

# Savings of the GCD concept

**greencity**  
distribution



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Bachelor thesis of

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## Summary

This report focuses on city distribution and has the main goal of expressing the effect of the concept of GreenCityDistribution (GCD). GCD adapts to the problem that is faced in most cities in the Netherlands: supplying shops in city centers is currently organized too chaotically and uses too many vehicles. As has been indicated in several supply profile reports for different cities, the consolidation of goods of different transport operators will be beneficial in this situation. GCD is willing to be part of the solution of this problem by offering the service of clustering goods of several national carriers and by taking care of the last mile of the national carrier's deliveries. In this report, the GCD concept proves to result in savings, both for the city as a whole as for national carriers.

For two cities the city-wide effect of the GCD concept has been calculated to be a potential 60% decrease of vehicle movements needed for the distribution of goods into the centers of these cities. This is a large improvement for the current problem of city distribution and is thus beneficial for the city as a whole. Also, the calculated potential savings show that the current manner of city distribution by the national carriers themselves is very inefficient. Increased efficiency due to the GCD concept can also be advantageous for the national carriers.

National carrier related savings have also been modeled. The model offers a manner of translating the difference between the current inefficiency of national carriers and the efficiency of GCD into potential cost savings. Illustrations from the data that had been required via a survey on transporting companies showed large potential savings (up to 90%) for most companies.

It has also been investigated whether national carriers expect to be able to realize additional savings in case of cooperation with GCD. Based on the results from a survey it can be cautiously said that approximately one half of the respondents expect additional savings on for example administration expenses and investments in small and green vehicles.

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## 1. Introduction

Nowadays, most city centers face problems in the field of city distribution. On the one hand, cities and customers want good shopping climates. A shopping street full of delivering vehicles is no part of this picture. However, on the other hand, shops have to get supplies in order to let the customers be able to go out shopping. So, supplies are both a necessity and an impediment for a good shopping climate. There is a way of maintaining the level of availability of goods at shops and simultaneously reduce the negative effects of supplies for a city's shopping climate. In this report, the benefits of this method for the city will be presented and besides the benefits for the city, it will be shown that also distribution companies may be able to reap the fruits of this way of working.

I enjoyed working on this project and I really appreciate the support of the people who helped me during the project. First of all I would like to thank Matthew Reindorp, who did a real good job as my supervisor from the University of Technology of Eindhoven. I am thankful for the conversations we had and for your ideas which helped me a lot. I also want to thank Roel Menheere, Henk Tol and Ramón Weekenstro for their willingness to help and their suggestions and information. I am grateful that TLN and [www.logistiek.nl](http://www.logistiek.nl) were willing to let us distribute a survey to a lot of their members. Further I want to thank Jesse Hoekstra and Natasha Theeuwen for our valuable teamwork for the first part of this project.

Joeri Jansen

## 2. The problem

### 2.1. Context

GreenCityDistribution (GCD) can be seen as a missing link between national carriers and shop-owners in the city centers. National carriers are nationwide operating transportation companies, who currently take care of supplies for by far most of the shops. These national carriers use relatively large trucks for their deliveries. Those goods will mainly be delivered from a few locations within the country (e.g. factories or large central warehouses). The national carriers that take care of this sort of supplies are mostly operating nationwide and deliver to several different cities.

The GCD concept will influence the city distribution dramatically. The concept entails warehouses outside the city centers where national carriers can unload their goods. Then GCD will consolidate the goods of different national carriers and will distribute the goods to the shops. Instead of a lot of trucks (belonging to national carriers) delivering only a small number of for example boxes or pallets, the GCD concept will result in better capacity utilization of the vehicles in the city center. The concept will thereby lead to a smaller amount of vehicles needed for city supplies. Combined with the fact that GCD uses clean and relatively small vehicles, the GCD concept will also positively influence the air quality and traffic safety. Within this research project, the focus will not directly be on those two advantages, but on cost savings that could be realized due to the GCD concept.

Several sorts of carriers are delivering in the city centers and might thereby be interesting for GCD to cooperate with. As has been on topic before, national carriers (e.g. Jan de Rijk) will be an important group of potential partners for GCD. But also the integrators (e.g. DHL and TNT) may be able to work more efficient when these collaborate with GCD. Compared to national carriers, integrators are already quite efficient in their operations: integrators need an estimated 11% of the total vehicle movements for about 51% of the volume of goods. For national carriers these numbers have an estimated value of almost 84% and 46% respectively<sup>1</sup>. Nevertheless, even the distribution activities of integrators can be improved in terms of efficiency.

GCD is a young company and is not yet active in most Dutch cities, but GCD's director, Roel Menheere, is ambitious and will rapidly exploit the concept throughout the Netherlands. GCD's operations are based on franchisers, which enable GCD to expand rapidly, because no significant investments have to be made to enter a new city.

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<sup>1</sup> Percentages are from a research on city distribution in 's-Hertogenbosch.

## 2.2. Problem definition

The fact that national carriers are still supplying the city centers by themselves has its effect on the number of vehicles used for city supplies. Currently too many vehicles with too little capacity utilization are needed for city distribution, which is inefficient and thus expensive.

GCD is able to make city distribution more efficient by clustering the goods from different distributors. This will result in less vehicle movements in the city centers, implying savings compared to the current situation. National carriers will further be able to save on their operating costs, because they might be able to plan easier or more efficient and they might not need to invest in environmental and small vehicles anymore.

## 2.3. Research goals

Related to the problem defined above, the goal of this research can be divided into two concepts. First, the goal is to compute an estimated amount of savings in terms of vehicle movements for a specific city. Computations of these savings will be based on a city-wide volume of goods that has to be delivered to the shops in its city center and the current number of vehicle movements needed for these deliveries. The savings in terms of vehicle movements will be calculated for both Tilburg and Amersfoort, but based on the developed model for these calculations, it will be easy to obtain results for other cities as well.

Second, the savings in terms of vehicle movements will attain a value to the inefficiency, suggesting cost savings as well. Another goal of this research project is to estimate the possible savings for a national carrier. To be able to do this, the costs related to the 'last mile' of a national carrier's journey to a city center should be determined and compared to these costs when GCD will handle the city distribution. These costs may consist of fuel costs or drivers wages and will be more or less the same per hour for both the national carriers as GCD. The difference is in the amount of time needed for these deliveries: GCD needs less time, because of its efficiency.

