 300 SEK (the carrying capacity of a bicycle), the delivery charge would be more than 25% of the total order. This is not economic feasible and acceptable for most customers. Therefore, the online grocery shopping will mostly replace the customer's original car shopping behaviour for stockpiling. Therefore, the car usage for grocery shopping is reduced.

2.2.4 Hinders to online grocery shopping

Online grocery shopping is a timesaving and convenient shopping experience. However, the market penetration of online grocery trade is still very low on the grocery market. Conventional grocery shopping is still dominating. What is hindering the online grocery shopping from taking a large share of the grocery market?

The process of adoption of innovation phrase

Innovations not only include new products and services, but also ideas and behaviours (Antonides, 1998). Adoption of an innovation is the psychological process of trying and repeatedly buying a new type of product. The process of adoption takes time. Adopters are also categorised as innovators, early adopters, early majority, late majority and laggards. Innovators only make up 2.5% of the population that adopt new products (Antonide, 1998). As a brand new experience, online grocery shopping behaviour can be regarded as an innovation. It still takes time to gain the acceptance of the customers.

Accessing to Internet

Although many Swedes have access to Internet, there are still about 50% who do not. The elderly, who might get benefit from online grocery shopping, have difficulty in using computers and accessing Internet.

Information about the store

Some people have no online grocery shopping experience because they have little information about where to go and how to go. Good marketing is very important in attracting more customers.

The interface between the online grocery store and customers

Many people feel inhibited in using new technology (Cairns, 1996). Shopping online does not have the personal service from the assistance. The design of the store homepage might be not too attractive or user friendly. They might hinder some customers from shopping online.

Price

Although the lower operation cost of online grocery stores could result in more attractive prices than conventional stores and might be able to cover the expenditure on delivery service, it is hard to achieve without a certain amount of sales. A lower amount of sales of an online grocery store will decrease the efficiency of its operation. Matomera's sales amount still could not cover all the delivery expenditures (Johnsson, 2000). Although the prices of the commodities are similar to the conventional stores, the charge for delivery service is

additional. For example, the delivery charge is 69 SEK per order. It is 8% of the average value of the orders. It means that online shopping at Matomera is about 8% more expensive than the conventional stores. However, most customers do not include their expenditure on car and fuel as the cost of grocery shopping. Perhaps those costs exceed 8% of the cost of groceries and there actually is not a difference in total cost. This might be especially true for Sweden where fuel prices and tax on car ownership are high.

Supply of groceries

The current supply of groceries in some online grocery stores is rather limited. NetGrocer offers a selection of more than 5,000 national brands, but perishable foods, milk, bread, meats, and eggs, for example, are not available (Phillips & Feldman, 1998). Matomera does not provide fresh fish for sale online. There are 4000 items of groceries in Matomera. However, there are about 14,000 items at Malmborgs in Lund. The number of the items at ICA Anderssons in Södra Sandby is about 16,000. There are about 100 items of organic food in Matomera while there are about 1400 items of organic food at Malmborgs in Lund. The rather limited supply of groceries online could be hindering sales.

Conventional shopping habits

There are many customers who want to touch, feel and smell the products they purchase (Lardner, 1998). Those people might accept purchasing brand commodities online, such as cans, packages of pasta etc. However, they might not accept purchasing meat, fruit or vegetable online without seeing, touching or smelling.

Others

There are also other reasons why people are hesitant to shop online. The online market is till not mature enough. Some people doubt the reliability, credibility, security of payment, privacy of personal data and trust of online trade.

All of the above factors together determine that the market penetration of online grocery trade is still low today. However, many organisations and individuals are optimistic to its development in the near future.

2.2.5 The market penetration of online grocery trade

The current market penetration of online grocery trade is about 0.1% of the total grocery sales in Sweden (Magnusson, 2000). The coverage of Matomera's business occupies 0.6% of the grocery market in its sales area[1] (Johnsson, 2000). There are however expectations for an increase in online grocery trade. ICA AB estimated that in 5 years, 4% of total grocery sales will go online (Magnusson, 2000). Forrester research Inc. expects that the online grocery trade's market penetration will reach 6% in Scandinavian countries by 2005 (Forrester, 2000). The Andersen Consulting expects that the online grocery shopping will reach 10% in 10 years, while Bill Gates is more optimistic and predict that it will reach about 30% (Forsebäck, L. 1998). These various expectations on market penetration are depicted in figure 2-3.

[1] The area including Malmö, Lund, Lomma, Bjärred, Staffanstorp, S. Sandby, Dalby, Bara, Klågerup, Oxie and Svedala in South Sweden.

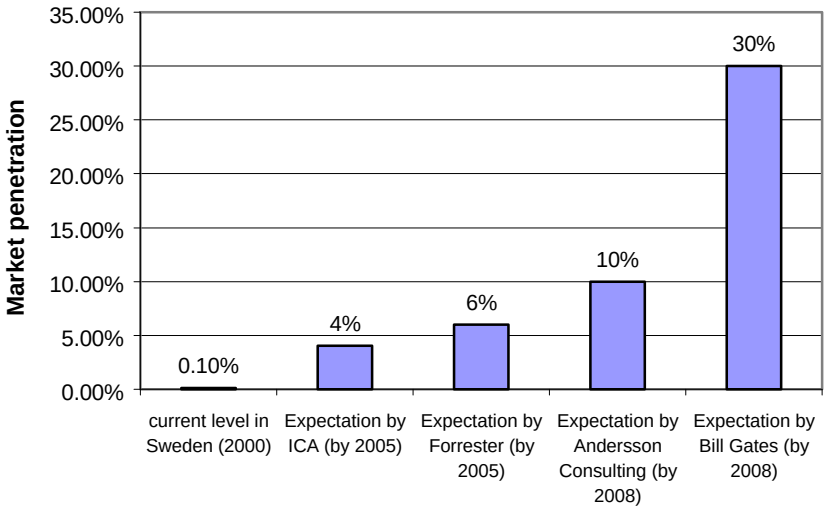


Figure 2-3: *Various expectations on market penetration of online grocery trade* (Source: Magnusson, ICA AB, Forrester research Inc., Andersen consulting, Forsebäck)

2.2.6 Conclusion

Online grocery shopping benefits its customers. However, online grocery shopping also has its limitations. It has to be admitted that online grocery shopping can not completely replace conventional grocery trade. However, it has the potential to develop and will co-exist with the conventional grocery stores, hence providing customers diverse channels for shopping.

3. How does E-commerce differ from conventional commerce?

Shopping is the driving force of grocery trade. Both conventional grocery trade and online grocery trade are to realise the grocery supply from the producers to their consumers. The flow of groceries can be described in figure 3-1. Groceries are transported from the producers to the wholesalers and then to the retailers (different grocery stores), and finally to the customers. The stores provide information regarding the groceries to their customers.

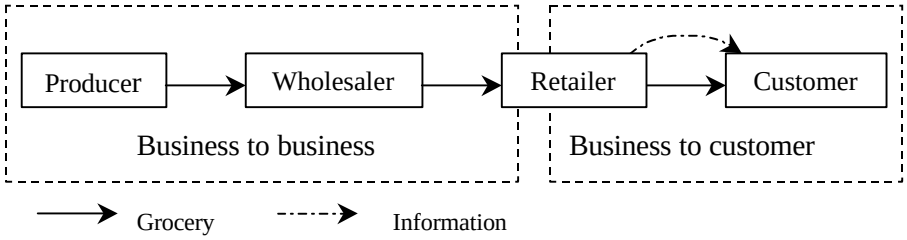


Figure 3-1: *The grocery trade chain*

The relationship between the producer and the wholesaler and between wholesaler and retailer is business to business. The relationship between the retailer and the customers is business to customer.

The realisation of E-commerce in grocery trade can be described as in figure 3-2. The realisation of E-commerce in the grocery trade chain includes business to business E-commerce, between the producer and wholesaler, wholesaler and online grocery store (E-store), and business to customer E-commerce between the business and customers. The business to customer E-commerce includes E-marketing and E-shopping.

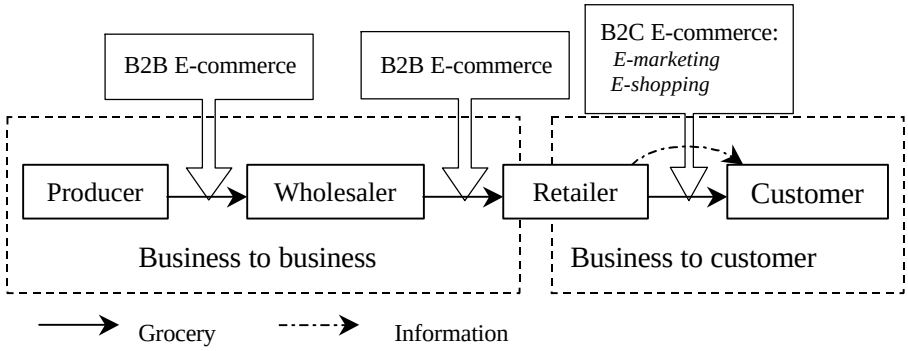


Figure 3-2: *E-commerce applied to the grocery trade chain*

3.1 Business to business: From producer to wholesaler to retailer

The business to business E-commerce between the producer and wholesaler, and then in turn, the wholesaler and the retailer with regard to grocery trade can be explained by the general concept of business to business E-commerce.

The business to business E-commerce includes the transforming of conventional business relationship to a digital relationship to realise the instant, accurate and efficiency. The business to business E-commerce also includes the transformation of the internal business through the application of information technology.

The E-commerce allows the different business to put their supply chain on Internet, therefore to reduce inventories, improve forecasting and eliminate mistakes and wasted production (Romm, 1999).

The business to business E-commerce can realise the online purchases of goods and services between companies (ITTA, 2000). The business to business E-commerce is larger than business to customer E-commerce and is growing rapidly (Romm, 1999). It currently accounts for at least 80% of total E-commerce activity (OECD, 1999). Global companies are already 28% active in at least one business to business site, with an additional 25% planning participation within one year. (ITTA, 2000). The main driving force is the reduction in transaction costs and improvement of product quality or customer service (OECD, 1999).

The information exchange between companies can go online by Electronic Data Interchange (EDI) system over Internet rather than the traditional way, by telephone, fax, and/or postal mails. E-mail can replace part of the regular mail and faxes. Online product catalogue can replace the printed catalogues. E-mail is expected to replace about 12% of business to business postal mail by 2005 (OECD, 1999).

The instant information exchange online can also contribute to reducing the number of inventories performed by companies. A key factor in reducing inventory costs is adopting a "just-in-time" (JIT) inventory system and improving the ability to forecast demands more accurately. Both of these can be accomplished through the adoption of E-commerce (OECD, 1999). A JIT approach has the main goal of reducing of the levels of inventory and its associated carrying costs, or to reduce waste altogether (Beard & Butler, 2000). The idea of JIT is to have the shipment of merchandise arrive just before its utilisation, such as the shipment of groceries from the producers arriving just before the wholesaler's distribution to its retailers. The application of JIT can reduce the storage time in warehouses. Therefore, the need for the warehouse and the size of the storage area can also be reduced. E-commerce can also reduce the errors (OECD, 1999). Therefore, the corresponding waste production can be reduced.

The paper-based invoices of the suppliers (producer or the wholesaler) and payment can be replaced by automated, electronic handling of invoices. The cost on the paper used for conventional invoices and postage can be saved. The process time of the invoices can be saved. Moreover, the process cost of electronic invoices is 25 –50% less than the conventional invoices (Contempus Inc., 2000). Furthermore, The inspection and follow up possibilities are improved.

3.2 Business: Online store and conventional store

Online grocery stores can be divided into two categories: pure online stores and combined stores. The pure online grocery store does not have real shops. The only interface between the store and the customers is the store's homepage. On the other hand, the combined online grocery store has a real store. Such a store's operation is not very different from the conventional grocery store. Therefore, in this section, the comparison of online stores and conventional stores will be focused on pure online grocery stores and the conventional grocery store.

The pure online grocery store differs from the conventional grocery store with regard to hardware, operation, management and shopping trips. The differences will be compared below, and Matomera will be used as an example of a pure online grocery store.

3.2.1 Inventory

The conventional grocery stores make inventories according to their experience. The inventories are displayed on the shelves for a certain period of time. However, inventory prediction not always corresponds to the actual

demand. Some commodities can stand on shelves for several days or up to a week. Some commodities will even expire and be disposed as waste.

