# Cost and environmental savings through route optimization

## - A case study at Bergendahls Food

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*This article is based on the Master Thesis with the same title, written for the Department of Industrial Management and Logistics at the Faculty of Engineering, LTH. The thesis considers a review of Bergendahl´s transports in order to investigate the potential of improvement and to provide measures to achieve costs as well as environmental savings.*

## Background

Effective transportation is a key stone in the modern society and the transportation sector is continuously improving. An article in 2007, Logistic Management, elucidated that *"Transportation management is moving out of the shadows and into a strategic role in driving supply chain excellence"*. In the beginning of the 50´s and 60´s Danzig & Ramser (1959) and Clark & Wright (1964) emphasized the problematization in vehicle routing. Since then, hundreds of different algorithms has been developed in order to find the optimal solution how to best deliver goods to a set of customers. Due to the combination of the computer revolution and the rising amount of transportation, investments in software for route optimization have increased. Historically, interest in these kinds of software has to a large extent been from an economic point of view, which has come to be broadened.

Research indicates that the major cause of our global warming is the unnatural increase in greenhouse gases. These can be traced to the transport sector and its combustion of fossil fuels where route optimization software now has become a tool for companies to reduce their environmental impact. The environmental focus has become a hot marketing tool for companies. Furthermore, due to the government's prospective management control systems, in order to reach the Swedish *"Environmental Goals"* (Miljömål, 2010) the importance of mapping, monitoring and controlling the environmental impact has grown.

## Problematization

Bergendahls Food AB is a wholesale and retail trade company and a subsidiary to Bergendahl & Son AB. Acting within three business units; food, fashion and home furnishing makes Bergendahls & Son AB the fifth largest trading group of Sweden.

Bergendahls Food AB customer base consists of 30 large supermarkets called City Gross and 200 smaller convenient stores. This study aimed to examine one third of the customer base which is served by their own fleet.

Large investments in recent years has resulted in a strong growth and increased market share. Like many expanding companies, the organization has not been growing at the same rate. In order to adapt to and manage further expansion Bergendahls has chosen to conduct a review of their transportation organization.

Due to the expansion, the complexity in Bergendahl's route planning is increasing. Currently, they have no system support to manage route planning, it is done manually based on experience

A thorough survey of the current situation provides opportunities to identify improvement in order to realize efficiency and optimization. Route optimization could also be seen as a first step towards reducing environmental impact but the lack of system support makes it difficult to identify possible improvement.

The aim of this case study is to contribute to the large transport review at Bergendahls with practical and thorough information in order to obtain decision support for future investments.

## Purpose of study
The main question which the study intended to answer was;

- *What economic and environmental improvements can be identified through route optimization?*

Two scenarios were also evaluated in order to recognize what benefits could be achieved through changed route planning. The scenarios were

- *What economic and environmental improvements can be identified by changing the customer time windows?*
- W*hat benefits can be identified by delivering six days a week?*

## Research design
To get a deeper understanding of elements influencing the route planning and transports, the initial part of the study consisted of an exploratory and descriptive analysis. In order to identify possible improvements a normative study was made in which shipments were

simulated and analyzed using the route optimization tool Route Planner. The potential of improvements of the transports as they are planned today were primarily analyzed.

Furthermore, two different scenarios were developed to analyze how a strategic change of the transports could affect the flow of goods with their associated costs and emissions. All analyses were primary analyzed in a cost and environmental perspective but delivery service and resource utilization were also taken into consideration.

A framework for evaluating the different parts of the analysis was constructed, se picture 1 below.

Emissions were calculated throughout the analysis with the exception of the scenario "*Deliveries six days a week*" where the new weights were unknown. The calculations were based on the methods of NTM (NTM, 2010)).

### Current situation
The purpose with the first simulation was to identify the basic settings of the program. The routes were planned exactly in the same way as they were executed in reality and it also worked as a first part of the analysis because many problems along the routes were identified.