### 3. Literature

A lot of general information about city distribution can be received from supply profile reports. For example, Buck Consultants International (2008) investigated the city distribution of 's-Hertogenbosch. One of their findings was the insufficient use of clustering. This means that many vehicles just have to deliver goods to a few addresses. For these deliveries, relatively many vehicles are being used. When the goods belonging to these deliveries could be clustered, fewer vehicles will be needed in total which will positively influence the congestion problems and shopping climate.

Another supply profile report (DHV, 2008) focused on Tilburg and also mentioned the problem of congestion in the city center. The congestion of delivering vehicles may be partly caused by the presence of time windows (time periods in which carriers are allowed to deliver goods to shops within the time window zone, but out of these time periods they are not allowed to enter the zone). It is also recommended that waste returns by shops should get clustered or optimized (for example returning wastes with the deliverers of goods), resulting in less trash traffic.

DHV (2007) also investigated city distribution in Eindhoven in a supply profile. Again congestion has been experienced as a major problem. Suppliers face heavy traffic flows and may face hindrance from other suppliers. Changes in time window regulations may reduce these problems of congestion, but again clustering is the magic word here.

A company that in practice offers the same services on city distribution as GCD is Binnenstadservice (BSS). The approaches of both GCD and BSS will reduce the number of vehicles needed for city distribution, based on the efficiency of clustering goods. Hendriks, Hofenk, Quak, van Rooijen & van Birgelen (2009) investigated the effect of BSS's approach in Nijmegen and concluded that after one year the shopping climate has been improved. They also mentioned the opportunities for national carriers when they cooperate with a city distributor, because they do not need to enter the city centers anymore and will thereby be able to use larger trucks and utilize a more efficient route planning. National carriers may also be able to take advantage, because they do not face disutility's anymore from (different) local regulations (e.g. time windows or milieu zones) and they will have enough space to load and unload goods. According to Hendriks et al. (2009), a city distributor thus will be advantageous for both the city itself and the national carriers cooperating with the city distributor.

In a report by Quak & de Ree (2009), again BSS has been the subject of a study. In this study the focus was on the effects for national carriers of an increased number of cities wherein BSS would be operating. Quak & de Ree concluded in two case studies that national carriers will be able to realize savings in terms of time, costs, kilometers and CO<sub>2</sub> emission, while cooperating with a city distributor.

## 4. The project approach

In this project, two sorts of savings are being investigated. First the city-wide savings in transport movements, which can be reached if most national carriers will cooperate with GCD, will be determined. These savings in transport movements give an indication of the opportunities for cost-based savings for national carriers. Second, the focus will be more directly on the cost aspect of the savings for a single national carrier, depending on its characteristics.

### 4.1. City-wide effect of the GCD concept

A schematic structure of the analysis of the city-wide effect of the GCD concept, in terms of possible savings in number of transport movements, is given in figure 4.1. As can be seen at the right, several sorts of input data are necessary to start with. For each data type, a short description is included:

- **Locatus:** this file gives a list which consists of every shop in a city or a certain part of a city (e.g. city centre). A Locatus file may be available at a city's municipality.
- **SPR:** SPR stands for 'Supply Profile Report' and is based on a previous investigation for a certain city. Within such an investigation, a sample of shops and other companies (all grouped per branch) is surveyed, resulting in data for those shops. These data include for example the number of deliveries per week and the number of pallets or roll containers delivered per week. These data have been received from DHV.
- **Kentallen:** Kentallen include the same sort of data as the SPR. These data however, are not only based on a city specific sample. It is based on several of these investigations, for several cities and thereby gives branch-dependent national averages for the data in the SPR. These data are necessary to compare with the data from the SPR and to use directly for the companies which were not included in the sample for the SPR investigation. Like the SPR data, the data from the Kentallen has also been received from DHV.
- **Relevant branches for GCD:** Not all branches are interesting for GCD because these for example may already have efficient transportations due to large volumes (e.g. supermarkets).
- **License plate investigation:** These data are based on a previous investigation for a specific city. Such an investigation results in a total volume of transport movements in a certain week and in a specific city.

Of these data, both 'kentallen' and 'relevant branches for GCD' can be used for each city, so for different cities, these data will be the same. On the other hand, the other

three kinds of data are city-dependent. Differences between cities will thereby depend on these data sources.