The E-commerce can work to reduce the inventories as discussed in section 3.1. The inventory at Matomera is managed by a data-warehouse program, with automatic order processing and ordering towards their suppliers, with some of the suppliers connected to the extra-net (Johnsson, 2000). The benefit of such Just-in-time processing is the reduction or even the elimination of storing some commodities in the warehouse. By realising the Just-in-time delivery, 500 items of groceries can be delivered directly from the wholesaler to the customers without storage in Matomera's warehouse (Johnsson, 2000). The space of the warehouse is saved and waste is also eliminated, hence to save the cost on rent and waste.

3.2.2 Hardware of the store: *store, warehouse and facilities*

As mentioned in Chapter 2, conventional grocery stores are usually located at places close to the customers' living area where the rent for the store is higher. The warehouse of the online grocery store does not need to locate in such area. It could be the place at the outskirts of a town, where the rent is cheaper. Because of no need for parking space for customers, the rent for such space is also saved. For example, Matomera is located in the industrial area in Malmö, where the rent is cheaper. The space can be used as efficiently. Therefore, the investment for such a grocery store can be 50-60% less than a similar sized conventional grocery store (Johnsson, 2000).

Conventional grocery stores usually have a storage area and a shopping area. The inventories are delivered to the storage area first. Then the employees will move the goods from the storage area to the shelves in the shopping area. Goods are arranged so customers can find them easily. Large spaces are necessary so the customers can walk comfortably with baskets or shopping carts. Appearances are also important to conventional stores. Customers like to see that the goods offered are clean, fresh and neatly arranged. Conventional stores, on average require more space than an online store because of the above mentioned requirements. Online stores only need a warehouse to store its inventory and its does not matter how the space looks because customers will not be walking down the aisles. The shelves can be taller and the aisles more compact. The warehouse of online grocery stores is designed more economic efficiently. Moreover, due to the efficient inventories as explained in section 3.2.1, the warehouse size can also be reduced by the Just-in-time inventories.

Furthermore, there is no need for as many open refrigerators and lighting that conventional grocery shops need. There is no cashier machine in the online store. The monitoring system and the safe gate can also be saved because E-stores do not need to worry about theft among the customers. Therefore, costs are reduced for facilities and energy.

However, an efficient and stable computer system is required to maintain the E-store's homepage and for receiving orders, process invoices and payments and other operations.

3.2.3 Operation

An online grocery store can reduce the cost of personnel on cashiers, safeguards and shopping assistants compared to a conventional store. However, online grocery stores need extra personnel to maintain the computer system to receive orders, pack the orders, deliver the orders, develop their web-site etc. A manager for the home delivery system is also required.

3.3 Business to customer: Store to customer

The grocery stores, including online grocery stores and conventional stores, will send the information to their customers to solicit their buying. This is called marketing. The process where customers obtain the groceries from the shop is called shopping.

3.3.1 E-marketing and conventional marketing

The conventional marketing to distribute information about groceries and advertise is by directly inserting paper newsletters to the inhabitants' mailboxes. This kind of marketing can also be done electronically. The store's homepage can be used as the information station for their customers. The store can also send updated product information to their customers by email. This can be called E-marketing by grocery stores.

E-marketing differs greatly to conventional marketing. First, it does not need paper for printing. There is also no need for a postman or other personnel to deliver. The digital newsletter can be animated, easier for searching and of lower cost. The information content of the online information in electronic newsletters can be larger than the paper newspaper because they are limited by the size of the paper and the number of the pages. If all grocery stores had their product information online, it would be much easier for the customers to compare the prices of all the products rather than travel to the various stores. Furthermore, this kind of digital newsletter is easy to delete and would not create any waste paper.

3.3.2 Interface between the store and the customers

The interface between the E-store and their customers is the store's homepage, while the conventional interface between grocery stores and their customers is the store's shopping area. The online grocery store needs to design their homepage carefully while the decoration and lighting of the real stores are unnecessary.

The customers need to walk in the aisles in the real stores to find the groceries they need. However, sometimes, there is difficulty in searching. The searching for groceries at the online grocery stores can be simplified by clicking on the product category or using the search function[2].

The flexible design of the grocery store's homepage can provide customers different shopping experiences. A short cut of 'Go organic' will lead you to all the organic food items. This service is available at Tesco [3], an online grocery store in UK.

3.3.3 Transport: E-shopping and conventional shopping

The customers who shop online can do it at home rather than having to go to the grocery store. The biggest difference is the transport of the groceries. The customers who shop online will have their groceries delivered rather than using their own means of transport to the stores, as is the case with conventional grocery shopping. The final transport of the groceries to the consumers is shifted from the customer to the grocery. As we discussed in Chapter 2, the car usage for grocery shopping will be reduced after adopting online grocery shopping. Therefore, it will be less necessary for the people to have a car.

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[2] Peapod, Netgrocer, Tesco and Matomera all have '*search*' function.

[3] Visit Tesco online: Available at http://www.tesco.com

3.4 Conclusion

The E-commerce of grocery trade differs from conventional grocery trade with regard to many aspects: business to business relationship, operation of the grocer store, business to customer relationship etc. These differences will lead to different economy impacts. Further more, these differences could also lead to different environmental implications. Such environmental implications will be discussed in Chapter 4.

4. What environmental implication does the shift from conventional commerce to E-commerce have?

The shift from conventional commerce to E-commerce in grocery trade lead to the changes on cost and operations of the business involves. Those changes have economic impact: the relationship between the different businesses will be changed, the efficiency in management, inventory saving and waste minimisation can achieve saving in cost. The changes can have social impact: the customer's shopping behaviour will be affected with the introduction of shopping online. There are also impacts on the employment in the E-commerce: more jobs will involve spending more time on the Internet.

Moreover, this shift also lead to the changes in respective environmental implications. In this chapter, the changes of environmental implication caused by the shift from conventional commerce to E-commerce will be explained in terms of business to business relationship, grocery store operation and business to customer relationship.

4.1 Business to business: From producer to wholesaler to retailer

As traditional manufacturing and commercial companies put their supply chain on the Internet, and reduce inventories, overproduction, unnecessary capital purchases, paper transactions, mistaken orders, and the like, they achieve greater output with less energy consumption (Romm, 1999).

The information exchange between different businesses can reduce the paper consumption for printing and its related energy consumption, also the cost for regular mails, envelopes, product catalogues etc. Saving paper utilisation means the saving for the material used for paper pulp, the chemicals and energy used for papermaking, the paint and energy for printing and related transportation of those paper products. Furthermore, the transport, handling and treatment for the waste paper are also saved. Therefore, by saving the paper using, raw material, pollutant and energy can be saved.

The reduced inventory by JIT delivery system can reduce the required area of warehouses. Construction is one of the most energy intensive industries, since the material used in constructions embody a high degree of energy. Furthermore, the energy used for construction itself is high. Less construction for warehouse can reduce material usage and hence energy consumption.

The storage time is an important indicator of energy consumption. In business to business E-commerce, the storage time of groceries in the warehouse can be reduced. Therefore, the related energy consumption is conserved.

The production of groceries embodies energy. The waste reduction by business to business E-commerce will thus also save raw material consumption and energy for the production. The related transportation, storage, waste treatment and environmental impact for the waste are also saved.

The time and paper consumption saved from the shift from conventional invoices to electronic invoices can save paper usage and energy consumption on process.

Although the Just-in-time has its advantages in reducing inventories, it is widely believed that accelerating delivery times means using more energy-intensive forms of transport, particular trucks and planes. It is also believed to lead to increases in deliveries by trucks that are not completely full and the empty return (Romm, 1999). However, due to the impact of JIT on energy consumption is poorly understood (Romm, 1999), it is

hard to estimate whether the energy saved from inventories using JIT could compensate the energy consumption for accelerating delivery transport.

4.2 Grocery store

The difference between pure online grocery stores and conventional grocery stores can lead to different energy consumption and environmental implications.

4.2.1 Inventory and warehouse

The reduced storage time of groceries in warehouses by reduced inventories can save the energy consumption of storage. The reduced inventories can also reduce the amount of waste production and hence reduce the waste of material and its embodied energy. The transport of the waste, the handling, treatment and the potential environmental pollution from the waste problem can be reduced.

The investment and electricity consumption of cashier machines, safeguard doors and monitoring systems in conventional grocery stores can be saved at online grocery stores. Material and energy consumption due to decoration of stores could also be saved. Compacted storage can give online grocery stores smaller warehouses comparing similar sized conventional grocery stores. Material and energy for construction of warehouses can also be saved. The compacted storage of groceries in online grocery store's warehouses can also reduce the energy consumption per item. The reduced area of warehouses can reduce the amount of land needed. The cities will not expend that fast. Fewer trees will be cut down.

There are also other facts we need to consider. The running cost of online grocery stores has its minimum level. The more orders, the more turnover of groceries, which leads to a lower cost and energy consumption per item. However, due to the market share of online grocery trade still being small (about 0.1%), it is still hard for online grocery stores to reach its satisfying turnover rate. When the actual turnover is lower than the warehouse's design level, the energy consumption per item will increase. Due to conventional grocery stores having a mature market, stable customers and stable sales, their warehouse can be used more efficiently today.

4.2.2 Organic food and local product

The production of organic food without pesticide and chemical fertilisers has less environmental impact than the regular production with those chemicals. Therefore, the consumption of organic food might have less environmental impact. The number of organic foods is still limited, searching for organic foods in the conventional grocery stores is also limited. However, using the search function at online stores, all the organic groceries can be assorted out easily. The environmental label of the groceries would be explained clearly[4]. This explanation can give the customers a better understanding and convenience in choosing the organic foods and the products with less environmental impacts. The methods in promoting the consumption of organic food could also be used for promoting the consumption of local products. Local products require a shorter distance of transportation. Therefore, the consumption of local products instead of the products from the producers faraway could save some of the embodied energy consumption and environmental implications from long-distance transportation.

[4] Such as in Matomera: www.matomera.se

4.2.3 E-marketing and conventional marketing

Comparing to the conventional paper-based marketing, E-marketing does not use any paper. There is also no need for the transportation and distribution for the electronic marketing publications. The papermaking is an energy intensive industry, which also consume much raw material and chemicals. The printing of the newsletter consumes much energy. It also consumes large amount of chemicals as paint, which will have potential environmental pollution. The transport for the raw material, paper, newsletters etc. and the distribution of the newsletter to the customers will cost much energy and have environmental impact from the emissions. The used newsletter as wastepaper will also cost energy for transport, treatment etc. There are also environmental implications related.

If the marketing could shift from conventional paper newsletter to Internet homepage and electronic newsletter, the paper consumption can be reduced. Therefore, the related energy consumption, transport and environmental implications will be reduced.

4.2.4 Shopping trips

If all cars used for grocery shopping could be replaced by delivery vans, the difference in transportation and their environmental implication will be immense. Just imagine there are only 1000 delivery vans driving in the city rather than 20000 cars!

All online grocery stores have adopted a delivery system. The delivery transportation can be integrative and will be possible to reduce the transportation and the corresponding energy consumption and environmental implications by individual's car transport. It is believed that the stores have greater possibilities to fill up the delivery trucks and to plan shorter and more effective routes than the households (Trivector Traffic AB, 1999). One delivery van can replace many individual cars used for shopping. The amount of cars driving at peak time for grocery shopping will be reduced. The corresponding noise will be also reduced. If online grocery shopping will decrease the demand for private car, it will also contribute to the environment since the production of a car is of high resource demanding and energy demanding.

4.3 Analysis

Although the operation of pure online grocery stores have the potential of energy saving and waste minimisation, the realisation of such efficiencies is limited by the store's turnover and online grocery trade's market penetration. Therefore, efficiency of pure online grocery store's operation is hard to reach. It is hard to compare it with the conventional grocery store' operation currently. This kind of comparison might be possible when online grocery trade has developed to a more mature and stable stage.

Furthermore, although E-marketing has advantages compared to conventional marketing, the realisation of the E-marketing is still very slow. For example, although Matomera has started sending electronic newsletters by email to their customers (about 6000 copies per week), they still distributed paper-based marketing to people, such as paper newsletters, direct mail, advertisement on newspaper etc. (Johnsson, 2000). There are limitations on E-marketing. The current post distribution system can cover almost all the inhabitants while only half of the Swedes have access to Internet. Not all people who have access to Internet will browse the grocery store's homepage for product information. The people who can receive electronic newsletters from the grocery stores are even fewer[5]. E-marketing, as a complement channel for paper-based marketing today, is not able to substitute the paper-based marketing currently. It is very difficult to predict whether this substitution will come in the future. Therefore, the paper newspaper still dominates today.

[5] Usually, only the customers who subscribed from the online grocery stores could receive their newsletter by email.

