Investigating the possibility of a coordinated goods delivery service to shopping centres in Uppsala city to reduce transport intensity

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Abstract

The current paper reports the results of the investigation made to determine the possibilities of promoting a coordinated goods delivery system to various galleria, located in the city centre, to reduce congestion and environmental impact.

Uppsala is the 4th biggest city in Sweden and has a very narrow city centre. Increasingly frequent goods delivery performed by less than half-loaded distribution vehicles lead to the consequences of congestion, traffic accidents, and pollution, particularly in the city centre. It was assumed that a co-ordinated distribution system is among the plausible strategies to address the current problem.

The objective of the work is investigate the possibilities of a co-ordinated distribution system in Uppsala city using a 'city goods terminal', which should be located at the suburb of the city. To reach the objective, the activities performed were: (a) mapping out goods flow to the four main galleria that are located in the city centre, (b) conducting a demonstration trial of coordinated distribution, and (c) determining constraints and possibilities of coordinated goods distribution.

97 transport companies delivered goods to these galleria. 15 to 60 deliveries were performed per day to each galleria and intensive deliveries were made before and during lunch. About 43% of the delivered goods were food including bread, brewery and dairy products, fruits and vegetables and about 69% of food deliveries were made before 11 a.m. Queue time was significant and the actual unloading time was found to be less than 50% of the duration of the delivery.
Nine boutiques participated in the small-scale demonstration trial on coordinated goods delivery from the terminal to galleria and it continued for a year. Goods were first delivered from suppliers to the terminal that was situated at the suburb of the city and thereafter to the galleria according to the time specified by the retailers. The result of the mapping activities indicates that transport system can be effective through coordination. The practical demonstration also confirmed this. In the current trial, the number of deliveries reduced by 40% through coordination.

The main conclusion of this work is that information, communication and change of attitude play central roles to promote coordination, and dialog between retailers, distributors and suppliers is necessary and essential.

1 Introduction

Transport plays an important role in stimulating economy. However, transport activities are among the major factors that contribute to problems associated with environment (in the form of pollution), health and traffic safety. In accordance with international directives, the Swedish government has decided to reduce CO₂-emissions by 25% by year 2010, or should remained at the level of CO₂ during 1990. However, CO₂ emission from transport has been increased by 20% in Uppsala from 1990 to 1999.

Uppsala is the 4th biggest city in Sweden and it has a very narrow city centre. Besides the local wholesalers, many other suppliers are distributing their goods in Uppsala. Currently, it is very common that half or less loaded vehicles from different transport companies are queuing up in front of shops or at shopping centres to deliver specific goods in time. Traffic intensity increases steadily in the city (increased by 10% between 1990 to 1999), and many of the retailers are concentrated in and around shopping centres in the city centre. As a consequence, congestion in the centre of the Uppsala is increasing.

To break such a tendency, the promotion of a co-ordinated goods distribution through application of the third party terminal with effective utilisation of IT is among the plausible strategies to attenuate the transport work in the goods distribution sector.

Coordinated transport within health sector in Borlänge administrative region in Sweden reduced the number of vehicles from 204 to 68, while the possibility to transport individuals increased by 30% [1]. After conducting field measurements and simulation, Gebresenbet [2] reported that the number of vehicles that distributed food in Uppsala region could be almost halved in case of coordination. However, the main constraint when implementing coordination was un-willingness to change the system. The study made in the city centre of Göteborg [3] in Sweden concluded that unless forced measures were associated, coordination couldn’t be implemented.

The objective of the work is to investigate the possibilities of a co-ordinated goods distribution system in Uppsala city using 'city goods terminal' which should be located at the suburb of the city.
2 Method

To reach the objective, the activities performed were: (a) mapping out goods flow to the four main gallerias that are located in the city centre, (b) conducting a demonstration trial of coordinated distribution, and (c) determining constraints and possibilities of coordinated goods distribution.

A questionnaire, concerning the current distribution system, was distributed to 89 retailers at the initial phase, and measurements of goods delivery were made at four galleria for 174 hours and 508 deliveries were registered. The field trial was depending on the retailers’ voluntary participation. They were offered coordinated distribution via a terminal at no extra cost. They only had to change their delivery address when ordering goods and inform the terminal of their participation, address and desired time of delivery. To attract the shops to participate in the system, a marketing campaign was carried out. The campaign was built mainly on personal contacts, per telephone, visits and information meetings. The primary targets for the marketing activities were the local shop owners and representatives, but also chains and dealers’ associations were contacted. Interviews were made with the locally based transport companies, to obtain information on their distribution systems and their opinions on transport coordination. After the field trial interviews were made with all the participating retailers and the involved staffs at the terminal.

