INNER-CITY EVENING DISTRIBUTION

An analysis of timesaving potential and environmental impact

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ABSTRACT

Inner-city night delivery has been tested by two companies in the grocery business in a pilot project in Stockholm, Sweden during 2005 - 2006. The aim with the project was to evaluate the consequences that night delivery will have on a number of factors, i.e., distribution time, environmental aspects, capital utilisation (personnel, storage facilities and vehicles) and working environment. This paper shows the results of the time- and environmental evaluation of the project as well as some experiences from a qualitative analysis of different stakeholders opinions of night distribution as a concept

The results show that the possible time saving is about 20-25 % when the delivery starts after 6 PM compared to morning delivery. The environmental benefits are in the same range for the specific traffic situation in this pilot action. A theoretical estimation show that the difference between driving in a cue at 33 km/h in average compared to 6 km/h for this kind of distribution vehicle can reduce the emissions with 50% per vehicle km for CO2 and 74% for PM.

The qualitative analysis shows that improvements can be expected with night delivery by improved utilisation of vehicles, personnel and delivery precision, if the actors are willing to change their routines and working conditions. There are, however, obstacles that needs to be overcome, e.g., changed working hours, correction possibilities for wrongly placed deliveries, etc. It is also an obvious risk of low vehicle utilisation and by that higher distribution costs if not enough shops accepts night distribution.

Key Words: Evening distribution, environment, congestion, timesaving, utilisation

1. INTRODUCTION

A pilot project investigating evening distribution has taken place during 2005 – 2006 in a Stockholm City district (Östermalm). The project was initiated by the Dialogue Forum "Framtida Handel" where different stakeholders in wholesale/retail business together with the government tries to support new and innovative concepts to reach environmental objectives (www.framtidahandel.se) in this business sector. The pilot project was a follow-up of a small test, in which the potential of evening distribution seemed promising. The evaluation work has been performed by Chalmers Energy Centre – CEC (www.cec.chalmers.se). Schenker Consulting was the pilot project co-ordinator.

A small international outlook (especially European) was made and the most recent results useful to the project in Stockholm can be found in the context of the EU-project NICHES (www.niches-transport.org). Night distribution has been tested in two cities, Barcelona and Dublin. The work in the two cities has had a special attention on noise issues, related to loading/unloading and driving activities. In Dublin, several types of vehicles and drivelines have been tested and the most applicable and realistic solution was low noise diesel engines (incl. handling equipment). Similar efforts have been performed in The Netherlands in the Piek Programme, which is a R&D programme to find good and acceptable solutions for night deliveries. However, the review showed no project with results from an investigation of time and environmental positive effects of evening distribution.

1.1. Scope

The scope of this paper is to present the results of time reduction potentials and the environmental effects through emissions to air from a real-life trial of evening distribution of provisions in a city district of Stockholm. Qualitative measures are also described on obstacles to overcome to realise the economic and environmental potential that exists with evening distribution.

2. METHODOLOGY

Quantitative and qualitative data have been collected mainly through inductive research. Two companies participated in the trial. One company delivered data on two different routs on a daily basis. Driving logs have generated trip times, stop times, location of shops, trip lengths and disturbances. To ensure that the driving logs was adequate and to get qualitative input from the drivers about the new working conditions the evaluators joined two of the distribution routs at an early stage of the trial. The companies had to design special dedicated routs for the shops that participated in the evening distribution trial. This implied that no normal morning routs were possible to use as reference cases. Due to requests from the shop keepers were most of the deliveries carried out in the evening during rush-hour and not as planned later in the evening when the traffic were less intensive. To evaluate the impact of late evening distribution and traditional morning distribution, fictive distribution routs with passenger cars were carried out on weekly tests at three occasions. The impacts of the congestion charges and the time of the starting point of the distribution routs have been evaluated. The evening distribution trial started one month before the introduction of the Stockholm congestion charges trial and ended almost two months after the congestion charges was stopped.

The second company faced working procedures problems related to union business and the trial were postponed for about 6 months. When the data collection was re-established it was holiday season and substitute drivers performed the deliveries. These drivers were not educated in the trial prerequisites and driving logs, which led to incomplete data from this period. The experiences from this test have resulted in useful qualitative data on unforeseen barriers and obstacles. However, the incomplete quantitative data has only been used to verify the results from the first company.

