ENVIRONMENTAL PROFITS IN RELATION TO HAMMARBY SJÖSTAD LOGISTIC CENTRE

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The following paper is a result of a Master Thesis, which constitute the final part of the Master of Science degree at Lund Institute of Technology.

The fuel consumption from freight deliveries in Hammarby Sjöstad has due to the use of a logistic centre decreased with about 8,000 litres of diesel per year. This leads to reductions of emissions like CO₂, NOₓ and particulate matters and improves quality of life and working environment. The number of goods vehicles moving in the area and noise levels will decrease through collective consignment. The result from this thesis show that HSLC can be regarded as a profitable investment from an environmental point of view. This despite of the poor savings the calculations have resulted in. This conclusion is a result of the consideration of other important factors such as the living and working conditions within Hammarby Sjöstad. The result of the calculations show in spite of the low economic savings a reduction in emissions and noise levels together with an increase of mobility.

SUMMARY

Hammarby Sjöstad is with its newly constructed dwellings one of the largest today ongoing construction project in Stockholm. To be able to manage the production plan, reduce the environmental impact and to create a better living and working environment a co-operation started between Stockholm Stad, the builders and the contractors. Hammarby Sjöstad Logistic Centre, HSLC, is a result of this co-operation. Thanks to the aim to decrease the negative environmental influences in the area, HSLC is now a part of the European project Trendsetter. Trendsetter has listed ten environmentally connected indicators for HSLC and the purpose of this thesis has been to calculate, estimate and evaluate these indicators. Estimations have also been made of what it could have been like at the construction site without the logistical solution. The result of this thesis shows that the fuel consumption has decreased with about 8,000 litres of diesel per year. HSLC is regarded to be a profitable investment from an environmental point of view if factors such as the living and working conditions are regarded.

BACKGROUND

Hammarby Sjöstad is with its newly constructed dwellings together with Södra Länken the largest today ongoing construction project in Stockholm. To be able to manage the production plan, reduce the environmental impact and to create a better living and working environment a co-operation started between Stockholm Stad, the builders and the contractors. Hammarby Sjöstad Logistic Centre, HSLC, is a result of this co-operation, and the centre was inaugurated during the spring of 2001. Located at the entrance of the area, small goods are collected for delivery to various unloading locations within the construction site. Bigger volumes are unloaded and stored at the centre before being delivered, ensuring that only full trucks enter the area. This leads to a lesser number of goods vehicles moving in the area and also decreases the risk for theft and sabotage.

Thanks to the aim to decrease the negative environmental influences in the area, HSLC is now a part of the European initiative Civitas and its subproject Trendsetter. Civitas goal is to improve the environment in European cities. The Trendsetter-projects are by for example improvements in the public transports and logistical solutions trying to ameliorate urban air quality and noise levels with retained or increased mobility. To make things easier regarding the comparison between the different cities involved in the project, Trendsetter has listed ten environmentally connected indicators for HSLC. HSLC will at the turn of the year 2003/2004 be closed down so that also this area can be turned into a residential area. Because of the close down the project now stands before an evaluation, both from an economical and an environmental point of view.

In an earlier thesis about HSLC the centre has been evaluated from a total economical profitable point of view. This has shown that if only income and costs are taken into consideration the centre is not profitable. Though, if other factors such as cost- and time savings for the conveyors are taken into consideration the centre is considered to be a profitable investment.
The environmental profits that can be reached by the use of a logistical solution like HSLC were not identified. This is the reason to the origin of this thesis.

The purpose of this thesis has been to measure, calculate, estimate and evaluate ten environmentally connected indicators listed by Trendsetter. Estimations have also been made of what it could have been like at the construction site without the logistical solution and the consequences this would have lead to for the environment.

METHOD
The scientifically rule of conduct for this thesis follows the positive approach. The gathering of data for the thesis has mainly been carried out by studies of literature and interviews with personnel involved within Trendsetter and HSLC. Conversations have also taken place with chauffeurs delivering goods to the construction sites in Hammarby Sjöstad. Two studies have taken place during the spring of 2003, one regarding deliveries to and from HSLC and one regarding the number of vehicles within a small area of Hammarby Sjöstad. Due to the indicators’ dissimilarities the investigations contains both qualitative and quantitative data.

ACCOMPLISHMENT AND RESULT
Trendsetter’s ten environmentally connected indicators

- Energy use – (joule/year)
- Emissions of carbon dioxide, CO₂ – (tones/year)
- Emissions of nitrogen oxide NOX – (tones/year)
- Emissions of particulate matter, PM – (tones/year)
- Noise levels – (dB)
- Mobility – (index)
- Vehicle kilometre – (Vkm)
- Total number of goods vehicles moving in demo area – (number of vehicles)
- Vehicle load factor – (%)
- Queuing time/Stop time – (minutes/trip)

Order statistics
Due to the low activity at the construction site during the time for this thesis a comparison has been made between the number of orders for this period and a period of high activity. The comparison shows that during the time for the case studies the number of orders where 60% less then that for the time when the production was as its peak.

Two studies
Two studies have taken place during the spring of 2003, one regarding deliveries to and from HSLC and one regarding the number of vehicles within a small area of Hammarby Sjöstad. The study regarding deliveries to and from HSLC shows the decrease of heavy vehicles in the area and the extent of the collective consignment. The study resulted in a collective consignment level of 2, 0. That means that two incoming deliveries to HSLC are transhipped into one outgoing delivery from the centre.

The second study gave 280 passing vehicles, from which 260 were heavy vehicles.

Accomplishment and Result from the Indicators
In this section a description of the accomplishment of the indicators follows. The result for each indicator is also presented.