3 Results

3.1 Questionnaire and interview study

The average response frequency of the questionnaire study was 29%. The responses showed that the retailers were generally satisfied with the current goods delivery system. However, the problems noted were delivery at non-suitable time, very frequent delivery, queues, and air pollution at the delivery points. The timing of deliveries caused problems since the staff often had to leave the shop to receive goods during the busiest lunch-hours. The large number of small deliveries were also mentioned as a problem. Environmental issues were seen important, but not as important as quality and safety of the delivery service. Suggestions to improve the delivery service included improved goods tracking possibilities, faster delivery, better service and delivery at fixed times.

The interview investigation showed that most of the transport companies were positive for the development of a coordinated goods delivery system in the city. However, most transport companies tended to valuate their own distribution system as rather effective.

3.2 Measurements at the delivery points

During the measurements at the delivery points of four shopping centres, a total of 508 deliveries and 62 vehicle stops for other reasons were observed. Goods delivery was done in different ways according to delivery contract. However, the
most common sequence were as follows: arrival – queue – parking – contacting the addressee – unloading – delivery signature – loading of return goods and packaging – departure.

Most remarkable were the bread deliveries, as the drivers occupied the delivery bay while price marking as well as placing the bread on shelf inside the shop. This had a major impact on the duration of delivery, and it will be presented later in the text.

3.2.1 Amount of goods
The four shopping centres, mentioned above, received between 14 and 44 goods deliveries per day during the observed period. Average daily deliveries are described in Figure 1. In general, the deliveries were rather small. Packages accounted for the major part of the number of deliveries even though pallet and cage deliveries provided the goods volume. Among the package deliveries, the smallest deliveries were the most common. The mean size of package deliveries was 5.4 packages. Deliveries of less than 5 packages accounted for two thirds of the number of package deliveries, yet only 27% of the total number of packages delivered (Figure 2).

![Figure 1: Average number of deliveries and goods by different loading units, per day](image1.png)

![Figure 2: Delivery size distribution for different loading units](image2.png)
3.2.2 Frequency and duration of deliveries
The goods deliveries were concentrated to morning and lunchtime and 58% of the deliveries arrived before noon. The St Per galleria received much more deliveries than the others, and most of them in the morning hours. Forum had also most of its deliveries in the morning, while Fenix and Svava had their peaks during lunchtime (57% of the deliveries to Fenix arrived between 11 a.m. and 2 p.m.). Especially, grocery distribution was highly concentrated to the morning hours, 69% arriving before 11 a.m.

The mean duration of delivery was 13.4 minutes, varying widely between 1 and 82 minutes. Bread deliveries had a mean duration of over 18 minutes and were the most common over 50 minutes. No significant correlations between amount of goods and delivery duration were seen. During the observations in Fenix, the time used for different activities of each delivery were registered and it was shown that the actual unloading activity was responsible for only 43% of the total delivery duration. The time used for unloading, contacting boutiques' staffs and other activities accounted for 4.2, 3.6, and 1.9 minutes, respectively. No queues occurred during the observations.

The concentration and duration of deliveries resulted in queues, frequently observed at the delivery points. Using the registered times of arrival and departure to determine if queues occurred, and comparing the duration of delivery with and without queue, queues were found to have an impact on the duration of deliveries (Figure 3).

3.2.3 Transport companies
A total of 97 transport companies performed the 508 observed deliveries. These transport companies are displayed in order of frequency in Figure 4. Most companies were observed only at one single delivery.

Figure 3: Number of observed deliveries (a) and duration of delivery (b), with and without queue
3.2.4 Load rate

The load rate distribution varied widely, ranging from 5% to 100%, with an average at 40% (Figure 5). The observations of load rate were based on occupied floor space in the vehicles.

3.3 Coordination field trial

The response to the marketing activities for the coordination field trial was mainly positive. However, when requested to come up with a decision, most of them choose to wait for various reasons, and the most common expressions were as follows:

"We would like to see the system functioning in practice first", "We would participate, if only the others in the galleria also joined", "It sounds good, but we are quite content with the current system, and therefore don’t want to risk it", "Yes, fine, but we’re quite busy at the moment, please come back in a couple of months", etc.

At the end, 9 shops actually joined the demonstration.
3.3.1 Participants' opinions and experiences
The pilot demonstration study went on from May 2000 until May 2001. The participating shops joined successively during the period. One of them, however, withdrew after only a few weeks due to the reduced interest from the surrounding shops.