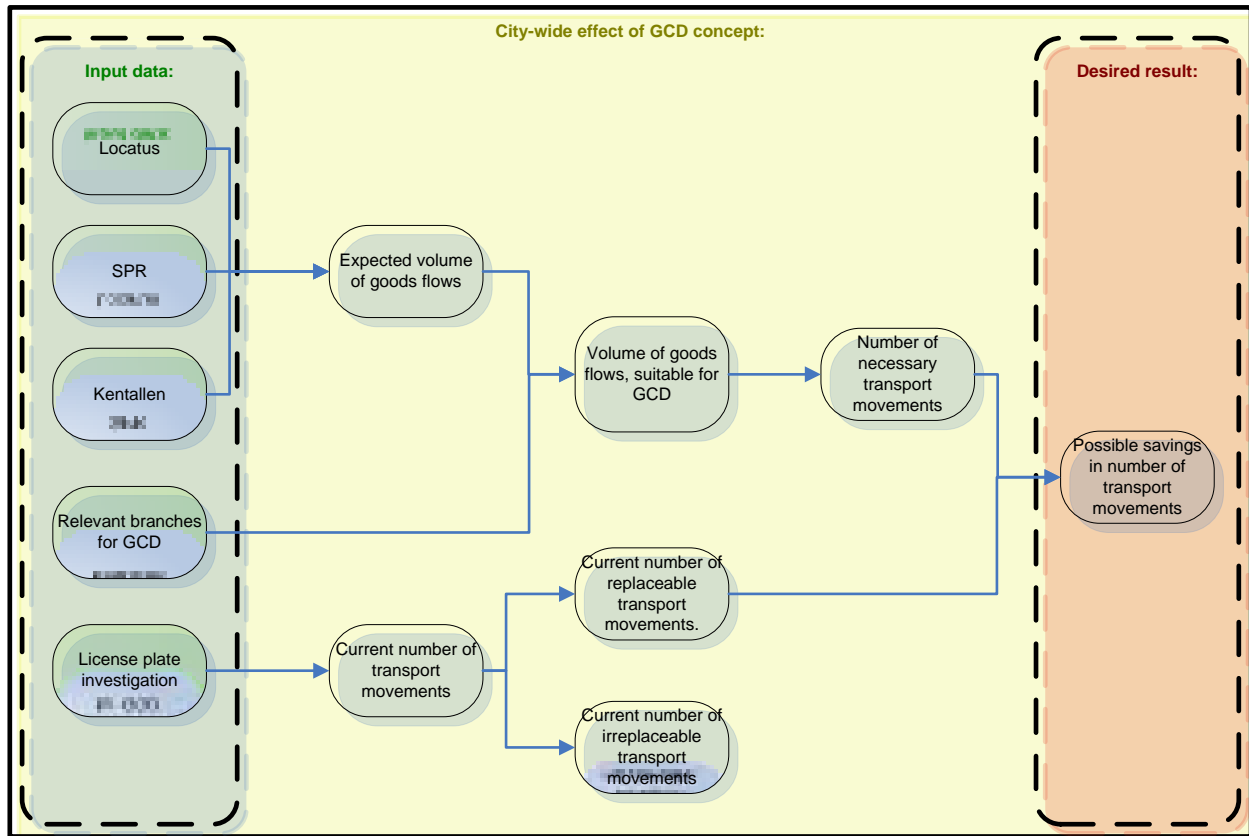


Figure 4-1: The city-wide effect of the GCD concept

Determining the number of necessary transport movements (the upper part of figure 4.1) is a quite straightforward task, when the data needed is available. The lower part, however, is a bit less straightforward, because assumptions have to be made to determine the current number of transport movements from the license plate investigation.

The analysis of the city-wide effect of the GCD concept follows in chapter 5.

#### 4.2. Effect of the GCD concept for national carrier in a specific city

A schematic structure of the analysis of the effect of the GCD concept for a national carrier is described in figure 4.2. Again, several sorts of input data are needed for this analysis. In this case there are two sorts of data: general input data and input data which is dependent of the national carrier being evaluated.

The general input data consists of time dependent costs for different transport vehicle types. These costs are time dependent because especially for the last mile of national

carriers, time is more important than distance. The distance they do in city centers is relatively small in comparison to the whole distance of a trip, and the last mile part of the trip will be more expensive per kilometer. It is thereby difficult to express costs depending on distance. Costs are more constant over time than distance dependent and average costs per hour are available for different types of vehicles. Several types of vehicles are considered<sup>2</sup>:

- Delivery vans (<3,5 ton)
- Small truck (>3,5 ton & <7,5 ton)
- Midsize truck (>7,5 ton & <18 ton)
- Large truck (>18 ton)

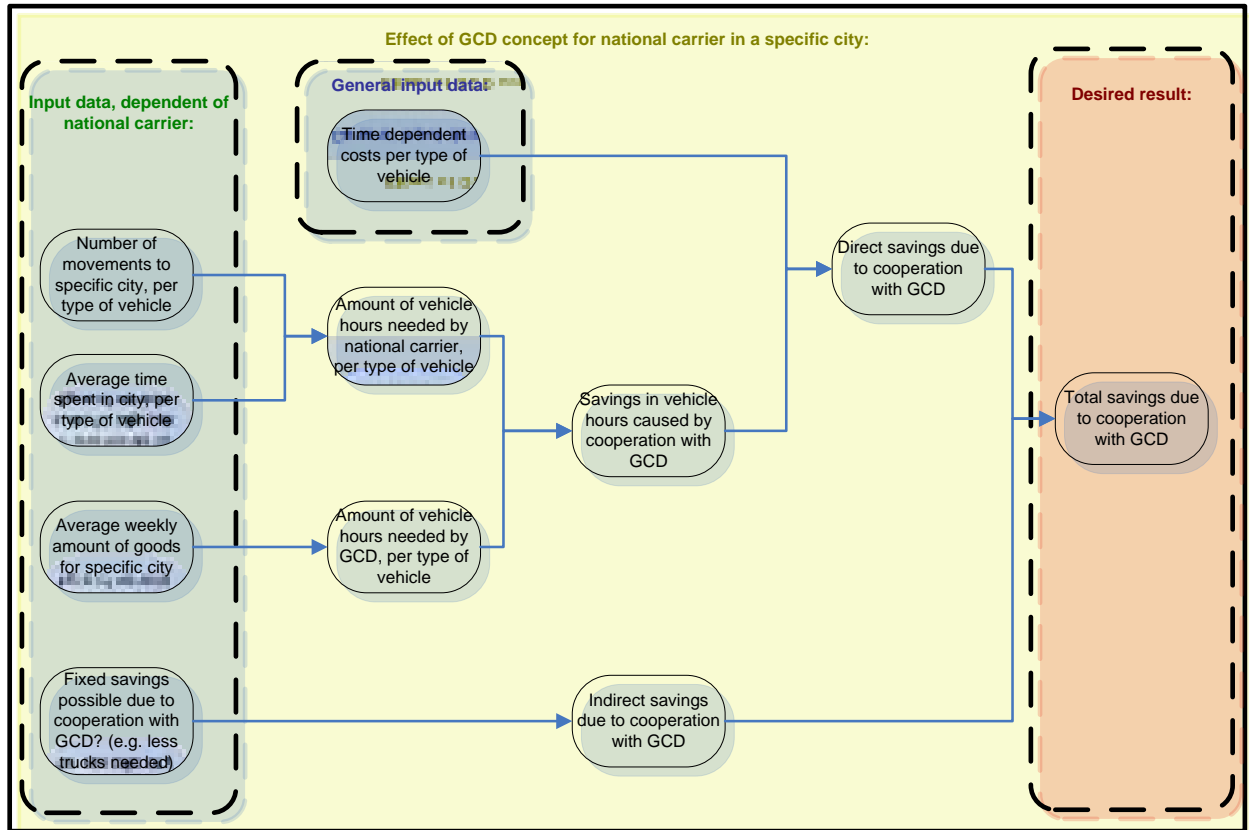
The amount of possible savings for a national carrier depends on several aspects which are unique for a certain national carrier. The input data which are dependent of the national carrier consist of:

- The number of movements to a specific city. Different types of vehicles are taken into account, because eventually costs depend on these vehicle types.
- The average time spent per movement, also per type of vehicle.
- The average weekly amount of goods a certain national carrier will deliver in a certain city.

As is shown in the upper part figure 4.2, the number of movements needed by a specific national carrier, combined with the average time needed for the trip, results in the total time needed by a national carrier for city center deliveries. Based on the average weekly volume of goods delivered by a national carrier, the time needed by GCD to distribute these goods can be computed. The difference in time (per vehicle type) necessary for city distribution multiplied by the hourly costs, results in the savings due to increased efficiency.