The environmental assessment was carried out by using the average speed for the different routs as input to the HFEBA emission calculation model (2004). The HFEBA model is used in several European emission models, e.g., the ARTEMIS project, that has the aim of harmonising the different national calculation models in Europe. The HFEBA is based on statistical data on different driving conditions, topography, vehicle quality, traffic situations etc.

The qualitative analysis comprises of the following parts. A literature study of international experiences has been carried out. A SWOT-analysis was made in a group discussion, where the opinions of the different stakeholders in the area about evening distribution as a concept have been identified. Additionally personal interviews have been carried out. It has made it possible for the actors involved to bring forward both negative and positive views on how the pilot project had been realised.

3. Effect on distribution time

Two different routs were analysed and the results show two clear trends. The first trend is that the congestion charges have significant impact on the distribution time and the second is that if the starting point is after 18.00 hour, the distribution time consumption drops significantly. The effect on the distribution time that the day of the week has was also evaluated. However, no clear trend could be noticed from this analysis. The average time and standard deviation has been calculated for each case, i.e., before, during and after the congestion charges and for the hour the distribution route starts respectively.

3.1. Effects due to congestion charges

For the first route, 75 observations were made. The results show that the distribution time increased significantly after the congestion charges were removed. Before the congestion charges were introduced were the delivery time even slightly shorter than during the charges. The reason for that can not clearly be explained from the data. One possible reason is that the number of observations made before the congestion charges started were comparably few and that it was both Christmas and New Year holidays during the test period. This might have affected the traffic situation. When the holiday observations are removed from the analysis of the first route, are there practically no differences in time consumption for the delivery before and after the introduction of the congestion charges. However, on route 2 is the effect significant (see figure 3). The standard deviation for the tests on route 1 is large, between 14-20 minutes or about 22 %. This indicates that the traffic situation varies significantly over

time and days of the week. The impact of the congestion charges has, however, no significant impact on the standard deviation.

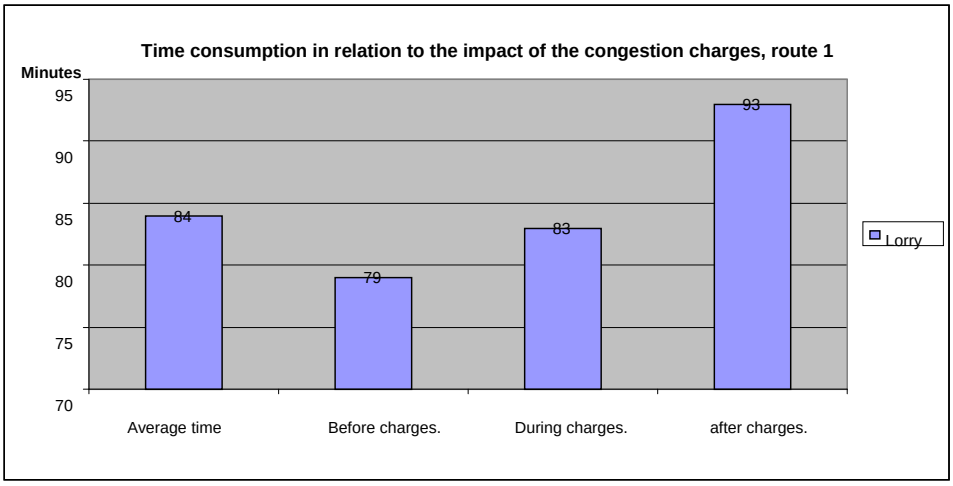

Figure 1 Time consumption in relation to the impact of the congestion charges (route 1)

The trend is confirmed by the results from the second route and of the simulated passenger car routes. For the second route was 43 observations made. A significant increase in time consumption is noted after the removal of the congestion charges. The standard deviations are about 18%, which is lower than for route 1. There is a clear indication from the results of the analysis of route 2 that the distribution time decreased during the time for the congestion charges and that this trend was strengthened when the observations from the holiday season were removed.