The predominant reason for participation in the trial was that the participants expected improvement of the delivery service, in terms of fewer deliveries at fixed times and avoiding lunchtime deliveries. Environmental concern was also mentioned as another reason for participation. According to interviews made with the participants, the deliveries actually were improved during the trial, mainly due to reduced number of deliveries. Even though the shops did not have all their deliveries coordinated, an average reduction of 40% was achieved.

Some problems also occurred during the field trial. Delays were rather frequent during the first one or two months and the promised delivery time windows were not kept. Moreover, problems with delays of more urgent deliveries occurred. Later on during the trial, the participating retailers experienced that the service successively improved.

3.3.2 Opinions and experiences of staffs at the terminal
It took some time for the terminal staff to adjust their routines so that the coordination could run smoothly. That was why it was impossible to avoid delays and at the same time deliver within desired time windows. After some time, however, the routines were adjusted, deliveries from the suppliers could be better predicted and the system performance improved.
4 Discussion and concluding remarks

Very few comparable studies of goods distribution have been conducted earlier, and therefore, this study made a valuable contribution to the field of distribution logistics. The different parts of the study contributed to a clearer picture of the system as a whole. The mapping showed that the existing delivery service was not very effective. A very large number of transport companies were involved in the distribution and a small goods volume accounted for a large proportion of the number of deliveries. Queues were frequent at the delivery points. The utilisation levels of vehicles were as low as in the previous investigations made by Gebresenbet [2], Kristiansson & Pettersson [3] and others. On the other hand, the shops would prefer fewer delivery stops, shorter time of delivery and fixed times of delivery. These findings put focus on the need, interest and possibilities for a coordinated goods distribution service in Uppsala city. Possible improvements to be achieved are:

- More effective use of vehicles through reduced numbers of delivery stops and vehicles, increased loading rate and shorter transport distance
- More efficient delivery through fewer and larger deliveries, on fixed times. Queues at the delivery points are avoided and the total time for delivery is reduced, to benefit of both shops and transport companies.
- Traffic and environmental improvements through reduced vehicle emissions, congestion and noise, improved traffic security and accessibility, which is a benefit for the shops.

The field trial was carried out successfully and showed that the proposed model for coordinated distribution is possible to realise. The coordination did function and no advanced technology was needed. At the same time, it was obvious that the approach to attract participants was not successful. Thus, the problem is rather social than technological. On the basis of the experiences from both the terminal staffs and participating and not participating shops, it could be concluded that for the coordination scheme to be successful, it is needed to address the following constraints:

- **Support** – involvement and interest from all relevant actors,
- **Extent** – enough goods volume incorporated to fill one vehicle per day,
- **Communication** – to enhance goods flow planning,
- **Flexibility** – possibilities to make exceptional arrangements for urgent deliveries, and
- **Competition** – transport companies operating under market conditions.

The main actors’ considered in the transport system all have benefits to gain from coordinated goods distribution, and they also have the possibilities to initiate the process. Transport companies may lower their distribution cost through initiating cooperation with other transport companies. Shop owners have the possibility to initiate the kind of coordination used in this study, while financing the local distribution has to be dealt with in cooperation with the involved transport companies who would also gain from making the system...
more effective. Official instances may also invoke coordinated distribution, through measures of control such as city centre zones with entrance fees or other restrictions.

The result of the mapping activities indicates that transport system can be effective through coordination. The practical demonstration also confirmed this. In the current trial, the number of deliveries reduced by 40% through coordination. The retailers were satisfied in general, but a few complained of delay of delivery. Improving communication between the terminal, boutiques and transporters may solve such a problem.

Coordination may promote the retailers so that they receive their goods at the specific time with reduced number of deliveries, and this could reduce staff resource requirement at goods reception/delivery point. However, they have not shown sufficient interest to be the driving force to initiate coordination.

A small number of companies control a major part of the goods flow. It will be possible to control a significant part of goods flow by co-ordinating the delivery system of these companies. To include others (many deliveries but smaller in volume), the retailers need to influence both the transport companies and goods producers (and wholesalers).

Possible arrangements for coordination are presented in Figure 6. While the ideal situation would be to have all goods coordinated at one single terminal (case b), this seems at the moment impossible to realise without forced measures. A more realistic scenario would be coordination involving a number of terminals (case c), at the same time improving the conditions for economic competition.

The main conclusion from the current work is that information, communication and change of attitude play central roles to promote coordination, and dialog between retailers, distributors and suppliers is necessary and essential.

![Figure 6: (a) Today's terminal distribution, (b) coordinated distribution with a single terminal, (c) coordinated distribution using multiple terminals; ■, terminal; ➔, transport](image-url)
5 References