### Optimization of the current situation
The purpose was to evaluate how route optimization software could help planning the transports at Bergenndahls. The settings were the ones identified in the first simulation but orders that earlier were split up into two were now brought together as one. This was done in order to save the extra mileage when two trucks were visiting the same supermarket on the same day.

The customer time windows were kept intact in almost all cases but when a large gain was identified small changes were made.
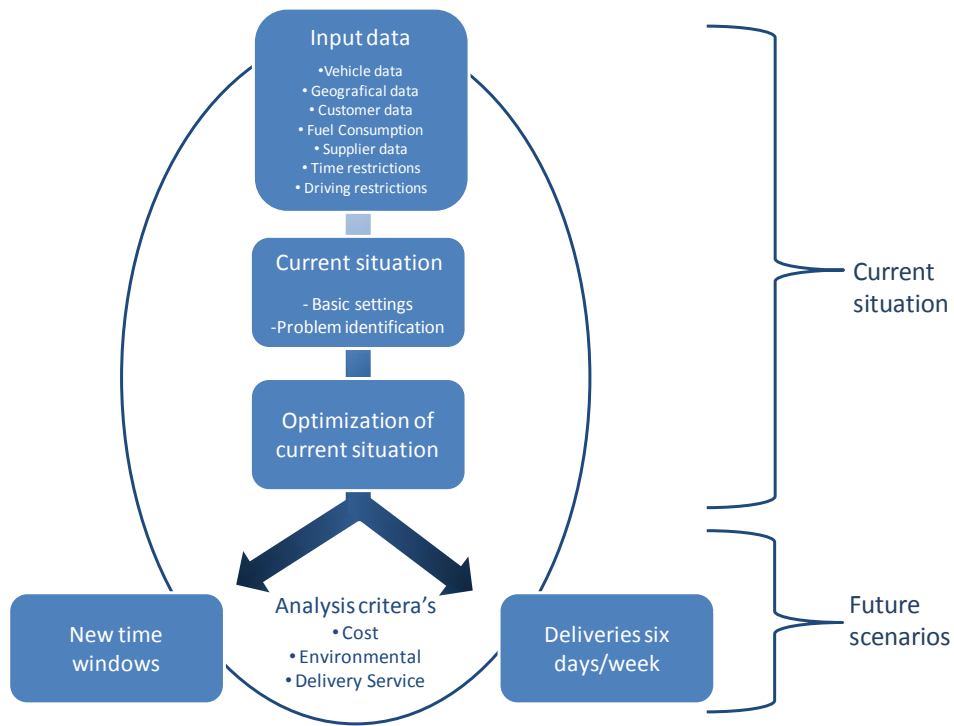
**Picture 1 Framework**

### New time-windows

In order to help the optimization process a simulation with large time windows was carried out. The original time windows were changed so the large City Gross-stores were given a time window between 7 AM and 10 AM and the small convenient stores a time window between 9 AM and 2 PM. Supplier pickups were scheduled between 11 AM and 4 PM.

### Deliveries six day/week

Due to shifting demand the flow of goods is changing throughout the weekdays. This makes the route planning more complex and by adding an extra delivery day the flow of goods could be more leveled. Because of the large quantities of the City Gross-stores the orders were divided and an extra delivery day was included in the transport planning.

The time windows were set to 7 AM to 11 AM on Saturdays. The costs for the extra deliveries were then compared to the savings due to the shorter mileage during weekdays.

## Findings

The results from the different steps of the analyze is presented below.