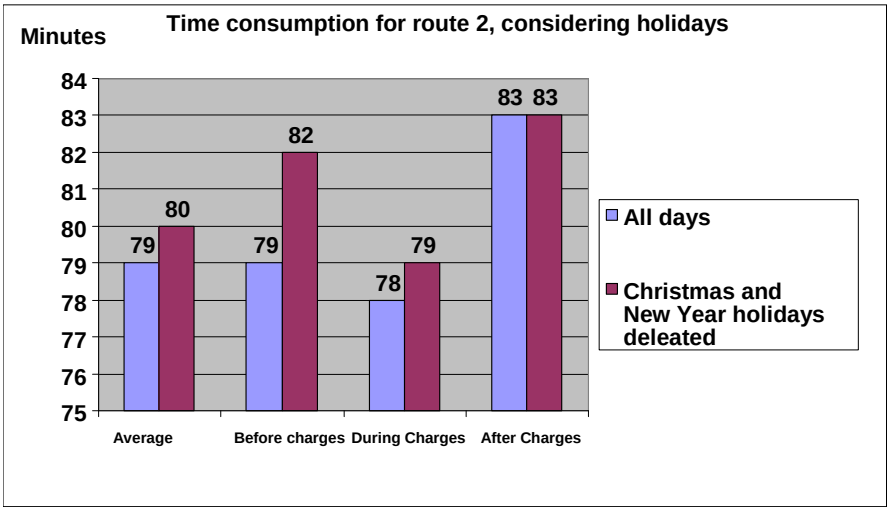

Figure 2 Time consumption in relation to the impact of the congestion charges considering holidays (route 2)

The standard deviation for the case where a passenger car simulated the distribution route was even smaller, 12-18 %. One probable reason is that only 12 observations were made for this case.

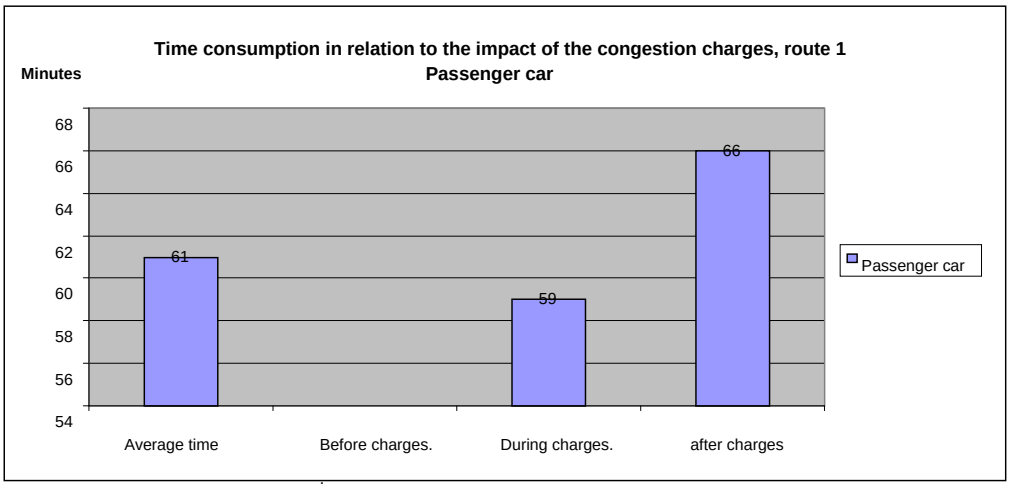

Figure 3 Time consumption in relation to the impact of the congestion charges (route 1 by passenger car)

3.2. Effects due to starting the time for the deliveries

The results show that the time consumption for the distribution decreases the later the starting point is in the evening. The trend is clear for both distribution routes and is confirmed by the simulated rout with passenger car. The distribution time is relatively constant from 14.00 to 18.00 and drops significantly for the deliveries that start after that. The time difference between delivering after 18.00 hour and the average delivering time over the period is 13 minutes or 17 % and if the starting time is after 19.00 the difference is 36 minutes or 43%.