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<sup>2</sup> This grouping of vehicle types has also been used in the SPR of Eindhoven by DHV (2007).



**Figure 4-2: The effect of the GCD concept for a national carrier in a specific city**

These data are directly related to possible savings, but cooperation with GCD might result in more savings which may be fixed and have indirect influence on savings (see lower part of figure 4.2). For example, due to cooperation with GCD, a national carrier does not need to invest in clean and small trucks anymore.

The effect of the GCD concept for a specific national carrier, as described in figure 4.2, will be analyzed in chapter 6.

## 5. Analysis: City-wide effect of the GCD concept

The analysis of the city-wide effect of the GCD concept follows the structure described in figure 4.1. Therefore, a file (excel sheet) has been created in which the different kinds of input data can be combined. The combination of these data is needed to estimate the total volume of goods that is weekly distributed to the shops in the city center (section 5.1). Depending on this total volume, the total number of vehicle movements GCD needs to deliver these goods, can be calculated (section 5.2). This result, compared with the current number of vehicle movements (section 5.3), will lead to the savings in terms of vehicle movements (section 5.4). The file wherein this is achieved is called the “Masterdatabase”. First, a description of this file will follow; thereafter the results for the cities of Tilburg and Amersfoort will be included, in terms of possible savings in vehicle movements.

### 5.1. Estimate total volume of goods

To estimate the weekly total volume of goods that needs to be delivered into a city center, several input data are needed. These different input data are combined into the masterdatabase. This file is created as follows:

First of all, it should be mentioned that all the available data will be sorted by type of branch, sub branch or even by company name within a branch, if such a company is sufficiently large or well known throughout the country. This is a necessity, because each branch has its own characteristic values for different input data, such as amount of goods delivered weekly. The different branches have their own branch code  $i$ .

When branches have been set out, the number of shops or companies belonging to a certain branch code should be filled in for the city under investigation. For this city a Locatus file is needed (see also section 4.1) with all the shops and companies located in the center of this city. The numbers of companies need to be sorted and counted by branch code, resulting in a summary of companies per branch.

The final sort of input data, used to estimate the total volume of goods, is also extractable from the Kentallen and is also ordered per branch code. The weekly volume of goods that is delivered on average per company in a specific branch is included in the masterdatabase. The volume of goods is expressed in the following sorts of loading units:

- Roll containers  $r$ ;
- Pallets  $p$ ;
- Boxes  $b$ ;

- Clothing frames c;
- Unpacked goods u.

It was possible to use, next to the data from the Kentallen, also data from the SPR for a certain city. In this way, estimation of the volume for a specific city can be more accurate, based on a survey from that city instead of national averages. Some difficulties were involved with using these data, which lead to the decision of using Kentallen only. First of all, a lot of the SPR data was not complete and thereby insufficient for usage. For other parts of the data, that were complete per company, a lot of big differences were found when compared to the Kentallen for a similar company. As the Kentallen are more reliable because these are averages, based on several studies, it is decided to use the more reliable data instead. For the SPR data not yet eliminated there is no real reason for use anymore, because these data are comparable to the data from the Kentallen. Therefore, only the data from the Kentallen has been used.

When the above described data is available, the total volume of goods for a certain city can be calculated.

From the Locatus file, it is known that in each (sub) branch  $i$ ,  $n$  (with  $n \geq 0$ ) shops are settled in a specific city. A company from the Locatus file belongs to one (sub) branch  $i$  with its unique average weekly volume of goods per shop ( $r_i$ ,  $p_i$ ,  $b_i$ ,  $c_i$ ,  $u_i$ , where the average number of roll containers delivered to a shop in (sub) branch  $i$ , equals  $r_i$ , etc).

Summed over each (sub) branch, the total volume for the city center, separated per loading unit ( $r$ ,  $p$ ,  $b$ ,  $c$  and  $u$ ), is calculated as follows:

$$r = \sum_{i=1}^I r_i$$

$$p = \sum_{i=1}^I p_i$$

$$b = \sum_{i=1}^I b_i, \text{ where the (sub) branches range from 1 to } I.$$

$$c = \sum_{i=1}^I c_i$$

$$u = \sum_{i=1}^I u_i$$

## 5.2. Estimate number of vehicle movements by GCD

Depending on the total volume of goods (expressed in  $r$ ,  $p$ ,  $b$ ,  $c$  and  $u$ ), the expected number of vehicle movements GCD needs to deliver these goods to the shops, can be calculated, under several assumptions:

- First, it is assumed that GCD will cooperate with each individual carrier and thereby delivers to every shop in the city center. Due to this assumption, a potential number of vehicle movements will be calculated, which results in the potential maximum savings in vehicle movements, for the city as a whole.
- Second, it is assumed that GCD uses only two kinds of delivery vehicles. These types of vehicles are relatively small: delivery vans and small trucks (with a lift).
- Third, it is assumed that boxes or parcels and unpacked goods will be delivered by using a delivery van and that a small truck is used for the delivery of pallets, roll containers and clothing frames.
- Fourth, it is assumed that GCD utilizes maximum capacity of its delivery vehicles.

To estimate the number of vehicle movements, depending on the total volume of goods, also data about the capacity of the vehicles of GCD should be used. The maximum capacity of both types of vehicles is shown in table 5.1:

**Table 5-1: Vehicle type capacities<sup>3</sup>**

Capacity	r	p	b	c	u
Delivery van	0	0	160	0	160
Small truck	18	12	0	18	0

From table 5.1, it can be concluded that for 160 boxes one delivery van is needed, or that for 80 boxes and 80 unpacked goods, one delivery van is needed. This also holds for the small truck. For this to be true, it needs to be assumed that the loading space is evenly divisible for different types of loading units.

The calculations of the expected number of vehicle movements ( $v$ ), needed for the given amount of goods, are as follows:

$$v_{dv} = b/160 + u/160$$

$$v_{st} = r/18 + p/12 + c/18$$

$$v = v_{dv} + v_{st}$$

where  $v_{dv}$  is the number of vehicle movements of a delivery van and  $v_{st}$  the number of vehicle movements of a small truck.

<sup>3</sup> These capacities have been determined by the actual capacities of the vehicles used by GCD.