In contrast, delivery service is almost offered by all the online grocery stores. Delivery service is more accepted by both the grocery stores and the customers. Transportation sector is a major user of energy and produces a large share of the total emissions of air pollutants (Johansson, 1995). Private car driving occupies a high percentage of the total transportation. One of the common reasons for driving a car is grocery shopping. It accounts for approximately 6% of the private car use (SCB, 1999). The households' transport on transporting groceries equals 25% of the energy used by freight transports, and 6% of the entire transport sector. There is apparently a large potential for a reduction in transports (Trivector, 1999). The delivery system offered by online grocery trade has potential to achieve such a reduction.

It is, therefore, important to study how the shift from individual shopping to online grocery shopping can affect transportation and what environmental implications this shift can bring. The impact of online grocery trade on transport and the environment will be studied in Chapter 5.

4.4 Conclusion

There is potential to reduce the environmental implications of the grocery trade by the shift from the conventional commerce to E-commerce provided the realisation of the efficiency operation in the grocery supply chain. The efficiency in business to business commerce can be achieved by the advanced logistic management with the information technology. The efficiency operation of the online store can be realised by enough sales and turnover from higher market share of online grocery trade, which can be realised by increasing Internet penetration, improved service from the store and the more acceptance by the customers. How the delivery system of the online grocery trade will achieve its efficiency in reducing corresponding environmental implications will be explained in Chapter 5.

5. Local E-commerce's effects on transport and the resulting environment implications

The current delivery system used is mainly home delivery: deliver of groceries directly to customers' homes. However, there are other delivery models, such as office delivery and pick-up point delivery. Three different distribution systems will be outlined in this chapter and they are based on the following studies:"IT, food and environment[6]" by Claes Wallin and Fredrik Orremo (1999), "New distribution models for electronic grocery shopping" by Kallio, J., Kemppainen, K., Tarkkala, M. and Tinnilä, M. (2000), and "Home shopping" by Olle Andersson and Jonas Winther (1997). Their difference to the conventional individual transport and emissions will be explained in this chapter.

5.1 The shift from the means of transport involved in traditional shopping transport to home delivery

Transport when shopping traditionally occurs mainly between customer's home and grocery store, which can be described as in figure 5-1. An alternative can be that: an online grocery delivers the groceries to the customers with a delivery vehicle starts from online store's warehouse. With this alternative, the transport of groceries to the consumer is shifted from the customer to the grocery store.

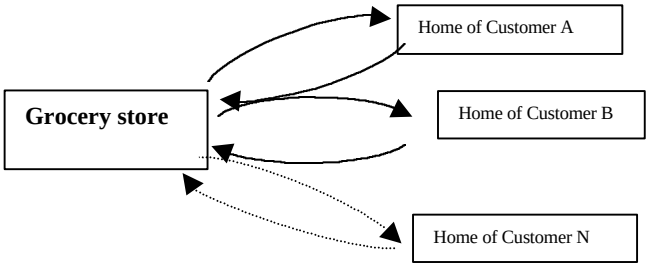


Figure 5-1: *Model of transport in conventional grocery shopping*

5.2 Different delivery models

Model 1: home delivery

The most common delivery model used today is delivering orders to customers' homes. (See figure 5-2).

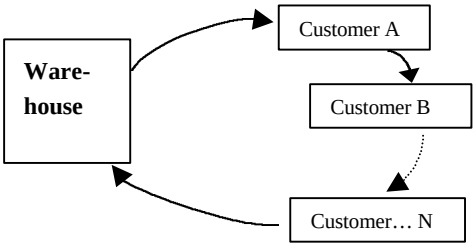


Figure 5-2: *Home delivery*

There is about only one order delivered at each stop in this model and thus the efficiency is lower compared to other models. Since most customers require the delivery in the evening when they are at home, the delivery time period is limited and making it even less efficient. The customers do not need their own means of transportation for shopping.

[6] The original topic of the report is in Swedish: "IT, mat och miljö".

Model 2: Office delivery

The orders can also be delivered to the workplace, such as an office building. Since there are more people from different households concentrated at the same place, several orders can be delivered at one stop. The customers then bring the orders home after work. This delivery is described in figure 5-3.

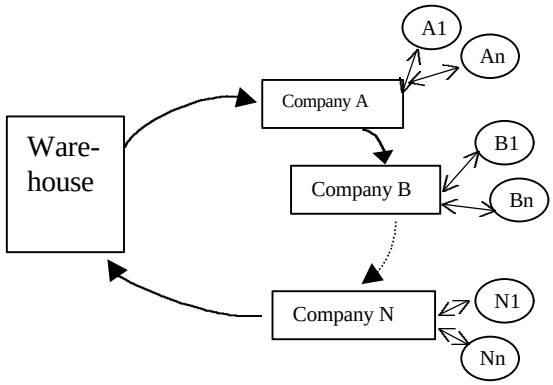


Figure 5-3: *Office delivery*

Since the number of orders delivered at one stop is increased, the efficiency of the whole delivery route is increased. More orders can be delivered within the same time period. The average delivery transport for each customer is also reduced. Matomera is consulting with a number of companies to conduct such a delivery service in the near future (Johnsson, 2000-11-01).

There is possible shortcoming of this model. If the bulk of order is large, it will be hard for the customer to transport it in any other means of transport than by private car. Therefore, the customers have to drive their car to work in order to bring the groceries after work.

Model 3 Pick-up point delivery

Instead of direct home delivery, the orders can also be delivered to a certain pick-up point, which the customers can easily reach and collect their orders later on. The pick-up point can be the parking building in a residential area, the nearest gas station, post office or a new-built pick-up station with lockers. The delivery concept can be simplified as in figure 5-4.

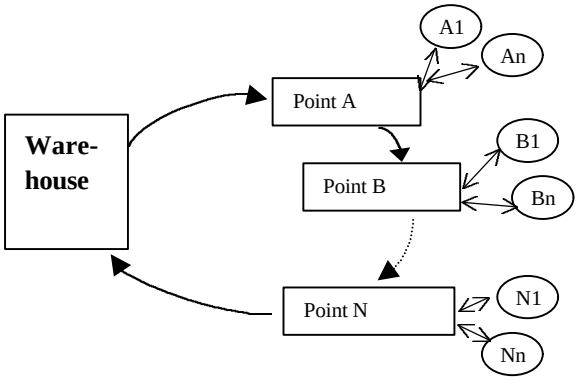


Figure 5-4: *Pick-up point delivery*

Similar to the office delivery in model 2, several orders can be unloaded at one stop. Therefore, the delivery efficiency is increased. This kind of delivery system will not increase the car transport to work as office delivery does. However, the transportation means between the pick up points and the customers' home are uncertain. One of the problems with this model is still the bulk of the commodities. They may not easily be

carried, even if the distance is only a couple of hundred meters away from home. Another problem is that people living in an urban area have access to grocery store within several hundred meters. Thus, one of the advantages of such a delivery model is lost when customers have to walk the same distance as when shopping in a grocery store nearby. Furthermore, if the distance is longer, a car might also be used for picking up the groceries.

5.3 Difference between home delivery systems and individual transportation

The online grocery trade delivery transportation is a kind of integrative transportation compared to many individuals' transporting their own groceries. The transportation route, vehicle and fuel used differ.

Since a delivery van or a delivery truck can load many orders, the number of delivery vehicles are much less than the corresponding number of private cars needed for grocery shopping.

Individual grocery shopping concerns mainly transports to and from the grocery store, which equal to twice of the distance between home and store. The delivery system, on the other hand, can link the warehouse and different delivery points into one circle. Therefore, the transport distances differ.

The vehicles used by households are mainly light private cars. The vehicles used for deliveries are usually vans or delivery trucks. The different vehicle types determine the different fuel types to use, consumption rates and their emissions. Most private cars consume gasoline in Sweden while most delivery vehicles run on diesel.

The differences between individual transportation and a delivery system cause differences in environmental implications.

5.4 Environmental implication of different delivery models compared to conventional shopping by individual cars

Transportation sector is a major user of energy. The use of transportation fuels is responsible for the large amounts of carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC_s), particulate matter (PM) and other air toxins. Throughout the OECD region, light-duty gasoline vehicles are a major source of VOC and NO_x, the main precursors to ozone, and are the single largest source of CO. Heavy-duty diesel vehicles are significant sources of NO_x, PM and SO_x. Transportation continues to be a major source of toxic air pollutants in urban areas and of greenhouse gas emissions, accounting for nearly thirty per cent of CO_2 emissions from the use of fossil fuels in OECD countries (OECD, 1993). Noise pollution also comes from road transport. Air pollutants and noise are harmful to human beings and the natural environment. There are many concerns about how to reduce the transport and its emissions. Therefore, it is one of the reasons to see whether the home delivery system can reduce the conventional transport and its environmental implications for grocery shopping.

As stated in 5.3, individual transportation and delivery systems differ regarding transportation route, energy consumption and environmental emissions. In order to compare the difference of environmental implications between the individual transportation and the delivery transport, rough calculations will be done. Since there are many variables, such as different quality of fuel consumed, the conditions of the vehicle, different driving patterns etc, the results from the calculation are uncertain and should be seen as rough approximations.

5.4.1 Energy consumption and emission levels

Energy consumption and emission levels of different delivery models mainly depend on their transport distance, vehicle type and fuel. The actual environmental implications also depend on how many individual vehicles can be replaced by the delivery service. In turn, this replacement depends on the market penetration of online grocery trade on the grocery market.

There are many variables affecting the actual level of environmental implication. In order to make a comparison of the various delivery model's environmental implications, it is necessary to make certain assumptions to simplify the calculation.

5.4.2 Conditions and assumptions

The average individual transport back and forth for grocery shopping is 7.81 km in Sweden (Orremo & Wallin, 1999). Most of the cars use gasoline as fuel. Diesel is also being used. The assumption is the amount of the groceries bought when shopping by car is equal to the amount of groceries the customer ordered from online grocery store.

Due to the amount of the orders can be delivered during certain time is limited[7], a light delivery van is used for home delivery in model 1. The van weighs about 3.5 ton on loaded and can load 20-30 orders at a time (Johnsson, 2000). In the calculation, 25 orders per van will be used and the delivery van uses either gasoline or diesel.

A truck (14 ton) is used for office delivery in model 2 since it can deliver many more orders in one delivery circle. The delivery truck can be loaded with 128 orders (Orremo & Mallin, 2000). Most of the trucks run on diesel. In the calculations for model 2, an extra private transport by car will be added because the customers need their car to bring the orders back home from the office. The increment rate depends on how many per cent people go to work by car. The assumption used in this thesis is that normally 50% of the people go to work by car. The average distance there and back from home to workplace is about 8.0 km.

The delivery vehicle used for pick-up point delivery in model 3 is similar to the one used in model 2. The delivery truck can load 128 orders. The transport means between the pick-up points and the customers' homes are uncertain. Since there is no related statistics available, the following assumptions are made. The pick-up points are within the distance of 500 meters to customers' homes. The average distance is 250 meters. About 10% of the customer use their car for collecting their groceries.

Energy consumption and emission levels

The emission levels were studied from the report of 'IT, food and environment' by Orremo and Mallin (Orremo & Mallin, 1999) (See Appendix). Different vehicle has different fuel consumption rate. The emission levels also differ from the fuel (gasoline/diesel) and vehicle (car/van/truck). The emissions calculated include the most common exhaust by vehicles: carbon dioxide ($CO_{2)}$, nitrogen oxides (NO_x), hydrocarbon (HC), carbon monoxide (CO) and particulate matter (PM).

[7] Usually, the home delivery is limited in the evening. In average, 10 orders can be delivered per hour. If the delivery circle is about 3 hours, the number of orders can be delivered per night can not be more than 30 orders. Therefore, a light van is used.

5.4.3 Calculated environmental implications of the delivery model compared to the equivalent private shopping by car

The environmental implication level induced by private car transport for an equivalent amount of traditional grocery shopping is set as 100%. The environmental implication of each delivery model refers to the energy consumption and emission levels per order. The delivery distance with an environmental implication level equal to 100 % is called the *critical distance*.

In figure 5-5, we can see that the energy consumption of model 1 is less than the equivalent private transport by car when the delivery distance is less than 80 km. The critical distance of office delivery is longer than home delivery. It can be explained by that the number of the orders carried by the truck is much larger than the number of the orders transported by van. Due to there will be more than one orders can be delivered at one stop, the efficiency is higher. The critical distance of model 3 is longer than that of model 2. It is because that surplus private car will be used in office delivery model. The surplus private transports related to model 3 is less than that of model 2, therefore, the critical distance of model 3 is longer than model 2.