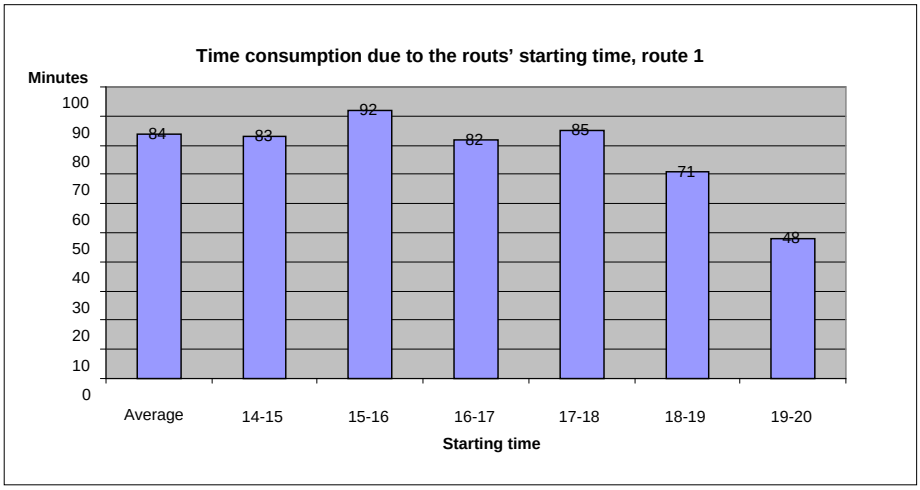

Figure 4 Time consumption due to the routs' starting time (route 1)

The simulated distribution with passenger car shows that there is a significant time difference between delivering in the morning compared to the evening. The time difference is 14 minutes.

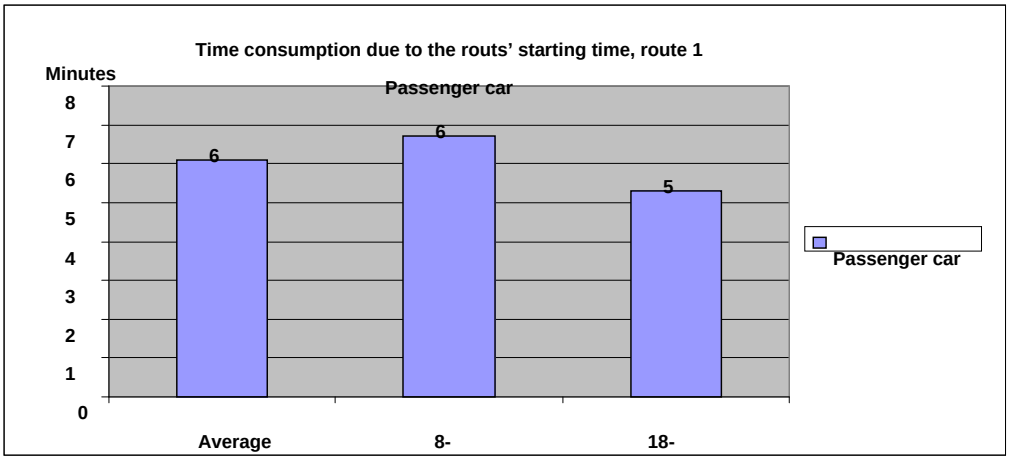

Figure 5 Time consumption due to the routs' starting time (route 1, passenger car)

The measurements also show that the average standard deviation is, as expected, in the same range as for the previous case, i.e., between 14-20 minutes or about 22 %. No significant differences in standard deviation can be seen due to the different starting time of the routs.

For the second route is the same trend noticed although the difference is not as clear as in rout 1. The distribution time varies between 77 to 81 minutes from 14.00 to 18.00 hour and drops after that to 73 minutes. Thus, the time difference between delivering after 18.00 hour compared to the average delivering time is 6 minutes or 8%. The simulated route with passenger car shows similar results.