However, these calculations are based on the assumption that GCD will transport goods for each (sub) branch. In reality, this is not true. GCD will not deliver goods to shops of all branches. Whether a branch is interesting for GCD to cooperate with depends on varying factors. For example, GCD will not transport goods to supermarkets, because within this branch, the distribution is already efficient due to large volumes of goods transported by large trucks, with good capacity utilization. Another example is the pharmacy branch, which will not be supplied by GCD, because of legislation issues. Choices to (not) supply certain branches are influenced by different factors. In consultation with Roel Menheere, an overview of the branches to be interesting for GCD, has been determined. This overview can be seen in appendix I.

Taking into account the relevant branches, and thereby excluding the irrelevant branches to determine the number of vehicle movements needed by GCD, the calculations will slightly evolve. Within the calculations of the total volume of goods (expressed in  $r$ ,  $p$ ,  $b$ ,  $c$  and  $u$ ), the sum was taken over all branches  $i$ . Instead, the sum should only be taken for the relevant branches, so if  $i$ =relevant. The volume of goods that is interesting for GCD can be determined as follows:

$$r_{GCD} = \sum_{i \in R} r_i$$

$$p_{GCD} = \sum_{i \in R} p_i$$

$$b_{GCD} = \sum_{i \in R} b_i, \text{ where } R \text{ is a subset of relevant branches.}$$

$$c_{GCD} = \sum_{i \in R} c_i$$

$$u_{GCD} = \sum_{i \in R} u_i$$

Given these results, the number of vehicles needed for the volume of goods that is interesting for GCD, can be calculated almost similarly as before:

$$v_{GCD,dv} = b_{GCD} / 160 + u_{GCD} / 160$$

$$v_{GCD,st} = r_{GCD} / 18 + p_{GCD} / 12 + c_{GCD} / 18$$

$$v_{GCD} = v_{GCD,dv} + v_{GCD,st}$$

### 5.3. Estimate the current number of vehicle movements

The license plate investigation (which was available for Tilburg) offers a way to estimate the current number of vehicle movements. Within this investigation by Ermens (2008), every vehicle movement has been counted, for a certain region in the city. Unfortunately, the number of vehicle movements seemed to be unreasonably large, when compared to the potential number of vehicle movements needed by GCD. This

may be caused by the broadness of the license plate investigation: also movements which were not distribution-related have been observed. In the end, the license plate investigation has not been used, because of its unsuitableness.

Instead of the license plate investigation, the current number of vehicle movements has to be estimated by a different method. Therefore the calculations are based on the number of deliveries ( $d_i$ ) a shop (within a specific (sub) branch  $i$ ) receives on average (per week). The numbers of deliveries are also available from the Kentallen, like the volume of goods for an average shop in a specific (sub) branch. The sum (over all shops) of the number of deliveries per shop, however, does not result in the current number of vehicle movements. The total current number of vehicle movements is smaller than just the sum of the number of deliveries per shop, because a vehicle movement may have more than one stop on its route. To make the step from the total number of deliveries to the number of vehicle movements, the average number of stops on a route should be determined for each branch.

For each (sub) branch  $i$ , information about the delivering vehicles can be extracted from the Kentallen. For each branch, a percentage of the use of each of the four types of vehicles (delivery van, small truck, midsize truck and large truck) is known and sum up to one. For a certain company, for example, 75% of the deliveries will be done by a delivery van, 25% of the deliveries will be deliveries by small trucks and there are no deliveries by midsize and large trucks. This information has been included in the masterdatabase.

Also for each (sub) branch and per type of vehicle, data about the average number of stops on a route is received from DHV. It should be mentioned that this data is based on an expert's view and is not scientifically proven to be right. Nevertheless, no better data is available, so the data is used in calculations.

The calculations start at branch level, to determine the average number of stops on a route for a vehicle that supplies a shop in that branch. This average number of stops on a route ( $\bar{s}$ ) is a weighted average of the number of stops on a route ( $s$ ) per type of vehicle (weighted by the percentages of use ( $pu$ ) of each of the four types of vehicles delivery van ( $dv$ ), small truck ( $st$ ), midsize truck ( $mt$ ) and truck + trailer ( $tt$ )). In formulas, it follows for branch  $i$ :

$$\bar{s}_i = pu_{dv,i} \cdot s_{dv,i} + pu_{st,i} \cdot s_{st,i} + pu_{mt,i} \cdot s_{mt,i} + pu_{tt,i} \cdot s_{tt,i}$$

Combining the number of deliveries with this branch dependent factor, the number of vehicle movements can be estimated. The current number of vehicle movements for branch  $i$  ( $v_{cur,i}$ ) is determined as follows:

$$v_{cur,i} = \frac{d_i}{\bar{s}_i}$$

Now that the current numbers of vehicle movements per branch are known, the total number of vehicle movements ( $v_{cur}$ ) in the city center can easily be estimated:

$$v_{cur} = \sum_{i=1}^I v_{cur,i}$$

#### 5.4. Savings in terms of vehicle movements

In the end, the savings in terms of vehicle movements should be estimated. In the current situation  $v_{cur}$  vehicle movements are needed for city supplies. On the contrary, when GCD is involved in city distribution, GCD needs  $v_{GCD}$  movements for branches  $i \in R$ . For the branches  $i \notin R$ , the number of vehicle movements ( $v_{nonGCD}$ ) do not decrease due to GCD and can be estimated as follows:

$$v_{nonGCD} = \sum_{i \notin R} v_i$$

Combining these results, the savings in terms of vehicle movements can be expressed in formula form:

Savings =  $v_{cur} - (v_{GCD} + v_{nonGCD})$  vehicle movements.

In percentages the savings are  $\frac{v_{cur} - (v_{GCD} + v_{nonGCD})}{v_{cur}} \cdot 100\%$ .

Note that these savings only will be realized if GCD replaces all vehicle movements for the relevant branches. In practice, this will be unrealistic, but these results should be seen as potential savings when the city is mainly supplied by city distributors. Note also that the calculations are based on full capacity utilization of GCD, which may not always be realized.

#### 5.5. Results for Tilburg and Amersfoort

The analysis, as described in the previous sections of this chapter, can easily be applied to a specific city. Just the Locatus file for this city should be filled in in the Masterdatabase and the possible savings in terms of vehicle movements will be calculated automatically. For Tilburg and Amersfoort, this has been done. The results for these two cities follow in sections 5.5.1 and 5.5.2 respectively.