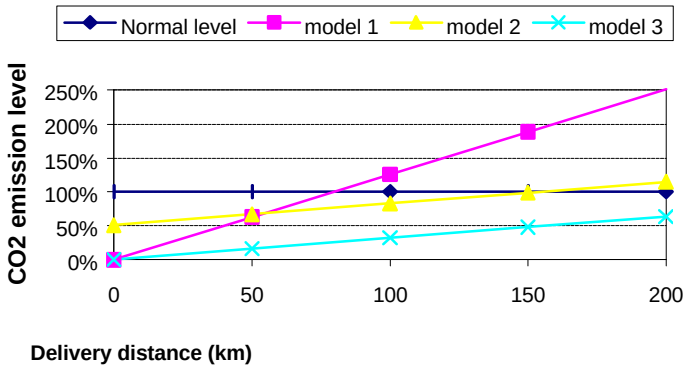


Figure 5-5: *Energy consumption levels of different delivery models compared to equivalent private shopping by car*

In figure 5-6, we can tell that the CO_2 emission levels of three models are lower than the private transport level when the delivery distance is less than 70 km. The critical distance of model 2 is longer than 150 km while the critical distance of model 3 is longer than 200 km. It can be explained by that the CO_2 emission rate of gasoline and diesel are similar. When the delivery average delivery distance is shorter, the emission level is lower as well.

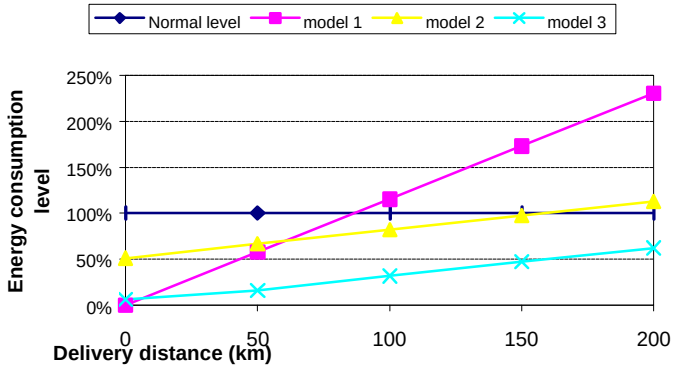


Figure 5-6: *CO_2 emission levels of different delivery models compared to equivalent amount of private shopping transport by car*

In figure 5-7, which shows the NO_x emission levels, we can see that the critical distance of model 2 and model 3 is about 50 km and 90 km respectively. They are shorter than the critical distance of model 1, which is longer than 200 km. This can be explained by that most of the private cars use gasoline rather than diesel. Diesel has higher NO_x emissions. The delivery trucks use diesel as fuel; therefore, the NO_x emission level is higher. The fuel type used in model one can be either diesel or gasoline, which results in a lower emission level.

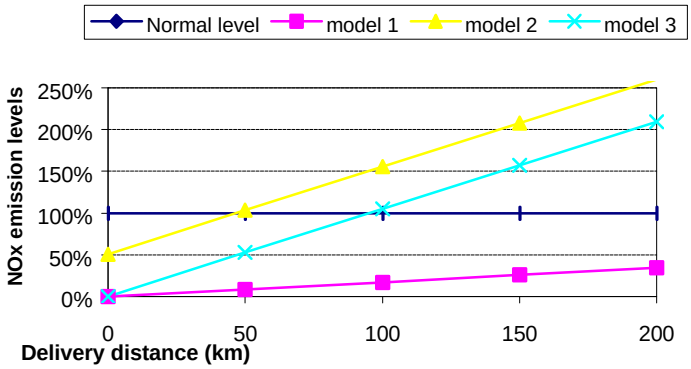
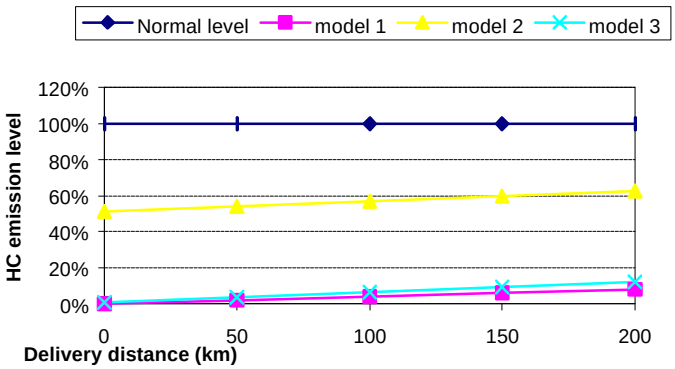


Figure 5-7: *NO_x emission levels of different delivery models compared to equivalent amount of private shopping transport by car*

In figure 5-8, we can tell that the critical distances of three models in the terms of HC emission levels are all longer than 200 km. Model 2 and model 3, which use diesel, have longer critical distances than model 1, which uses both diesel and gasoline. It can be explained by that diesel has lower HC emission levels than gasoline.

Figure 5-8: *HC emission levels of different delivery models compared to equivalent amount of private shopping transport by car*



In figure 5-9, we can see that the critical distances of the three models are all longer than 200 km. It can be explained by that the diesel vehicles have lower CO emission level.

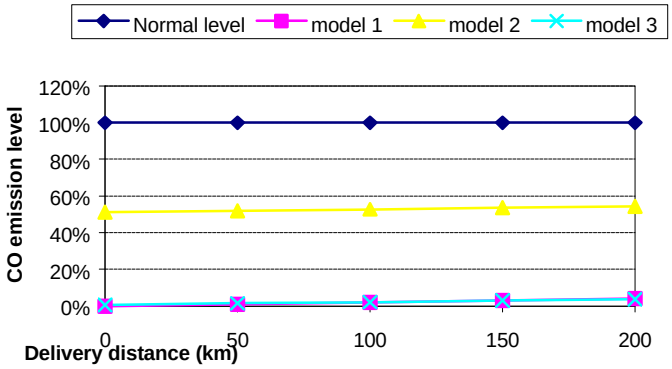


Figure 5-9: *CO emission levels of different delivery models compared to equivalent amount of private shopping transport by car*

In figure 5-10, we can see that the critical distances of the three models are no more than 50 km. The critical distances of model 2 and model 3 are even shorter. It can be explained that diesel vehicles have higher PM emission levels than gasoline vehicles.

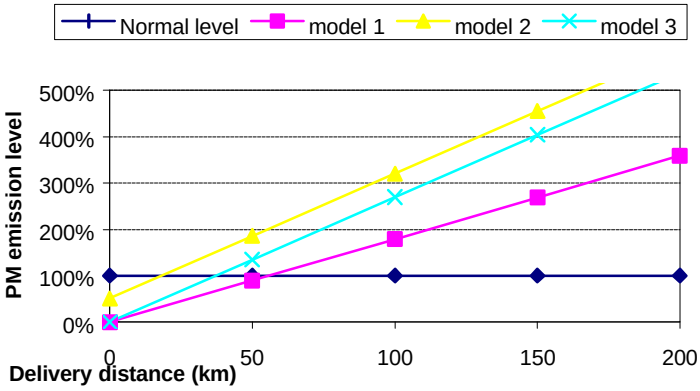


Figure 5-10: *PM emission levels of different delivery models compared to equivalent amount of private shopping transport by car*

Consequently, we can conclude that:

- The critical distance of different models differs in different delivery models with different environmental emissions.
- Within the critical delivery distance, the delivery transport is able to achieve a better environmental performance than the individual shopping by car.
- The energy consumption level and CO_2 emission levels of model 2 and model 3 are lower than model 1. However, the NO_x, HC, CO and PM emission levels of model 2 and model 3 are higher than model 1.
- The critical distances of model 2 and model 3 with NO_x Emission levels are shorter than 100 km. Their critical distances in case of PM emission levels are shorter than 50 km.
- Model 3 could have lower environmental implication levels than model 2 given the same circumstances.

5.5 Analysis

The calculations above are based on assumptions. It can only provide for the rough comparison. There are many variables, which can affect the actual environmental implication levels. The results from the calculation will be explained.

5.5.1 Transport when shopping conventionally

The energy consumption rate and emission levels of the private cars used in the calculation are the average levels. Most of the private cars in Sweden have catalytic converters (Vägverket [Swedish National Road Administration, SNRA], 2000). Their emissions can be reduced when the catalytic converters work. However, the catalytic converters of the cars will not work before it has reached an operating temperature (Johansson, 1995). The transports involved in individual grocery shopping are usually short: from several hundred meters to a few kilometres. The catalytic converters can not fully work within such a short transport distance. Therefore, in these circumstances, the actual emission level of the car used for short distance grocery shopping can be higher than the level used in calculation.

5.5.2 Delivery models

Model 1

As we explained in section 5.2, the efficiency of home delivery is lower than the office delivery and pick-up point delivery. Therefore, the critical distance of home delivery model is also limited. The critical distance in terms of energy consumption level and CO_2 emission level is lower than the other two delivery models. Although the energy content of diesel is higher than gasoline, the volume of diesel consumed by delivery vehicle is higher than car. Therefore, the overall energy consumption is similar. The CO_2 emission levels of diesel and gasoline are similar. Model 2 and model 3 can delivery more orders, therefore, their average energy consumption levels and CO_2 emission levels are lower.

Model 2

The efficiency of the office delivery model could be higher than model 1 because there are more orders could be delivered at one stop, instead of at numerous homes. This kind of delivery system would also reduce the amount of time for the online grocery stores to deliver all the orders. The critical distance in terms of energy consumption is higher than the model 1. However, as we discuss in the section 5.2, the office delivery will increase the individual transport by car to workplace for the purpose of carrying groceries they ordered to home. Therefore, the total amount of the transport distance is increased by the surplus individual transport. This kind of surplus individual transport by car also increases the average energy consumption and the environmental emissions from the use of car.

The delivery trucks used for this kind of delivery use diesel as fuel. Diesel combustion has higher emission level in terms of NO_x and PM. This is the reason that the critical distance of model 2 is shorter than model 1 in terms of NO_x and PM emission levels.

There are other problems with this system. In the workplace, space is required to store the orders. If the delivery is made much earlier than the time when the customers leave, a suitable storage with equipment for cooling or even freezing will be required for some of the products, such as milk, meat etc. Provision of space and storage facilities is sometimes not feasible for all the companies. Furthermore, the storage facilities themselves are high energy-embodied appliances. The storage space and facilities may also consume a lot of energy.

Model 3

Comparing to office delivery, the pick-up point delivery has lower energy consumption level and lower emission levels. It is because that the surplus individual transport by car created by this delivery is lower than that in office delivery. Efficiency is the higher with this kind of delivery system as well. The space for pick-up points is required. If the points need to be new-built, the construction itself is of high energy consuming. If the delivery will be done much earlier than customers' collection time, a suitable storage with cooling equipment is

required. Furthermore, lock will be needed if there is any consideration of theft. Therefore, the cost on space (rent or new built), facilities, maintenance and electricity bill has to be shared by the customers.

5.5.3 Vehicle and fuel

The emissions from the vehicles are determined by the vehicle construction, the fuel used, and how the vehicle is maintained and used. Catalytic converters can be used to reduce the HC, CO and NO_x emissions. However, the catalytic converters can not be used in vehicles with diesel engines.

It is believed that with the technology development, the emissions from diesel engines will be reduced with the refined engine technology, improved grades of fuel and exhaust after-treatment system (Volve, 2000).

There are alternative fuels available, which have lower emission levels. Natural gas has been introduced in Sweden as an alternative fuel for heavy-duty vehicles. The emissions of PM and NO_x from natural gas fuelled vehicles are at least 80% lower than current Swedish emission standards. Biogas can be used as fuel which has almost the same properties as natural gas (Johansson, 1995). Other alternative fuel, such as Liquefied petroleum gas (LPG), will contribute for a less emission levels if adopted.

5.5.4 Calculation

The result calculated in section 5.4 is rough due to many variables. The proportion of the different fuels used by private cars and delivery vans are not accurate. The average of the individual driving length for grocery shopping would differ from different places. The delivery distance is determined by the distance from the warehouse to the customers and the distance between stops. They are decided by the location of the warehouse and the customers.

The calculation is made with the assumption that the delivery vehicles are fully loaded. This is an ideal situation. When the orders from the customers are less than the capacities of the delivery vehicles, the delivery efficiency would be decreased.

The energy saving and environmental emission saving could be realised with ideal situation: within the critical delivery distance and with full load. However, the total energy saving and environmental emission saving also depends on how many per cent of individual shopping transport by car could be replaced by this kind of ideal delivery. The replacement depends on the market penetration of the online grocery trade.

5.5.5 The load in delivery vehicle

For the same delivery route, more orders delivered means less environmental implications per order. When the amount of the orders loaded in one vehicle is less than its capacity, the average energy consumption and emissions per order will increase.