### Current situation

The results indicated a great difference in time and distance while comparing the results from the simulation with the actual numbers from the survey done by the truckers.
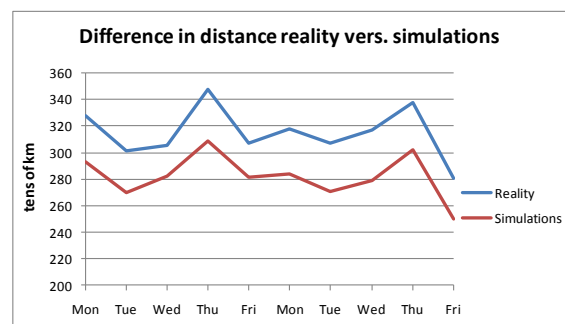


**Figur 2 Difference in distance reality vers. simulations**

In average the difference was 325 kilometers per day. The reasons for the time and distance differences were identified as;

- The extra distance driven due to the leave of trailers in order to make routes more smooth and flexible
- Different road choices
- Customers on the same main routes were visited in different order
- Waiting time at customers and suppliers
- Traffic problems
- Transshipments between truck and trailers
- Others; such as different stops for lunch breaks

The main reason was the fact that truckers are leaving their trailer. On some routes the difference connected to the leave and pickup of trailers could be up to 80 percent.

If Bergendahls could eliminate 50 percent of the problems connected to the differences stated above they could save up to 590 000 SEK per year. In the same time they could decrease their emissions by 5 percent which is equal to 49 tons $CO^2$ and 0,4 tons $NO_x$.

## Optimization of the current situation

By using a route optimization software, Bergendahls could eliminate the different planning solutions, such as splitted orders and external transports, used to manage the complex planning.

By reducing the amount of splitted orders, Bergendahls could save money and at the same time increase their service. Depending on the number of splitted orders they could save up to 5000 SEK per day. The savings should however be evaluated according to the increase in workload.

The use of external transports once a week results in a annual cost of 104 000 SEK. When trying to include the orders sent by external transports the results varied. Days, when external transports were used as a planning solution, often coincided with a large amount of customer visits. Consequently, the many time windows had a great negative influence on the optimization. By changing some of the time-windows Bergendahls could save up to 3000 SEK per day not using the external transports.

According to the current situation the annual savings could reach 530 400 SEK on average per year by optimizing the transports. In order to manage the new optimized routes Bergendahls has to eliminate the problems affecting the way the routes are executed. In proportion to the savings in distance the emissions would decrease by 5 percent.

## New time windows

Throughout the analysis the results indicated that the time-windows were a great limiting factor. The more and narrow restrictions, the fewer amount of solutions is possible to be evaluated. Consequently the results are further from the optimal solution.

By changing the time-windows the total distance were reduced on average by 1 910 km, per week which could result in cost savings up to 1,4 million SEK per year and environmental savings by 9 percent. The results could be used as inspiration of new routes and time windows.

## Deliveries six day/week

Since the goods flow to the largest stores represents 55-80 percent of total flow depending on the weekday, a more constant and evenly flow of goods could help transportation planning. The changes made in order quantity did not provide any cost savings directly.

However, the strategic change to deliver six days per week could function as a tool for the problems identified throughout the analysis.

Additionally the smoother planning and optimized routes could benefit the customers

by reducing supply peaks, less waiting time during delivery and lower stock-keeping costs.

## Conclusion

Primarily a number of problem areas were identified which did not require reorganization of the routes since the problems were connected to the way the routes were executed. Therefore the problems seemed relatively easy to handle and eliminate. If half of the problems were eliminated cost savings could be as much as 590 000 SEK. The environmental savings connected to the improvement could be 5 percent.

In order to reach optimization, Bergendahl has to deal with the basic problems identified. Due to increased demand the manual route planning has become more complex. In order to manage the planning, the transport planners use different solutions which are quite costly. The analyze indicated that a route optimization software could help avoiding these planning solutions.

Throughout the study the results showed that time windows have a great influence on the optimization process. Assuming that Bergendahls is able to handle the basic problems cost savings could be as large as 22 percent. In the same time the emissions could decrease with 18 percent.

Introducing deliveries six days per week could help Bergendahls to handle and eliminate some of the problems identified in the study. Besides the improvement of their own distribution, the improvements could have a positive effect to the stores and final customers.

A recommendation to Bergendahls would be to further investigate how time windows can be used as a tool against supplier in order to make pickups more accurate. They should also do follow ups on problems identified long the routes and take actions against extra problematic customers.

## References

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