### 5.5.1. Results for Tilburg

With the Locatus file of Tilburg as input data for the analysis for Tilburg, results have been obtained (see table 5.2). The GCD concept may save approximately 1141 vehicle movements weekly, which is a saving of 63,2% compared to the situation without city distributors. This implies that the GCD concept provides important benefits to national carriers and to the city. The national carriers will be able to reduce their costs for city deliveries, because the savings in terms of vehicle movements imply that city supplies can be more efficient and thereby cheaper. The savings should not only be seen quantitatively, but they also positively influence the shopping climate due to less congestion of delivering vehicles, less pollution, less accidents, etc.

**Table 5-2: Results for Tilburg**

<b>Volume for GCD:</b>						
total number of movements	number of unchanged movements	total number of rc's	total number of pallets	total number of boxes	total number of clothing racks	total number of unpacked goods
1806,9791	326,396358	2539,7226	777,85321	13041,11	743,203	1707,137
<b>Capacity</b>	delivery van small truck	0 18	0 12	160 0	0 18	160 0
<b>Movements for GCD:</b>						
	number of movements					
delivery van	92,1765433					
small truck	247,205857					
total	339,3824					
potential savings	1141,20038			63,16%		

### 5.5.2. Results for Amersfoort

With the Locatus file of Tilburg as input data for the analysis for Amersfoort, results have been obtained (see table 5.3). The GCD concept may save approximately 807 vehicle movements weekly, which is a saving of 59,0% compared to the situation without city distributors. The absolute savings are smaller than those in Tilburg, but approximately the savings are comparable to the savings in Tilburg. Doing this analysis for more cities will provide suitable data to estimate the average savings and a confidence interval for a city, caused by well organized city distribution.

**Table 5-3: Results for Amersfoort**

<b>Volume for GCD:</b>						
total number of movements	number of unchanged movements	total number of rc's	total number of pallets	total number of boxes	total number of clothing racks	total number of unpacked goods
1389,2522	374,888077	1170,309	411,69635	8747,09	590,4333	1241,007
<b>Capacity</b>	delivery van	0	0	160	0	160
	small truck	18	12	0	18	0
<b>Movements for GCD:</b>						
		number of movements				
	delivery van	62,42561				
	small truck	132,12707				
	total	194,55268				
	potential savings	819,81148		59,01%		

### 5.6. Branch dependent savings

In section 5.5, savings have been determined taking into account a total replacement of the national carrier's vehicle movements for relevant branches by trips of GCD. This gives a good impression of the potential city wide savings, but ignores the differences between branches. Some branches may lead to more potential decreases in terms of vehicle movements and might thereby be more interesting to focus on.

Figure 5.1 shows the results for the potential savings per branch, for both the cities Tilburg and Amersfoort.

For most of the branches, the potential savings are more or less the same for both cities. However, for some branches, differences between the cities exist. The branches of supermarkets and warehouses (both not relevant for GCD actually<sup>4</sup>) seem to have less than average potential savings for both cities, but in Amersfoort the potential savings

<sup>4</sup> All irrelevant branches are marked with a single \* in figure 5.1. The branches that are partly relevant are marked with \*\*. See also Appendix I for more details on the relevance of the branches.

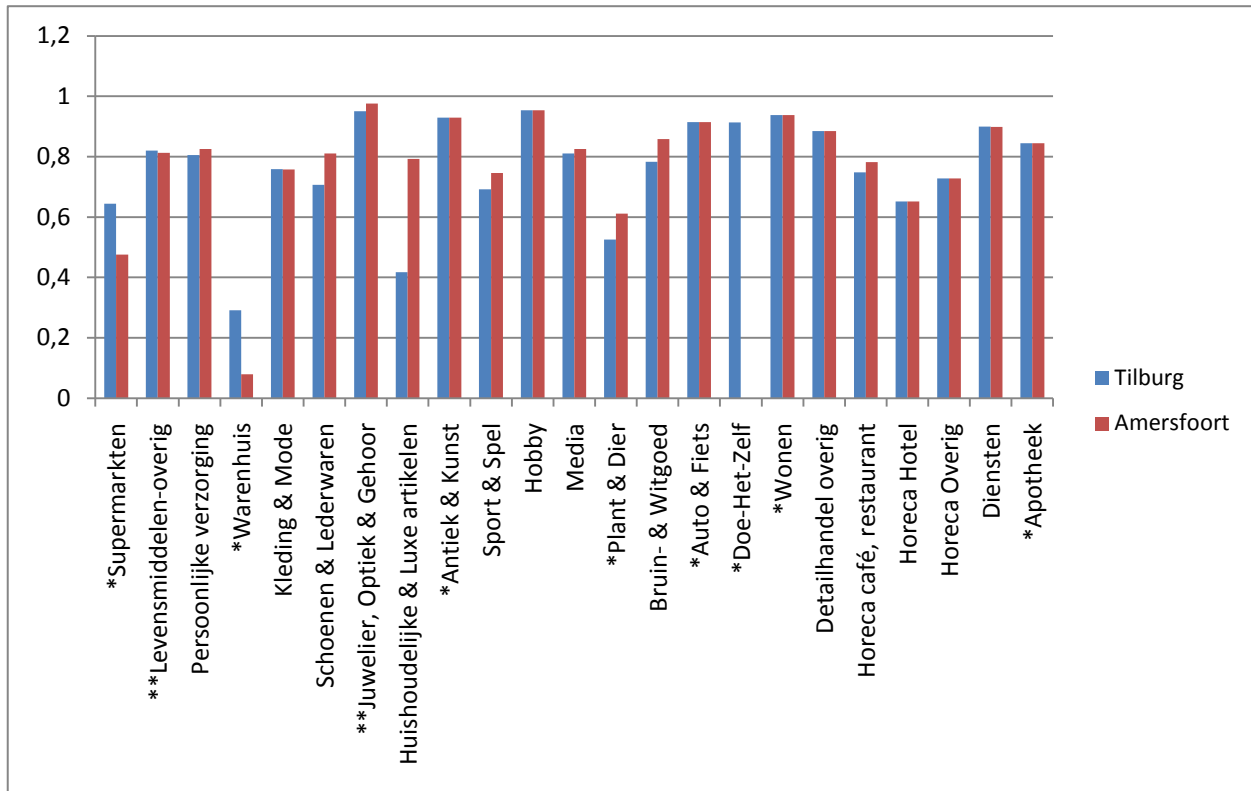


Figure 5-1: Branch dependent savings

are even worse than in Tilburg. It is not strange that these branches have smaller savings than other branches, because in the current situation for these branches the distribution is already quite efficient, which is one of the reasons for these branches to be of less interest to GCD. However the branch of household and luxury products is a relevant branch for GCD but differences in potential savings within the two cities. A reason for this might be the amount of shops within this branch. Amersfoort has 50 of these shops where Tilburg has only 29 of these shops in its city center. The last major difference can be found in the do-it-yourself (DIY) branch. In Amersfoort there will be no savings within this branch, because the city center of Amersfoort does not contain any DIY shops.