5.6 Conclusion

Therefore, we could draw the conclusion that when the delivery conditions are ideal, the energy saving and environmental implication savings can be realised. With the higher market penetration of the online grocery trade, the savings would be increased. The model2 and model3 are easier to realise the energy saving with longer critical delivery distances. However, the environmental emissions from the diesel combustion, such as NO_x, PM emissions could not be ignored.

6. Realising the environmental potential of local E-commerce

The share of the local E-commerce is so small that their impact is also too small to be noticed today. However, their impact will be amplified with the emerging of the local E-commerce. We can commit that local E-commerce has possibilities to bring more efficient living styles. However, the negative impact with the development of the local E-commerce might appear without pre-awareness. Those possible negative impacts could be the constraints for a more sustainable society. It is important to realise such impact today and try to find the ways to realise the environmental potential of E-commerce. This chapter describes some of the potential impact we might encounter with the shift from conventional commerce to E-commerce and analyse the way for a more sustainable solution.

6.1 The stakeholders of local E-commerce

There are many factors who can affect the local E-commerce (see figure 6-1). These stakeholders include the technological environment: such as the Internet, technology development, universities/institutes etc. Government, including central government and local government, is also included. The entities, such as the investor, producer, wholesaler, competitors of conventional grocery stores, other grocery stores, also act as stakeholders. There are also internal actors: online grocery store itself and customers, etc. Others, such as media, also have their effect on the local E-commerce.

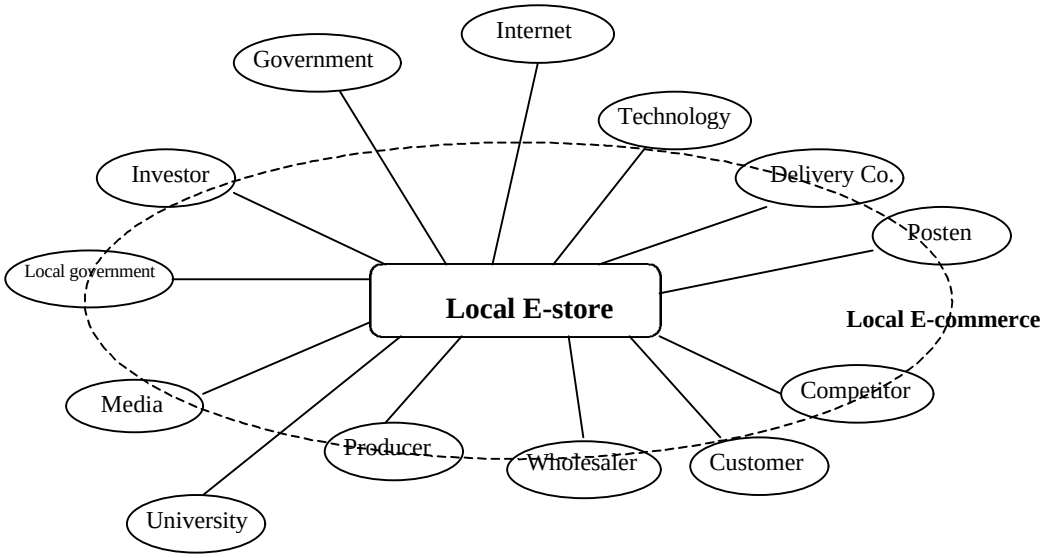


Figure 6-1: *Stakeholders of Local E-commerce*

6.2 Greening the local E-commerce – Issues to consider, possible solutions and stakeholders' impact

In order to have a more sustainable local E-commerce, it is important to understand what kind of potential issues we need to consider and what environmental impact those issues might bring. How the stakeholders can have their impact on such issues will be considered. In which way the stakeholders can contribute for a more sustainable local E-commerce will be analysed in this section.

6.2.1 Appliances for E-commerce environment

In order to participate E-commerce, the companies need to purchase more computers, cables, servers and other appliances for a completed intranet environment and its connection to Internet. The customers also need accessing to Internet. Therefore, the customers will purchase more appliances for Internet access, such as personal computer. The high quality and speedy network is also required for the development of E-commerce. The completed Internet network needs the infrastructure construction to cover all the households and the business. All of the computers, cables and other appliances are high energy-embodied and resource-consuming products. The running of such appliances needs much electricity. The construction of the network infrastructure is also of high energy demanding. The waste from the old computers will increase the amount of the waste and the energy used for waste transport and treatment.

The utilisation of such information technologies can help the business to achieve more efficient operation. As we discussed in Chapter 3, the realisation of the business to business commerce will be able to save paper consumption, inventory, storage, warehouse and related transportation. Accordingly, the energy and resource can also be saved. It is hard to compare these savings and the expenditure on the appliances. The key issue is to make the best use of the potential efficiency brought by the information technology. The logistic design and management of the companies with the information technology will contribute for such an energy and resource saving.

Logistic companies, who can provide professional logistic management solutions, will help the companies to realise the efficient and logistic management with information technology. The companies involved in local E-commerce, such as the *producer*, *wholesaler*, *online grocery store*, are the key actor to adopt such efficient and logistics management, therefore to realise the saving in energy and resource consumption.

6.2.2 Inefficient operation in online grocery store

The energy consumed per commodity stored in the online grocery store's warehouse will increase and even surplus the energy consumption per commodity in the conventional store if the volume of the turnover is much lower than the storage capacity of the warehouse. This is because of the basic energy consumption for the warehouse on lighting, heating, cooling and freezing facilities are fixed. Smaller amount of the commodities stored in the warehouse means the higher energy consumption on each item. The inefficient operation might happen when the sales of the online grocery store are low and when the market penetration of online grocery trade is low.

The solution of such inefficient operation is to increase the amount of turnover. When the market penetration of online grocery trade increases, the sales of the online grocery store might also increase to increase its amount of turnover.

The *online grocery store*, *conventional grocery store*, *other online grocery stores*, *customers*, and *government* have their impact on the market penetration of online grocery trade. The online grocery store can attract more customers and sales by improving their service, attractive price and more user-friendly interface. The store could also use various marketing techniques to attract more customers. Therefore, their sales would be increased and the efficiency in utilising the warehouse will be increased. The competition from the conventional stores and the other online grocery stores is the other reason of small amount of turnover. Due to the market penetration of online grocery trade is still low in the grocery market, more online grocery stores means stronger competition and smaller turnover for each other. Government's policy will also affect the development of E-commerce. One of the reasons that customer hesitate to adopt shopping online is due to the consideration of security. With more regulation and law on the security of the E-commerce from the government, more customers will feel safer to do shopping online. Therefore, the sales of the online stores will increase; hence the turnover of the stores will increase as well.

The Swedish government gives support to the development of E-commerce. “Electronic commerce will be stimulated. Regulations must be clear and help ensure adequate consumer protection. Continued support will be provided for skills development in schools, companies and institutions of higher education” (Swedish Government, 1999). Furthermore, the proposal on qualifying electronic signature, in order to facilitate the E-commerce, was approved and the act will start from the first of January 2000. These actions will contribute for promoting the development of E-commerce, including online grocery trade in Sweden.

6.2.3 Side effect of JIT delivery system

As discussed in Chapter 4, the potential negative effect of JIT delivery system comes from using more energy-intensive transport forms in order to catch the time. It could also lead to the inefficient delivery: truck are not full, and increase the empty return (Romm, 1999).

The reason for the side effect of JIT delivery system can be explained as the time constrains of the delivery period. The buyer orders before they need, rather than plan long time before. Due to the time constraints, the provider will more likely to choose the faster transport, such as truck rather than train, or plane rather than ship. Such faster transports will consume more energy than the slower ones. The amount that buys order is equal to their current need, rather than for a stock. The buyers order smaller amounts time to time rather than one big bulk more seldom will increase the frequency of transport hence the number of transport will increase. Therefore, the total transport amount is increased. Such increment will lead to the more energy consumption and environmental implications. The amount of the product per order will be smaller in JIT delivery than stock order. The transport for smaller amount of products will be less efficient than the bigger amount because it can lead to empty space in the delivery vehicle. The empty space will be waste. The empty return by the increment of transport frequency will also increased. Therefore, the related energy consumption and emissions increase.

The actors playing role are the buyer and the provider in the business to business E-commerce. One of the reasons to adopt JIT delivery system is for reducing the storage space and period in buyer’s warehouse therefore to reduce storage area, unnecessary construction and related energy consumption. However, the side effect of the JIT delivery system is possible. How to compare the energy saving in storage and the energy wasting in extra transport is hard to resolve. From the economic aspect, if the transport cost is lower than the saving in storage, the buyer will have more concern on storage saving.

The potential solution for a better delivery system could be the co-ordinated distribution. Trying to combine the JIT delivery with other delivery for a full load, then to make the transport more effective. It is believed that Internet-based systems for auctioning off that empty space can raise the efficiency in transportation (Romm, 1999). Not only the empty space when delivery the products can be utilised, the empty return of the delivery vehicles will also be reduced. The *transport company* and an *Internet-based auction company* can co-operate to achieve a more efficient transportation therefore to reduce the side effect from JIT delivery system.

6.2.4 Overlapped deliveries

If the customer order from more than one online grocery store at same time, and if each store has their respective delivery agency, many deliveries will be sent to the same customer. If there are many deliveries arrive at the same time, the amount of the vehicle passed by the same place will increase, hence the noise pollution might increase. Many deliveries will increase the total amount of transport. Hence the energy consumption and emissions will increase. When there are more than one online grocery stores, the customers have more choices in shopping online. This is caused by the competition of various online grocery stores.

Since those many deliveries arrive at same place, at least part of their route might be overlapped. The possible solution is to assign the deliveries for one delivery agency. The delivery agency can combine various deliveries

for same destination at one time. Therefore, the overlapped delivery transport and related energy consumption and emissions could be reduced.

The *local government* can act as the co-ordinator for such co-operation. The local government can collect suggestions and requirement from the online grocery stores and bring the suggestion of co-ordinated delivery to the online grocery stores. The local government can also act as the co-ordinator between the online stores and delivery agency. The *online grocery stores* can decide which delivery agency they want to co-operate. Since this kind of co-ordinated delivery agency might decrease their delivery cost if shared by different stores, the online stores might welcome such co-operation. The *transport company* is the one who will be in charge of the delivery. It should be capable to design the best route for all the deliveries.

6.2.5 Paper-based marketing

In order to compete with the conventional stores, attract more customers and earn more profit, the E-store will try to use every effort to do the marketing. The store will choose all kinds of media: TV, radio, newspaper, direct mail, insert brochures to mailbox, and Internet. Although the replacement of electronic newsletter has its advantages on material and energy saving, the paper-based is still dominating the information distribution. The E-marketing is used as the supplement to the paper-based marketing, rather than the substitute. The local E-commerce is still in its beginning stage, the E-stores must put more effort than the existing conventional stores to win the market share. Therefore, the paper consumption on advertisement by the E-stores nowadays is of high volume. This kind of paper consumption will lead to the negative environmental implications of the E-store. For example, Matomera has its printed advertisement on daily newspaper and on monthly or bi-monthly magazines. Matomera also dispatch paper-based newsletters 4-5 times per year, each edition 5000 – 30000 copies. Each copy has 10 pages (Johnsson, 2000). Total they are about 1000,000 pages, which is about 700 kg of paper. This is similar to the conventional shops.

Customers are the targets of online grocery store's marketing strategies. If the customers prefer to the paper-based information rather than the digital version, the amount of paper will not decrease since the stores want to use the most effective channel to realise their business. Therefore, the customers play an important role in stores' marketing strategies. The stores are the sender of the brochures. If the stores decide to reduce the amount of paper-based newsletters, the corresponding paper consumption will be saved.

The potential solution for the paper consumption is to suggest the customers to adopt digital newsletters. The other possible solution is the stores reduce their paper-based newsletters.

By the increment in *Internet* using and Internet experience, the customers will be more used to the digital versions, including digital newsletters. If more customers have the awareness of saving paper consumption, therefore to choose digital newsletters, the distribution of the paper-based newsletters will be discouraged. Such awareness can be brought to the public by the *government, local government* and regular *media*. Local government usually is the one who promotes the environmental activities for its residents. If the digital-based information, including electronic newspaper, digital newsletter etc., and the idea of saving paper consumption will be introduced to the people by the local government, the acknowledgement of the digital-based marketing will also be accelerated.

6.2.6 Energy consumption and environmental emissions from delivery transport

The energy consumption, emission levels of the delivery transport will exceed the conventional transport if the delivery distance is very long (as discussed in Chapter 5, longer than its critical distance). The critical distance

differs in terms of energy consumption and different emissions. The energy consumption and emission levels will increase when the amount of orders load in the vehicle is considerably less than its capacity.