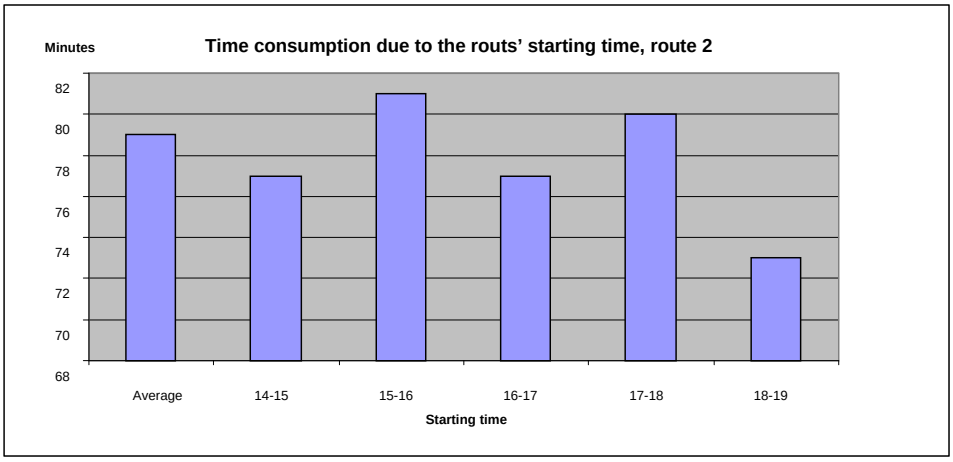

Figure 6 Time consumption due to the routs' starting time (route 2)

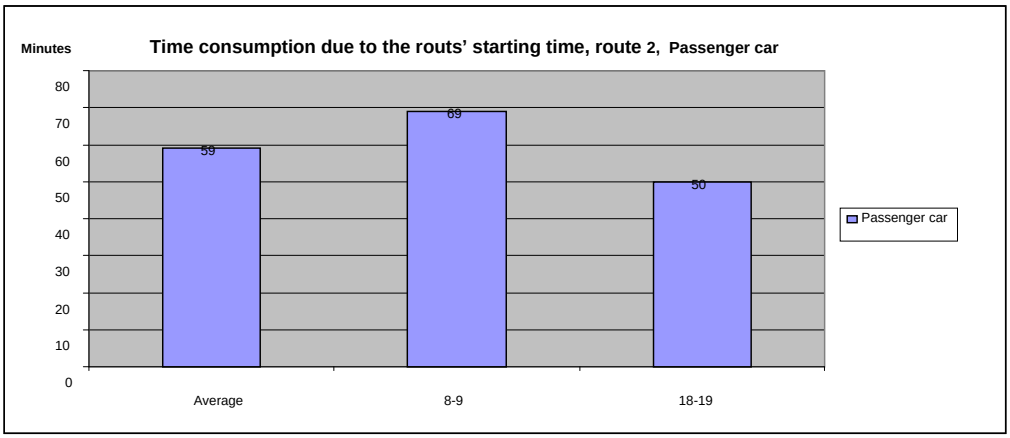

Figure 7 Time consumption due to the routs' starting time (route 2, passenger car)

The analyses show clearly that there is a potential in saving time with evening delivery. However, to reach the full potential of the concept must, of course, the distribution take place after the rush-hour.

For the second company was the input data too uncertain to be used in reliable analyses. However, based on the comparably few correct observations that were made can the following indications be noted: Evening distribution saved about 10 % of the total distribution time. The distribution time increased with about 10 % when the congestion charges were removed.

As only one company were able to deliver correct data to this analysis can the validity of the results be discussed. It is clear that more trials needs be carried out in the field of evening distribution before the potentials given in this analysis can be regarded as valid for evening distribution in general. The data given should be regarded as estimations and a proven potential for one representative company for the provision delivering business in a city of Stockholm size. The time saving potential will be dependent on several factors, e.g., the size and traffic situation of the city, the route length, the number of stops, delivery time, etc. However, it is clear from this analysis that there is an obvious time saving potential in evening distribution and that savings up to more than 40% has been achieved.

4. Environmental assessment

The driving logs showed that the time for delivering within the city centre did not differ substantially due to starting time or congestion charges. The difference appeared on the congested freeway into the city. The average speed for the stretch was calculated and used as input to the HFEMA emission calculation model:

- Rush-hour: 6 km/h
- Afternoon: 18 km/h
- Evening: 33 km/h

The results of the calculated environmental assessment are show in tables 1 & 2 below.

Table 1 *Reduction of emissions when evening distribution is used compared to afternoon distribution*

NOx	**20 %**
PM	**26 %**
CO2	**21 %**

Table 2 *Reduction of emissions when evening distribution is used compared to rush-hour distribution*

NOx	**53 %**
PM	**74 %**
CO2	**50 %**

It is clear from the results that evening distribution has a substantial potential in reducing the environmental impact. Not only by the fact that the vehicles emits less harmful emissions when the accessibility improves on the freeways, but also due to the fact that they don't contribute to the congestion in rush-hours anymore. This secondary effect is, however, not quantified in this paper. It should also be noted that the positive environmental effect is only achieved if the distribution routs are unchanged before and after evening distribution is introduced. If half of the shops want evening distribution and the other half won't, there is an obvious risk that there will be two distribution routs instead of one for achieving the same work. The environmental impact is, of course, in that case negative. The results shown in this analysis must therefore be regarded as potential for the saving potential. The real outcome is much dependent on the chosen routs and load rates of the vehicles.