The potential savings in other branches seem to be more or less equal in both Tilburg and Amersfoort. A lot of branches show a possibility of vehicle movement savings over 80%, although not all of these branches are relevant for GCD. The branch of jewelry and opticians for example (which is partly relevant: jewelry is not, optician is) has an enormous potential for savings in terms of vehicle movements. Shops within this branch normally get deliveries of small volume, for which, if clustered, a negligible amount of vehicle movements is needed.

## 6. Analysis: effect of the GCD concept for national carriers

As is demonstrated in chapter 5 the GCD concept has important effects for the city in which GCD is operating: about 60% of the total vehicle movements can be saved. This means that city distribution can be much more efficient and thereby it does not have to be as expensive as it is today. In this chapter the efficiency of GCD will be translated into decrease of costs by the approach outlined in section 4.2.

First, in section 6.1, the cost savings will simply be based on the differences between the operational costs of a national carrier and of GCD for a certain volume of goods. These costs come to the same thing as the variable costs that have been mentioned in section 4.2. In section 6.2, basically the same calculations as in section 6.1 will be done, only the model will now take into account the duplication effect: when goods of more national carriers will be distributed by GCD, probably the goods for one shop can be clustered within one vehicle movement, which results in less stops on a route and less time needed for that movement. The duplication effect can be viewed as economies of scale. Section 6.3 shortly describes the method of surveying the national carriers. The survey is used in section 6.4, to illustrate the potential savings of several companies. As mentioned in section 4.2, besides the variable cost savings due to more efficient operations, the GCD concept may lead to more cost savings which are not directly related to efficiency. These cost savings will be clarified in section 6.5, also using the results from the survey.

### 6.1. Cost savings due to efficiency

Potential cost savings for a national carrier heavily depend on its current operations. To be able to determine the cost savings for national carrier  $j$ , information on this carrier should be used as input data. As is described in section 4.2, several sorts of input data are needed to determine the potential cost savings. The national carrier's situational description will be based on:

- Its number of movements to a specific city per type of vehicle  $k$  ( $m_{j,k}$ );
- Average time the carrier spends in a city per movement (also per type of vehicle  $k$ ) ( $t_{j,k}$ );
- Its average weekly volume of goods distributed into this city (per type of loading unit  $i$ : where  $i$  can equal  $r$  (roll containers),  $p$  (pallets),  $b$  (boxes),  $c$  (clothing frames) or  $u$  (unpacked goods)). The number of roll containers distributed by carrier  $j$ , is coded as  $r_j$ .

Depending on these data, the operational costs of the last mile of the national carrier's trip into a city (in section 6.1.1) and GCD's operational costs for a comparable volume of goods (in section 6.1.2) can be estimated.

### 6.1.1. National carrier's last mile operational costs

The costs of the last mile that the national carrier has to take care of in the current situation can be based on the time needed by the national carrier for this last mile. This is possible because of the availability of a common hourly cost rate (HCR) for different types of delivery vehicles  $k$  (where  $k$  can be equal to  $dv$  (delivery van),  $st$  (small truck),  $mt$  (midsize truck) and  $tt$  (truck + trailer)). These rates are shown in table 6.1, where the hourly cost rates (HCR's) include all relevant time depending costs (variable costs such as driver's wages and fuel, but also overhead costs).

Table 6-1: Common hourly cost rates per type of vehicle<sup>5</sup>

Type of vehicle	Dv	St	mt	tt
HCR	€25,-	€40,-	€50,-	€60,-

The table shows that a smaller delivery van is on average cheaper than a large truck (as will be expected). With these HCR's, the time a vehicle of a national carrier spends in a city, can easily be transformed into the costs involved with the last mile of a trip into a specific city. Per type of vehicle, the weekly costs of carrier  $j$  ( $TC_{j,k}$ ) can be calculated as expressed in the following equation:

$$TC_{j,k} = m_{j,k} \cdot t_{j,k} \cdot HCR_k$$

Summing  $TC_{j,k}$  over each type of vehicle  $k$  will result in the estimated total costs of the last mile for national carrier  $j$  ( $TC_j$ ):

$$TC_j = \sum_k TC_{j,k}$$

### 6.1.2. GCD's operational costs for goods of national carrier $j$

Also for GCD, operational costs can be based on the common hourly costs of table 6.1, because these values roughly depend just on the vehicle types and not on the company that uses the vehicles, i.e. the differences between costs of different distributors are insignificant.

Before the HCR's are used within the calculations, the number of vehicle movements needed by GCD should be determined and this should be combined with the average

<sup>5</sup> These HCR's have been estimated by experience of Roel Menheere.

time GCD needs to deliver these goods. The number of vehicle movements depends only on the volume of goods of the national carrier and the calculations are more or less similar to the calculations in section 5.2, only here no distinction is made between different branch codes  $i$ , but instead just the goods belonging to national carrier  $j$  are taken into account (assuming that GCD will be able to deliver all goods from that national carrier, also when national carrier delivers to non interesting branches). As in section 5.2, GCD uses two types of vehicles, with capacities as described in table 6.2 (These values are the same as in table 5.1, but are repeated here for convenience).

**Table 6-2: Vehicle type capacities**

Capacity	r	P	b	C	u
Delivery van	0	0	160	0	160
Small truck	18	12	0	18	0

The number of vehicle movements needed by GCD for the goods of carrier  $j$  ( $v_{dv,j}$  for delivery vans and  $v_{st,j}$  for small trucks) is calculated as follows:

$$v_{dv,j} = b_j / 160 + u_j / 160$$

$$v_{st,j} = r_j / 18 + p_j / 12 + c_j / 18$$

In this section it is assumed that GCD needs an average time per vehicle movement with a certain delivery vehicle. At the moment GCD needs on average 8 hours per vehicle movement with a delivery van and on average 2,5 hours per vehicle movement with a small truck. A small truck consumes less time per movement compared to a delivery van, because it mostly has less stops on its route, because of the larger volume of an average loading unit that is transported by a small truck. A delivery van is used for small loading units (boxes and unpacked goods) and therefore needs to stop more often in a vehicle movement, which is more time consuming.