The vehicle emission level depends on the vehicle, fuel, and how the vehicle is maintained and used (Johansson, 1995). If the vehicle used for delivery have lower combustion rate, the energy consumption and emissions will increase. The diesel fuel has higher emission level of NO_x and PM emission levels. If there is no treatment facility, the NO_x and PM emissions will increase by the using of diesel engine vehicles for delivery.

The deliveries to the offices and to the pick-up points will lead the requirement for extra space and facilities for temporary storage for the groceries. The space and facilities are all energy-embodies. The storage also needs extra energy to operate the facilities.

The energy consumption and environmental emission levels of delivery transport is mainly determined by the length of one delivery circle, the type of delivery vehicle and the type of the fuel.

The length of one delivery circle is determined by the distance between the warehouse and the destination area and the distance between the customers. If the customer order the groceries from the online grocery store very far away, the delivery distance might be over the critical distance. Therefore, not only the energy consumption and environmental emissions will exceed the critical level, it is also not economic feasible for the stores or the delivery agent to do such service. The store can define the scale of its service area to eliminate such long-distance delivery.

The orders of the E-stores are usually delivered by the third party. The delivery agent usually is a professional transport company. Such as Matomera assigns Schenker-BTL, a transport company as their distribution partner. It is believed that the E-store (delivery company) has greater possibilities to fill up the truck and to plan shorter and more effective routes than the households do (Trivector, 1999). The good logistic design can contribute for an efficient and reasonable delivery system to make the delivery distance shortest and fastest, hence to reduce the expenditure on transport and related environmental implications.

It is the *delivery agent* who has the final decision on the delivery route, vehicles and fuel used for delivery. The reason that the delivery agent wants to have logistic design of the delivery rout to shortest length is because that shorter transport could save the time and fuel they use and make the most profit for the company. With the same economic consideration, the delivery agent will make full use of their available vehicles. In order to reduce the cost and make more profit, the delivery agent will choose high energy-content and cheap fuel for their operation.

The fuel used by delivery vehicles today are mostly diesel fuel but not gasoline. It is because diesel fuel has higher energy content and the price is cheaper than the gasoline. Diesel fuel has a much higher effluent of particles than gasoline. The *delivery company* has the chance to choose alternative fuel or alternative vehicles. Therefore, the emissions from the vehicles might be reduced. However, due to the fact that most of the alternative cleaner fuels are more expensive than the diesel, the company would not choose those more expensive fuels because of the consideration of economy and profit thinking. There is possibility to encourage the cleaner fuels' utilisation by economic incentives. Raising the tax on the gasoline and diesel to subsidy the cost of cleaner fuels might be feasible. If there is incentive for the delivery agent to adopt the alternative cleaner vehicles and fuel, the environmental impact will be reduced.

Academic organisations, such as university and institutes, have noticed the development of E-commerce and started studying on their environmental consequences. A project named 'E-commerce and consequences for transport logistics", together with seven companies and three institutes of technology in Sweden. The aim is to generate logistical systems that support e-commerce and that are effective from an economical and environmental perspective (Gustafsson & Eliasson, 2000). The research from the academic organisations

might contribute for a better environmental consequence of the E-commerce in designing a more logistical reasonable and environmental feasible system.

The *producers* of the vehicles could be another actor affect environmental implications from delivery transport. For example, Volve has dedicated in reducing the emissions in diesel engines. They have introduced exhaust gas filter for their truck to reduce the emission of CO, HC and PM by 80-90%. They also developed new natural gas truck. Diesel engines designed for alternative fuels is also developed (Volvo, 2000).

The *government* can also have their impact on the transport emissions. If the government raise the tax on the fossil fuels and subsidy on the facilities for reducing emission or the cleaner vehicle and cleaner fuels, the delivery agent will be more willing to choose such clean transport mean.

6.2.7 Extra transport by the customers

If the customers adopt online shopping instead of their original shopping by bicycle or walk, the amount of the total transport is increased. The corresponding energy consumption and emissions are also increased. If the customers use the time they saved from online grocery shopping for other transport by car, the total transport distance, energy consumption and emission levels will increase again. This might be another side effect from online grocery trade.

It is hard to predict the change on customer's transport behaviour after adopting online grocery shopping experience.

Some activities initiated by the *government* may have impact on people's behaviour. For example, the European Union (EU) initiated the activity of 'Car-free-day'. The 'Car-free-day' offers the information and possibilities to the people to demonstrate that they can have better air quality, less noise and better public transport (Wallström, 2000).

Local government is the one who promotes such activities in the region. The local government could launch such activities to bring the information of the environmental implication of transport to the citizens. Such awareness will discourage people's car using and therefore to reduce the total transport behaviour.

6.2.8 Others impact from the stakeholders

There are other stakeholders they have impact the local E-commerce and hence on the its environmental implications.

6.2.8.1 Internet and technology

Internet is the prerequisite of E-commerce. The coverage, reliability and knowledge of the Internet can determine the development of E-commerce. The accelerating development of Internet penetration can accelerate the E-commerce's development and hence the market penetration of E-commerce. With the higher market penetration and more mature technology, the E-commerce will be easier to carry out. Therefore, the efficient operation of the E-commerce and its energy saving will be easier to realise.

6.2.8.2 Government

The high penetration of the Internet usage is promoted by the government. As government started 'Sweden shall be a leading IT nation. IT know-how and expertise must be brought in at every level of the educational system' (Swedish Government, 1999). With the support and even subsidy from the government, the IT and Internet will spread more quickly.

6.2.8.3 Online grocery store

An environmental report could make the online grocery store not only aware of their saving in operation, cost and other expenditures, but also aware of what kind of environmental benefit those savings can lead to. The environmental report can also bring the environmental information about the online stores to their stakeholders and public. With the achievement and encouragement, the stores will devoted in further effort to save cost and reduce environmental impact.

6.3 Conclusion

The local E-commerce has potential negative environmental impacts. However, there is also possibility to green the local E-commerce to a better environmental friendly way. The realisation of the possibilities needs the efforts by the companies, the awareness of the normal people. The technical support and economic incentives from the government can contribute for reducing some of the negative impact brought by online grocery trade. The impact from the government on people's awareness could also contribute for a more sustainable consumption and living style in online grocery trade. With all the effort, the greening of the online grocery trade will be possible.

7. Case study in Lund

In order to apply the studies on local E-commerce in previous chapters, a case study is made with the actual situation in Lund and its emerging local E-commerce. The overall aim is to explore whether the local E-commerce contributes for the sustainable development in Lund. Furthermore, I will investigate how the local government of Lund can influence this development – how to "green" the local E-commerce.

7.1 Background of Lund

Lund is a town that appears to be well adapted for local E-commerce. It is a university town with young, well educated, "new" people. It also has an active atmosphere and is ready for new concepts. The acceptance of new technology concepts, such as online grocery shopping, is likely to be more quickly accepted here than elsewhere. In addition, computer literacy is exceptionally high in Lund.

Moreover, the local government of Lund is endeavouring in achieving sustainable transportation for Lund through the LundaMaTs project (LundaMaTs: Sustainable Transportation System for Lund). The local government of Lund and LundaMaTs has taken on a very interesting and unique challenge in trying to harness the development of local E-commerce for sustainable society in Lund.

7.2 Is Lund ready for the local E-commerce?

In order to understand whether Lund is ready for the development of E-commerce or not, and in order to apply the studies in the previous chapters, a survey was conducted for some of the inhabitants in Lund. Questionnaires on grocery shopping habits were distributed to 56 people in Lund, with the help of Per Hansson from local government of Lund. There were 24 respondents, giving an answer rate of 43%. The respondents in the survey were from the employees of the local government of Lund, Lund University (students and teachers), Trivector Company etc. Among the respondents, there were 5 respondents who have shopped online volunteered to join and share their experience. Among the other 19 respondents, 3 of them have experience of online grocery shopping while others have never tried. Although these respondents might not be interpreted to be the representative of Lund, the results of the survey may help understand people's shopping behaviour. The results could also be used as reference for the potential development of local E-commerce in Lund.

The questions cover the aspects of the respondents' shopping habits with or without online grocery shopping experience on (Refer to appendix 2).

- Conventional grocery shopping habits;
- Attitude towards conventional shopping;
- The benefit and the limitation of online grocery shopping.

7.2.1 Online grocery trade in Lund

7.2.1.1 Online grocery stores

In the city of Lund, there is one online grocery store, which can offer its customers to purchase groceries from its homepage: Malmborgs in Lund. It also has own delivery service, which charge 80 SEK for each order (40 SEK for picking and 40 SEK for delivery). Malmborgs in Lund's online store is based on its conventional store, which is located in the town of Lund. The customers they serve are the inhabitants living in the city of Lund (Holst, 2000).

Matomera, which is a pure online grocery store with warehouse located in the industrial area of Malmö, also has its customers from Lund (Johnsson, 2000).

7.2.1.2 Online grocery customers

Of the 24 respondents, 8 have experience of shopping groceries online. The online grocery store all of them have tried is Matomera. Although the percentage of the online grocery shopper in this survey can not represent the actual percentage market penetration of online grocery trade in Lund, it tells the facts that there are already online grocery trade and online grocery customers existing. These 8 people will not be the only online grocery shoppers in the city. Many of respondents, especially the respondents with online shopping experience state that some of their friends also have experience in online grocery shopping.

7.2.2 Acceptance of online grocery trade

With good prerequisites for E-commerce in Lund, and great expectation for a huge market expansion, it is still questionable whether the citizens of Lund will accept this way of shopping or not. In order to understand people's acceptance and eagerness for online grocery trade, the respondents were asked about their attitude towards conventional grocery shopping, their will to have change and whether they want to accept the online grocery shopping.

7.2.2.1 Attitude towards conventional grocery shopping

The respondents' attitude towards the conventional grocery shopping is described in figure 7-1.

There are about 39% respondents like conventional grocery shopping while 44% dislike. The others include the respondents between like and dislike. As we discussed in section 2.2, the people dislike grocery shopping will be more prone to try the online grocery shopping.

For the people who dislike grocery shopping, most of them (about 89%) state of reason of 'wasting time'. About half of them (56%) treat the grocery shopping boring while 33% of them think it cost too much energy.

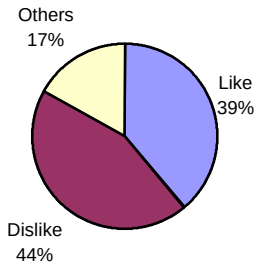


Figure 7-1: *Attitudes towards conventional grocery shopping*

7.2.2.2 The will to try alternative shopping experience

It is interesting to know whether the people dislike conventional grocery shopping want to try an alternative shopping experience in order to reduce their original shopping. The respondents, who dislike the grocery shopping, were asked about their will to try an alternative way to reduce their original shopping. Nearly 30% of the respondents want to try immediately. More people (about 45%) want to consider the cost first. About 15% respondents want to see other people's experience. At the same time, there are some respondents (about 15%), who state that they do not want to try the alternative.

7.2.2.3 When will try online grocery shopping?

The respondents, who do not have experience in online grocery shopping, were asked to expect when they will go grocery shopping online. The results are shown in figure 7-2.

Most of the respondents (about 77%) express that they will try this shopping experience in the future. With the people who will try, most of them (about 90%) want to try within 2 years. About one quarter of the respondents (23%) do not want to try the online grocery shopping.

We should be conservative when interpret the results above. First, the statistics above could not represent all the inhabitants in Lund. Secondly, even the respondents express that they will go shopping online, the actual online shoppers might be less than their expectation due to many factors, such as time, facilities, change in interest, other people's impression etc. However, the results indicate that there are some people who want to try online grocery shopping in the future.

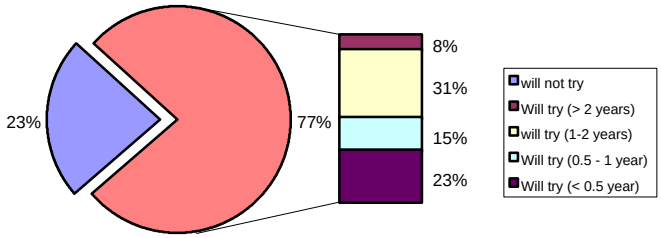


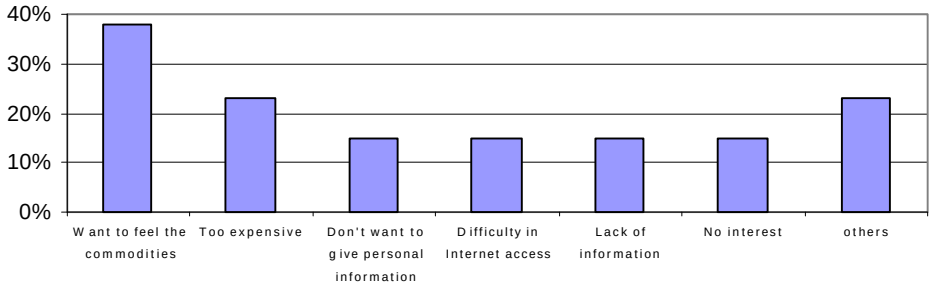
Figure 7-2: *When will try online grocery shopping online*

7.2.3 Limiting factors in online grocery shopping

There are factors limiting the people from trying the online grocery shopping. For the people who have experience on shopping online, there are also other hinders and limitations.