5. QUALITATIVE DATA AND ANALYSIS

A first tentative SWOT-analysis was made using the methodological approach of group discussions with invited stakeholders. The preliminary list of SWOT-elements was used as the main input for an in-depth interviews with relevant stakeholders. A "hot list" of the most important issues related to evening distribution could then be prepared. They have all to be considered when future large scale implementations are planned.

Better usage of the vehicle fleet can be expected, especially as the wholesale dealers involved in the study already are convinced that new processes should be introduced for goods distribution. The use of vehicles over the whole day is the target and deliveries 8-22 are introduced. However, the opening hours of the gates for receiving goods are still often closed before the shops are closed for the customers. There is of course a solution if the routines of the shops are changed, but some smaller retailers can face difficulties. Especially as the risk of robberies is increased during evenings and other issues of vulnerability can be identified as community services not available in the evening as during day time. Efforts must be made to

break the strong power of tradition. Statements like: “We have always done like this, why change?” must be met by good examples and show cases.

Schools, canteens, etc. must be handled as “special” clients and they must normally get their deliveries during day time. Furthermore, certain delivery trips include both leaving and collecting goods, all within a narrow time window, and a differentiation of customer categories (with respect to delivery time) is often made. As such transport services become more and more common, these customer demands must be integrated in the more traditional distribution services of a city. Otherwise there is a risk that vehicles with lower and lower load factor will take care of the deliveries to the shops, which in the long run will lead to increased traffic and a negative impact in the quality of life for the citizens. There is also a risk of increased costs both in shops and for the distribution

Evening distribution has resulted in less traffic in the city as well as to smoother traffic flows. The drivers therefore face less stress mainly because the trips are made outside the traffic peak hours. However, the blockage in loading zones can be a nuisance as the enforcement until today has not been strong enough. On the other side, the access to loading and unloading at the special loading docks has been easier as there is no longer a waiting time as during early morning hours.

More strict noises regulation can be expected in the future; health being an important driver. Technical solutions are underway but more R&D is needed in order to make them economically feasible for all parties involved in distribution activities. Another way to make the noise issue less infected is to argue for goods distribution as being in the similar category as waste collection or newspaper distribution, i.e. being something necessary for a good life in the city, and therefore accepted.

The qualitative analysis can be summarised as follows. Improvements can be expected with night delivery by the improved utilisation of vehicles, personnel and delivery precision. But only if the actors are willing to change their routines and working conditions. There are also other obstacles that need to be overcome, e.g., changed working hours, correction possibilities for wrongly placed deliveries, etc. It is also a risk of low vehicle utilisation and as a consequence higher distribution costs if not enough shops accept evening distribution.

6. CONCLUSIONS

The main results of the pilot project can be summarised as follows:

- There was a clear reduction of the trip time by ca 10 minutes when the congestion charging scheme was in operation
- There is a clear reduction of trip time (10-20 minutes) for evening distribution (18-20) compared to afternoon distribution (14-18). This is confirmed by trips made by passenger cars when morning trip time 88-9) is compared with evening trip time (18-19)

- The environmental impact (calculated) is reduced by 20-25 % per vehicle related to the typical evening distribution trip lengths used in the project. The impact is related to the average speed of the vehicles in the different traffic situations encountered.
- It is easier for the drivers to unload the vehicles at the specific loading bays as there are fewer competing vehicles around. However, the number of passenger cars parked (wrongly) in loading zones increased.
- The success with evening distribution is dependent on the attitudes of the shop keepers; i.e. are they willing to go against a strong tradition and in favour of a change?

Most stakeholders look favourably on Framtida Handel. The forum has already created an increased possibility for contacts and provides the basis for a better understanding among the different actors in the field. It is their expectations that the experiences from this study will stimulate the launch of new projects and contribute to a sustainable development in the area.

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