The energy use is taken by the fuel consumption for the lorries and is for the logistic centre 4 830 litres per year for the three lorries. This represents an energy use of 170 GJ per year.

The emissions are calculated through stereotyped values from NTM (The Network for Transports and the Environment). The emissions per year from the three lorries from HSLC are:

\[
\begin{align*}
NOX &= 76.9 \times 10^{-3} \text{ tones/year} \\
PM &= 1.25 \times 10^{-3} \text{ tones/year} \\
CO₂ &= 12.5 \text{ tones/year}
\end{align*}
\]

Noise levels are taken from a program supplied by Miljöförvaltningen in Stockholm. The program gives a noise level of 81 dB for a passing lorry. The investigation is also a study for the maximal level, which means that it studies the number of times a certain limit of the noise level is exceeded by the roadside. The limit in this investigation is set to be 55 dB. With the help of the measure of the traffic flow the result is that the limit (55 dB) was exceeded 260 times during one day (07.00 AM – 16.00 PM).

The Mobility has due to the low production at the construction site during this thesis been a difficult indicator to measure. Instead it is based on interviews with chauffeurs and estimations. An index for the mobility was produced with a basis from these interviews. It is a scale from 1 to 5, where 1 represents very low mobility and 5 represents very good mobility. Estimations are made that the mobility has increased thanks to the use of the logistic centre. During the time for this thesis the mobility index is estimated as a 3. This represents normal mobility with few stops and not more than 30 minutes of queuing time.

The Vehicle kilometres are taken directly from the lorries’ meters and are listed below.

<table>
<thead>
<tr>
<th>Lorry</th>
<th>Vkm/year</th>
</tr>
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<tbody>
<tr>
<td>Lorry 1</td>
<td>2 950</td>
</tr>
<tr>
<td>Lorry 2</td>
<td>1 450</td>
</tr>
<tr>
<td>Lorry 3</td>
<td>2 500</td>
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</tbody>
</table>

Total number of goods vehicles moving in demo area is taken from the second study. This indicator is highly dependent on face of the production in the area. There was no possibility to get a picture of the number of vehicles moving in the whole area and therefore a smaller area was chosen for the study. The activity was during the time for the study low and the area with the highest activity was
therefore chosen. The number of in passing vehicles to the chosen area was 280 during one day.

The Vehicle load factor for the lorries from HSLC is taken from interviews with personnel in HSLC and were then estimated to 84 %. The personnel in HSLC are the people with the best knowledge about this indicator. The vehicle load factor is hard to measure since the type of goods going through HSLC vary a lot and depending on what goods it is the load factor can be measured in volume or weight.

Queueing time/Stop time was estimated after interviews with chauffeurs. A trip together with one of the lorries from HSLC did also take place to let the authors make an own opinion of the situation. The interviews gave a queuing time ranged from 15 – 60 minutes for the chauffeurs not using HSLC and almost none for the drivers from HSLC.

ANALYSIS
In the chapter of the analysis estimations have been made of what it could have been like at the construction site without the logistical solution. The starting point has been the collective consignment level of 2.0. With an average for the time for idle running the total savings for the fuel consumption during one year are approximately 8 000 litres which represents energy savings with 286 GJ. The reduction of emissions is per year 20 tones carbon dioxide, 130 kilogram nitrogen oxides and 2 kilogram particulate matter. The limit for the noise level, 55 dB, would be exceeded 20 times more during one day if HSLC was not in use. The mobility index is estimated to 2 which mean low mobility, rather long queuing time and a lot of unwillingly stops. The queuing time is set to be from 30 minutes up to 2 hours. The Vehicle kilometres would decrease with 2 000 kilometres per year and the number of heavy vehicles in the area would increase with approximately ten per day which leads to longer queuing times and more stops.

An economic estimation
In the calculations for the economic estimation over the consequences for the environment marginal costs for carbon dioxide, VOC, particular matter, nitrogen oxides, wear, accidents, and noise levels have been taken into consideration. For carbon dioxide three different marginal costs have been chosen since these vary a lot depending on which study you read. Three different values have also been chosen for the time for idle running; these are 30, 60 and 180 minutes.

The yearly savings depend a great deal on the input data used in the calculations. The savings do range from 4 680 € to 122 500 € per year. These savings can be put in relation to the income of 323 000 € and the cost of 957 000 € per year for HSLC.

CONCLUSIONS
HSLC and the environmental profits
The fuel consumption has through the use of Hammarby Sjöstad Logistic Centre decreased with about 8 000 litres per year. This represents 11 400 kilometres with a heavy vehicle. The emissions have been reduced and the collective consignment decreases the total number of vehicles in the area. The reduction of vehicles leads to increased mobility and decreased noise levels.

HSLC – Economic profitability
Only looking at the economic calculations with a collective consignment level of 2.0 it is hard to defend HSLC. Despite this a statement is now made that HSLC really is profitable. The statement is based on the fact that a whole new district is being built and that the production will be in progress for many years ahead. A lot of people will have to live at a construction site for many years with all the disturbance and complications that follows. Therefore the living conditions are a very important factor to consider. This thesis has in fact shown a decrease in emissions and noise levels and an increase in mobility. This makes the centre profitable from a national economic view.

The higher the collective consignment the better the economic profit
Since this thesis follows a scientifically rule of conduct the collective consignment level of 2.0 taken from one of the studies has been used in all the calculations. Since the production at the time for the study was low interviews with the personnel in HSLC have also taken place to get their opinion of the collective consignment level. They estimated this to 6.0. Calculations have also been made for this level. The result shows that the collective consignment level and the time for idle running have a great importance to the result of the economic calculations.