7.2.3.1 The reasons for having not tried online grocery shopping

The respondents are asked about the reasons that they have not tried the online grocery shopping. There are many various answers. The results are shown in figure 7-3.



* Other reasons include complicated, not necessary etc.

Figure 7-3: *The reasons for having not tried online grocery shopping*

Want to feel the commodities before purchasing

The number of respondents who want to feel the commodities is more than other reasons. The conventional shopping behaviour is still dominating. We have to admit that the online grocery trade will not replace the conventional grocery trade.

However, there are many brand groceries available at online store, such as can, packaged pasta, sugar etc. Purchasing these commodities do not need to try and feel by self. Such commodities might be accepted by the people to purchase online while they will continue shopping of other commodities, such as fruit, vegetable etc. in conventional stores.

Difficulty in accessing Internet

Although the Internet coverage in Sweden is high, there are still half of the inhabitants who do no have access to Internet. This is one of the obstacles in the development of E-commerce.

However, the Internet coverage is increasing. Swedish government is investing to facilitate the Internet access for the public. For example, broad band is being installed across Sweden. It is believed that the Internet access will be wider and easier in the future.

Price

More than 20% of the respondents think shopping online is more expensive than shopping in the conventional stores.

As we discussed in section 2.2, usually, the online grocery stores only charge for the delivery fee for the orders. The prices of their groceries are similar to the conventional stores. Most of the customers do not count their expenditures on car and fuel as the cost for their conventional grocery shopping. However, those costs might be possible to exceed the delivery charge because the fuel price and car taxes are very high in Sweden. If the customers realise the difference between actual expenditure on conventional grocery shopping and the online grocery shopping is small, or if the stores can prove their delivery charge is similar or even less than customer's own expenditure on private transport, the reason of 'expensive' will be weaker. Secondly, as we discuss in Chapter 3, with the increment in the amount of sales and turnover, the online stores will be able to achieve efficient operation and therefore to reduce cost. Hence it will be more possible for the stores to offer more attractive prices for their customers. Furthermore, online grocery shopping can save customer's time on conventional grocery shopping. If their time saved can be calculated as value, the online grocery shopping will not be treated as expensive anymore.

Security

Some respondents have not shopped online because of the security consideration: they do not want to give out their personal information.

As we discussed, the E-commerce has been developing too quickly to be mature in all the aspects. The security is one of them. However, efforts are being done to improve the security for the business and the customers in E-commerce. The regulations will be established to ensure the protection for the customers in E-commerce (Swedish government, 1999). The act on qualifying the electronic signature, in order to facilitate and protect the E-commerce will also be taken into action soon. With more related law and regulation, the customers will feel safer to participate the E-commerce, including the online grocery trade.

Lack of information of online store

Lacking of the information of the online store is one the reasons that some people have not tried online shopping.

However, it is obviously that the online stores will make all their effort through all the marketing channels to publicise themselves. As the number of the E-customers is increasing, the information of the online store will also spread by the existing customers to the potential customers.

Lack of interest

We should admit that not all the people would welcome the online grocery trade. Some people do not like to accept such new technology. Some people maybe do not like computers. Some people maybe like the atmosphere and social contact in the grocery stores. People have freedom to choose the shopping they like.

7.2.3.2 The difficulties in online grocery shopping

For the respondents who have experiences in online grocery shopping, there are also some difficulties in constraining their shopping online. Of those respondents, about 50% of them feel the information about the groceries is not enough, about 25% feel the prices are too high, about 25% feel that the supply of the groceries is not enough. Someone also feel that some foods are not fresh enough.

Most of the limitations stated by the respondents are about the service of the online stores. The online grocery stores are new established and lack of experience. However, the stores have strong will to imporve their service in order to attract more customers and more sales. They will improve their service according to customer's requirement by more communication (Johnsson, 2000). Therefore, we can tell that the current difficulties online grocery shoppers met today will be reduced. Online grocery shopping will be more convenient in the future.

7.2.4 Conclusion

Although the respondents may not be able to represent all the inhabitants in Lund, they can reflect part of the realities. From the results of the survey, we can tell that at least some people in Lund are preparing to participate in the online grocery trade in the near future. The number of the E-customers will increase. The obstacle and difficulties for online grocery shopping will be resolved or partly reduced by the development and improvement of the network construction, regulation environment and online grocery trade itself. Therefore, we can draw the conclusion that the emerging of the local E-commerce is coming to Lund.

The residents in Lund are relatively well prepared for local E-commerce. With a potential market, the online grocery trade will emerge in the city of Lund. The obstacles for the online grocery trade will be reduced by the development of E-commerce and its environment. Therefore, the local E-commerce will most likely expand within a near future in Lund.

7.3 The impact of local E-commerce on the sustainable transport system in Lund

Since the beginning of 1977, the local government of Lund has been conducting a study on the possibility of creating an environmental friendly transportation system for the city. From 1997, LundaMaTs, the project for sustainable transportation system in Lund, was launched. Since the local E-commerce is emerging in Lund, it is important to understand whether the local E-commerce will be harmonised with the transportation system. Furthermore, it is also interesting to know whether the local E-commerce could be harnessed to contribute for the sustainable transport system in Lund.

7.3.1 LundaMaTs – sustainable transportation system in Lund

LundaMaTs is the name of the project for sustainable transportation system in Lund. The main targets of LundaMaTs are to reduce the total amount of traffic, minimise the use of non-renewable resources and reduce the greenhouse gas emission.

There are five major reforms designed in LundaMaTs. These five reforms include 'town and country planning', 'the bicycle friendly town', 'extended public transportation', 'environmental friendly car traffic' and 'commercial and industrial transportation'.

Town and country planning

Anticipatory local authority planning can assist in reducing the total amount of travelling necessary (SNEA, 2000). This is because proper land-use planning could integrate people's commuter (such as from home to office or from home to shop) in an area within the radius of bicycling acceptable distance. Therefore, the necessary for car driving is decreased.

The bicycle friendly town

Lund is one of the most bicycle-friendly towns in Sweden. This reform aims at further improving the situation for bicycles. The projects for this reform include 'high priority to bicycle traffic', 'improving infrastructure by creating an extensive network of pathways for bicycles', 'organisation improvements', 'maintaining bicycle safety' and 'scientific evaluation'. The bicycle traffic in the urban area of Lund can be increased (Trivector, 1998). As the increment in bicycle transport, the necessary and amount of car transport would be decreased.

Extended public transportation

This reform aims at reducing dependency upon private cars through public transportation (Trivector, 1998).

Environmental friendly car traffic

This reform aims at making the trips taken by car more environmental friendly. It includes changing people's driving behaviour, parking management strategy, stimulating car-pool etc. (Trivector, 1998). These actions could reduce the total amount of private car driving and car emissions.

Commercial and industrial transportation

This reform aims at making transport by firms more environmental friendly (Trivector, 1998). It promotes the efficient goods transportation, employees' environmental friendly transport by carpooling, car sharing, utilising public-transport and etc.

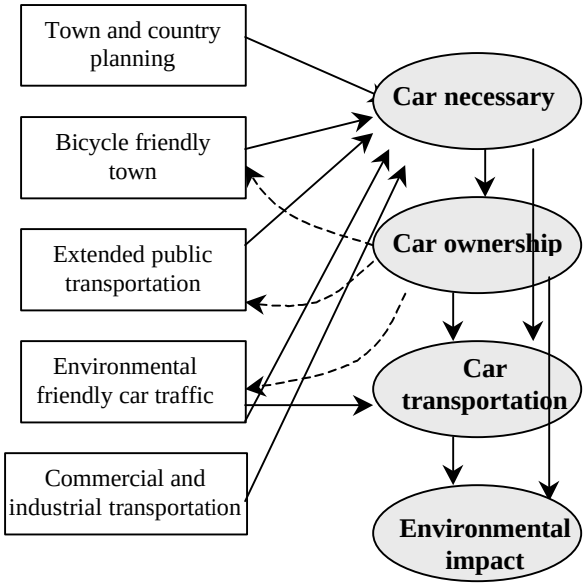


Figure 7-4: *The implication of LundaMaTs reforms*

7.4 LundaMaTs and local E-commerce

The implementations of the LundaMaTs reforms are all aiming to reduce private car usage. In turn, this may decrease the car ownership and decrease the amount of car transport with positive environmental consequences as previously discussed.

7.4.1 Local E-commerce for LundaMaTs

Local E-commerce for 'Environmental friendly car traffic'

Since the car transport grocery shopping is mostly short, it will have higher emission levels than average due to the working facts of catalytic converters (Johansson, 1995). Online grocery trade can be used to replace such short and higher emission transport by its integrative delivery system. Therefore, the higher polluting car transport will be decreased. It will meet one of the projects 'Changing of attitudes and behaviour so that car are driving in a less polluting way' in the 'environmental friendly car traffic' reform of LundaMaTs (Trivector, 1998).

Since there is no need to use the private car for grocery shopping, this local E-commerce will not stimulate more demand on private cars. It will contribute to keep the lower car ownership of Lund.

As we discussed in Chapter 3, the local E-commerce will decrease the usage of a car. Therefore, the need for a car is also decreased. Such lower usage of car and lower requirement for a car will be more feasible for stimulating a carpool project with such situation, which is also part of the 'Environmental friendly car traffic' of LundaMaTs.

Local E-commerce for 'Commercial and industrial transportation'

Since it is stated that "It is believed that the stores have greater possibilities to fill up the delivery trucks and to plan shorter and more effective routes than the households" by Trivector AB, a 'home delivery' project is listed as part of 'Commercial and industrial transportation' reform of LundaMaTs. The studies in Chapter 5 in this thesis might be helpful in finding a suitable home delivery system in Lund. If the design of the delivery route is shorter than the critical distance for energy consumption and emission levels, the delivery will contribute for a sound environment. Since the population density in Lund is high, it will be easier to achieve a more efficient delivery system. There are many individual houses. Home delivery system can be used for delivery to such houses. There are many densely residential areas with multi-storey apartment buildings. The pick-up point delivery system could apply for such area. There are also many big companies with many employees in Lund, such as Tetra Pak, Ericsson etc. Office delivery might work fine with such area. (As seen in figure 7-5)

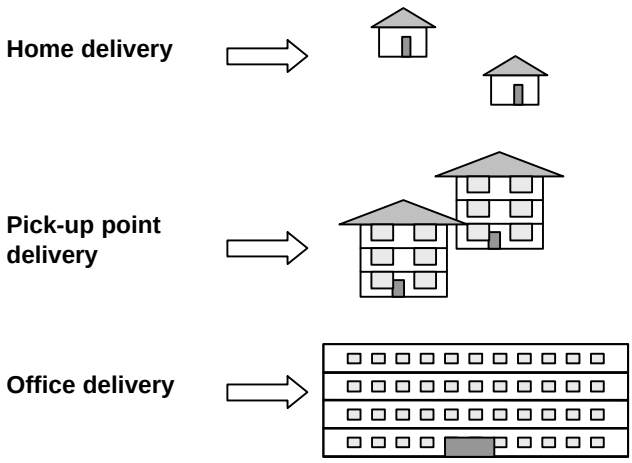


Figure 7-5: *Delivery system for Lund*

The actual design needs more detailed geographic facts, data and other statistics. The design of the delivery route also need to be aware of the actual emission level since diesel engine will have higher NO_x and PM emission levels. If the diesel engine will be improved or the replaced by other cleaner engine or fuel, the delivery system will be more effective and environmental friendly.

7.4.2 LundaMaTs for local E-commerce

'Commercial and industrial transportation' for local E-commerce

As discussed in Chapter 6, local E-commerce does not necessarily induce only positive environmental impacts, and may lead to rebound effects, such as the increased transportation in the JIT delivery system. The 'Co-ordinated distribution' project in 'Commercial and industrial transportation' reform of LundaMaTs can help the local E-commerce to reduce part of the problem. The JIT delivery system is easy to have empty space and empty back in their transport. The space, transportation, energy consumption are wasted. If these empty spaces can be used, it will reduce the transportation for other deliveries. The municipality's role in this reform is to initiate such project and serve as catalyser for the co-operation between the transportation firms and their customers to achieve full load (Trivector, 1998). With the catalysed co-operation with other firms, the side effect of the JIT delivery system in local E-commerce will be reduced.

7.4.3 Conclusion

To reduce private car transportation is one of the major targets in LundaMaTs. However, people still need to purchase the groceries to fulfil their need. Online grocery trade's home delivery could be used to fill in such a gap. When delivery system is well designed for different area in Lund, when the delivery route is designed within the critical distance, when the emissions from the delivery vehicle is controlled, the local E-commerce will be compatible with the LundaMaTs. The LundaMaTs will also contribute to eliminate part of the side effect in the local E-commerce. With the optimised the co-operation between LundaMaTs and local E-commerce, it is possible to achieve a more sustainable transport system in Lund.

7.5 What can the local government of Lund do?

The local government of Lund should realise that the local E-commerce is coming. The increment of the local E-commerce could be predicted. Therefore, the local government should be aware of the possibilities of what the Local E-commerce could bring, both positive and negative as discussed before. And in order to achieve better environmental performance, there are some methods that Lund Municipality can do for a greener local E-commerce:

- Suggesting paper-free information style

  This could includes the

  - Informing people about the consequences of paper consumption, such as de-forestry, pollution from papermaking and greenhouse effect.
  - Suggesting people to accept the paper-free or less-paper life style, such as accepting digital newsletter rather than paper newsletter
  - Suggesting the companies to use paper-free information distribution: such as the digital information distribution
- Co-ordination and suggestion for the delivery service

  The local government could suggest the E-commerce business to choose combined delivery system, such as Posten. A combined delivery and making use of the existing vehicles for delivery should be encouraged. The local government could also act as the co-ordinators of the transportation firms and the companies to have instant freight transport information exchange to achieve the most possible full load of goods transport in order to reduce the side effect brought by JIT deliveries.
- Environmental requirement on delivery companies

  The local government could have environmental requirement on the environmental performance of the delivery companies in order to avoid delivery company's using heavy polluting vehicles or fuels. The

adopting of cleaner vehicles and cleaner fuels could be encouraged by economic incentive, such as related tax policy.

- LundaMaTs projects

  The local government of Lund can act as a co-ordinator and catalyser to promote the co-operation in transportation of goods. The local government can encourage the transportation firms and the companies to have instant freight transport information exchange to achieve the most possible full load of goods transport in order to reduce the side effect brought by JIT delivery systems of local E-commerce.

- The increasing E-shopping behaviour might have more need for carpool. The municipality could continue implementing its original carpool project in LundaMaTs project and the project could be expanded according to the requirement.

8. Conclusion and Recommendation

The local e-commerce, particularly online grocery trade, provides us with the opportunity to design a system that has a more efficient management, lower material consumption, produces less waste, and a more efficient delivery system, as compared to the traditional way of shopping. If these promising gains are realised, a larger market share of the local e-commerce would raise the chances to achieve these efficiencies. Economic and environmental savings would go hand in hand. However, it is hard to predict whether local e-commerce at the same time would trigger other more resource-consuming behaviours or not. Therefore, it is important to closely study how the potential improvements could be gained, and how to avoid the negative impacts from the so-called rebound effects.

By studying something that is most likely only an embryo of the expectedly booming online grocery trade, it is hard to make too far-reaching conclusions from this limited study. I would, however, like to share some thoughts on what could be done, to move this development in a more sustainable direction.

Cooperation

First of all, I believe that a more proactive 'Greening' of the local e-commerce, have to be a joint effort between the businesses' own initiatives, consumers, as well as local and national authorities. The issue is complex and involves many parties, hence one actor alone will have difficulties in changing something that affects the whole society. This could be materialised as a working group involving different stakeholders. The local government may be a good coordinating partner in such a group.

Awareness

Bring the environmental issues up on the agenda. Make the business sector, consumers, government and local authorities aware of the environmental potential of e-commerce, and their roles in influencing the environmental performance. It is important that the environmental gains are not taken for granted. With an environmentally conscientious approach for the design and implementation of local e-commerce, this development could significantly contribute to a more sustainable commerce. This is also true for the customers. By providing information of the environmental effects from different shopping options, customers are able to incorporate the environmental parameter as well.

Market penetration

It is far too early to tell how large share that e-commerce will of gain out of the total local market. What we can tell is that customers now have another option, and that this option is likely to grow, regardless of the environmental implications.

Should Local e-commerce be promoted using environmental arguments? This thesis indicates that there are both potential positive and negative effects, making it hard, or even impossible, to say yes or no. I believe that by accepting the development and actively follow and influence the environmental implications, this growth could be one of many steps toward a sustainable development.

Further research

It is believed that the development of e-commerce will shorten the distance between the producers and the customers. In e-commerce of groceries, it is possible to connect the wholesalers, as the distribution centre, directly to the customers. Therefore, one step in the product chain will be surpassed. Even though this kind of relationship has not been realised, yet, its potential economic and environmental benefits make the solution an interesting candidate for further research.

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Abbreviations

B2C	Business to customer
B2B	Business to business
IT	Information technology
JIT	Just-in-time

Appendix 1 Calculation for transport energy consumption and emission levels

Energy content in fossil fuels

Fuel (l)	Energy content kWh/l
Gasoline	8.72
Diesel	9.77

Source: Svenska Gasolineeum Institutet [Swedish Institute of Gasolineeum], Homepage at: http://www.spi.se

Energy consumption and environmental emission level

Type of vehicle	Fuel (l/km)	Energy	CO_2 (g/km)	NO_x (g/km)	HC (g/km)	CO (g/km)	PM (g/km)
Private car							
Gasoline (Cat. *)			213	0.37	0.57	3.87	0.01
Gasoline			213	2.53	5.07	23.34	0.03
Diesel			202	0.52	0.13	0.30	0.15
Average	0.1	0.87	213	1.11	2.03	10.22	0.02
Delivery van (3.5 ton)							
Gasoline	0.28	2.44	650	0.098	0.203	1.47	0.005
Diesel	0.18	1.76	468	0.497	0.147	0.497	0.098
Average		1.96	523	0.38	0.16	0.79	0.07
Truck (14 ton)							
Average	2.75	2.69	676	11.59	1.15	1.61	0.54

*: Catalytic converter.
Source: (Orremo & Mallin, 1999)

Appendix 2 Questionnaire on grocery shopping habits

Questionnaire on grocery shopping habits

General questions

1. Budget food and other groceries per month
2. Household
3. Do you like shopping in the grocery stores?

___Yes, I like grocery shopping, Because:

❑ Fun ❑ Support local trade ❑ Like the atmosphere in shops

❑ Killing time ❑ Try to make good use of my budget ❑ Other _____

___No, I do not like shopping to grocery stores, Because:

❑ Cost too much time ❑ Too much energy ❑It is routine shopping, too boring.

❑ Other _____

If there is any alternative to reduce conventional grocery shopping, such as home delivery, Internet shopping etc, you will

❑ Try without hesitation, even a little more expensive ❑ Depends on how it cost.

❑ Will try after other people's experience ❑ Other _____

4. Have you tried Internet shopping/E-shopping for groceries?

___Yes, I have.

❑ Less than 0.5 year ❑ 0.5 – 1.0 year ❑1.0 – 2.0 years ❑ More than 2 years

Reasons to buy from Internet grocery shops

❑ Convenience ❑ Save time ❑ Less car usage ❑ Commodities are cheaper

❑ Fun. ❑ Other _____

___No. I have no experience in E-shopping for groceries. Because:

❑ Difficulty in Internet access ❑ Do not want to give my personal information

❑ Too expensive ❑ Want to feel the grocery by self before buying ❑ Not interested ❑ Other, _____

But, I might try

❑ In half a year ❑ In 0.5 to 1 year ❑ In 1-2 years ❑ In more than 2 years

❑ I will not try Internet shopping for groceries

Conventional shopping habits

* If you have experience in E-shopping, please answer according to how did you do shopping before the adoption of E-shopping.

Name of grocery store(s)	Distance to home	When to go	How often?	How to go **	How long per shopping? ***	How much to buy each time (value)

** Walk, bike, bus, train, car, carpooling or else __ If by car, which fuel _____

*** Including travelling time and shopping time

❑ Do/did you do you shopping on the way back from office to home?

Online shopping habits

How many e-shops for food and daily groceries do you know in Lund Municipality?

Which Internet grocery store(s) do you order your food and other groceries

1. E-shopping

Shop_____ How often: _____ (how many times per week?)

1.1 When do you do your e-shopping usually?

1.2 What do you order from online grocery store(s) in general?

- ❑ Food ❑ Household goods ❑ Except _____
- ❑ Others _____

Why?

1.3 How much do you order in average? _____

How many percent to your monthly grocery budget _____

1.4 Where do you want the shop(s) deliver the commodities?

- ❑ Home (Evening / Daytime / weekend / other _____)
- ❑ Workplace ❑ Pick-up point ❑ Others _____

1.5 What benefit have you got from E-shopping?

- ❑ Saving time ❑ Saving energy ❑ Save fuel consumption
- ❑ Other _____

With the time saved, what will you do?

- ❑ Driving to other places ❑ Stay at home ❑ Other

What limit your E-shopping?

- ❑ Difficulty in accessing to Internet ❑ Categories not clear enough
- ❑ Difficulty in searching ❑ Too expensive
- ❑ Interface not user friendly ❑ Food are not fresh
- ❑ Delivery service is not good enough ❑ No take-back service
- ❑ Other _____

1. Supplemental shopping besides E-shopping.
   Will you go to other supermarket besides your online shopping?

Name of grocery store(s)	Distance to home	When to go	How often?	How to go **	How long per shopping? ***	How much to buy each time (value)

Other questions

Other home shopping (Such as telephone shopping, fax shopping etc.)

- ❑ Is there any other home shopping have you done?
- ❑ Is there any other home shopping will you do in the future?

Organic products

- ❑ Do you pick organic food/environmental label products in purposely?
- ❑ Do you think it is easier for you to choose such products when doing e-shopping?
- ❑ Do you buy more organic products in E-shopping?

Shop newsletters: (advertisement)

- ❑ How much newsletters/advertisement (shop pamphlets) will you receive each week?
- ❑ How much do you use them? (Percentage)
- ❑ In E-shopping, do you have such paper-newsletter?
- ❑ If you do E-shopping, do the shops have such advertisement?
  - ❑ If yes, how? ❑ Paper newsletters ❑ On homepage ❑ Newsletter by email
- ❑ Which way do you prefer?

Future e-shopping

- ❑ Do you think you will increase your e-shopping in the future?
- ❑ Do your friends have E-shopping experience?

If yes, how many percent of your friends do online grocery shopping?

Environmental awareness

- ❑ Do you think you are environmental concerning person?

Other suggestions

Appendix 3 Comparison between conventional local commerce and local E-commerce

	Conventional Commerce	**E-commerce**
Business to business		
Internal management	Regular management	Logistic management by IT
Information exchange	Via fax, telephone, postal mail etc.	Via Internet
Product catalogue	Printed catalogue	Digital catalogue
Invoice	Paper-based invoices	Digital invoices
Inventory system	Regular stock inventory	JIT inventory system
Grocery store		
Inventory	Make inventory according to experience	Automatic order processing, JIT processing
Warehouse	Close to customers Parking space for customer Storage area and shopping area Wider aisles for walking Shop's decoration, lighting Open refrigerator Cashier, monitoring system	Outside of the town No parking space Only storage area More compacted storage No decoration, less lighting Compacted refrigerator No cashier, no monitoring
Operation	More personnel for cashier, safeguard	More personnel for computer maintenance, order processing, picking and delivery
Business to customer		
Marketing	Paper-based marketing	E-marketing
Interface	Shopping area	Online store's homepage
Shopping	Own transport to stores	Shopping online, delivery

Appendix 4 Potential rebound effect from local E-commerce

Issues to consider	**Possible solution**	**Stakeholder's impact**
Appliances for E-commerce environment	Realisation of efficient operation	Business to business E-commerce, logistic company
Inefficient operation in online grocery store	Increase sales, turnover	Online store, conventional grocery store, other online store, customer, government
Side effect of JIT delivery system	Co-ordinated distribution Internet auction Tax regulation	Transport company, Internet-based auction company, government
Overlapped deliveries	One delivery agent	Online grocery stores, local government, transport company
Paper-based marketing	Customer's awareness to adopt digital newsletters Store reduces paper-based marketing	Local government, store, customers
Energy consumption and emissions from delivery	Logistic design of delivery route, cleaner vehicle and fuel	Online store, delivery agent, government, academic organisations
Extra transport by customers	Less private car usage	Local government, customers