With this information, the operational costs of GCD necessary to replace the movements of national carrier  $j$  ( $TC_{GCD,j}$ ), can be determined like this:

$$TC_{GCD,j} = 8 \cdot HCR_{dv} \cdot v_{dv,j} + 2,5 \cdot HCR_{st} \cdot v_{st,j}$$

The difference between  $TC_j$  and  $TC_{GCD,j}$  equals the operational savings for the deliveries of the goods of national carrier  $j$ . Note that the above calculations only hold in the situation of several cooperating national carriers with GCD. If GCD cooperates with just one national carrier, GCD would not be able to gain a significant amount of money due to this cooperation. Without the assumption of several cooperating carriers, the calculations of the vehicle movements of GCD would also not be correct. These calculations may result in a non integer value of vehicle movements which should be rounded off upwards, because half a vehicle movement does not exist. In case of more carriers cooperating with GCD, it is less important for the number of vehicle movements

to be an integer value, because summing over all national carriers  $j$  will result in a larger amount of vehicle movements. This number should also be rounded off upwards, but the effect of rounding off will be relatively small in comparison with the situation of a single cooperating national carrier.

Note also that the cost savings focused on in this section are more or less a translation of the efficiency of GCD compared to that of the national carriers. These calculated potential cost savings are an upper bound for the real cost savings, because it is assumed that GCD is able to utilize the full capacity of its vehicles. Also, the national carriers will not see their own operational costs diminish when GCD will take care of the distribution into the city center. Instead of delivering goods into the city center by themselves, they need to unload their goods at GCD's warehouse outside the city center. Nevertheless, this action consumes less time than the city center deliveries they were used to do. The realized cost savings will therefore be lower than the potential cost savings which can be calculated as described in this section.

## 6.2. Cost savings due to efficiency and economies of scale

The calculations described in the previous section are rather straightforward: the model translates capacity utilization into cost savings, regardless of other effects. In fact the calculated savings by that method is simplified slightly too much. Nevertheless it serves as a clear basis for further calculations on an extended version of this model. In this section, the effects of economies of scale will be implemented in the model of section 6.1. Economies of scale occur for GCD when GCD cooperates with an increasing number of national carriers.

More carriers to provide supply services for, will result in possibilities of clustering goods more efficiently than in a situation of just a few cooperating carriers. More efficient clustering of goods means that a full truck will be filled with goods for a specific part of the city and that all goods (which normally would be supplied by different national carriers) for one shop will mostly be clustered into the same vehicle. Under these conditions, vehicle movements will be less time consuming and thus less costly. In section 6.2.1, the extension of the model will be described.

### 6.2.1. Extended model

The expected time needed for an average vehicle movement (both for the types delivery van and small truck) depends on the number (or percentage) of national carriers cooperating with GCD. When GCD cooperates with  $n\%$  of the national carriers which are active in a specific city, the average time needed for a vehicle movement can be described as a function  $f$  of  $n$  ( $f(n)$ ), for both types of vehicles that GCD uses. Therefore, the average time needed for a delivery van (with full capacity utilization) becomes  $f_{dv}(n)$  and for a small truck  $f_{st}(n)$ . Without assuming a specific form of these functions, the

functions can be inserted in the model of section 6.1. The number of vehicle movements necessary for the goods of carrier  $j$  remains the same as in the previous section, because that number depends only on the volume of goods and the capacity constraints of the vehicles used by GCD. The operational cost calculations for GCD do become slightly more sophisticated. The total costs for GCD, belonging to the supplies for carrier  $j$ , with  $n\%$  of the national carriers cooperating with GCD ( $TC_{GCD,j,n}$ ) can be formulated as follows:

$$TC_{GCD,j,n} = f_{dv}(n) \cdot HCR_{dv} \cdot v_{dv,j} + f_{st}(n) \cdot HCR_{st} \cdot v_{st,j}$$

So the total operational costs for GCD depend now on the percentage ( $n$ ) of cooperating carriers, where the domain of  $n$  equals  $(0,100]$ . Note that the calculations are useless when  $n=0$ , because in that case, GCD will not distribute goods and operating costs will be lacking.

Until now, no assumptions have been made about the underlying function of the decrease in vehicle movement time. In section 6.2.2, it will be investigated which mathematical distribution might be a suitable approach for the decreasing average movement times.

### 6.2.2. Underlying distribution of decreasing average movement times

The function needs to behave according to a number of criterions. First of all, the function of average movement times should decrease for increasing market share of GCD. More interesting is the manner of the declining average movement times. No literature about this effect is available, so within this section, the decrease in average movement times will be approached by the declining marginal costs caused by economies of scale.

In literature (among others Varian (2005)) the effect of decreasing costs when economies of scale are utilized, has been mentioned. Actually, literature does not prescribe a certain function for this decrease. In fact this is comprehensible, because the development of the costs (in micro-economic circumstances) depends on the specific circumstances of the company under concern. Nevertheless, most models show a non-linear decrease, which is steeper at the beginning and flatter at the end. This means that economies of scale will result in relatively large improvements within the first stages of conquering the market. On the contrary, increasing market share when market share is already large will have less impact on marginal costs.

In the context of GCD, I think this effect will be roughly the same. An increase of GCD's market share from 5% to 10% will for example lead to relatively more (compared to an increase from for example 80% to 85%) goods which can be delivered to the same address or to the same part of the city center, resulting in more efficient and less time consuming transport movements into the city center.

Several non-linear functions behave according to these characteristics. Based on a numerical example of the possible declining movement times of GCD's delivery vans, the exponential, logarithmic and power function will be compared.

Figures 6.1, 6.2 and 6.3 are all based on the current average vehicle movement times for GCD (on average eight hours per movement at 5% market share) and on the expected time needed in case of a full market share (which is estimated to be equal to five hours per movement<sup>6</sup>). Between these points, the values depend on the assumed underlying distribution. The distributions are fitted between the two end-points by using Microsoft Excel.

Figure 6.1 shows the decreasing vehicle movement times in case of an assumed exponential decrease. In this figure, the fitted function of  $f_{dv}(n)$  becomes:

$$f_{dv}(n) = 8,200 \cdot e^{-0,005n}$$

This underlying distribution is very close to a linear relationship, although it is slightly curved. To mediate the vehicle movement times (between eight hours at 5% market share and five hours at full market share), the market share should increase to approximately 50%. In reality, a market share of 50% is already very large (it is not realistic to assume full market share) and the effects of more cooperating national carriers should be larger by then.

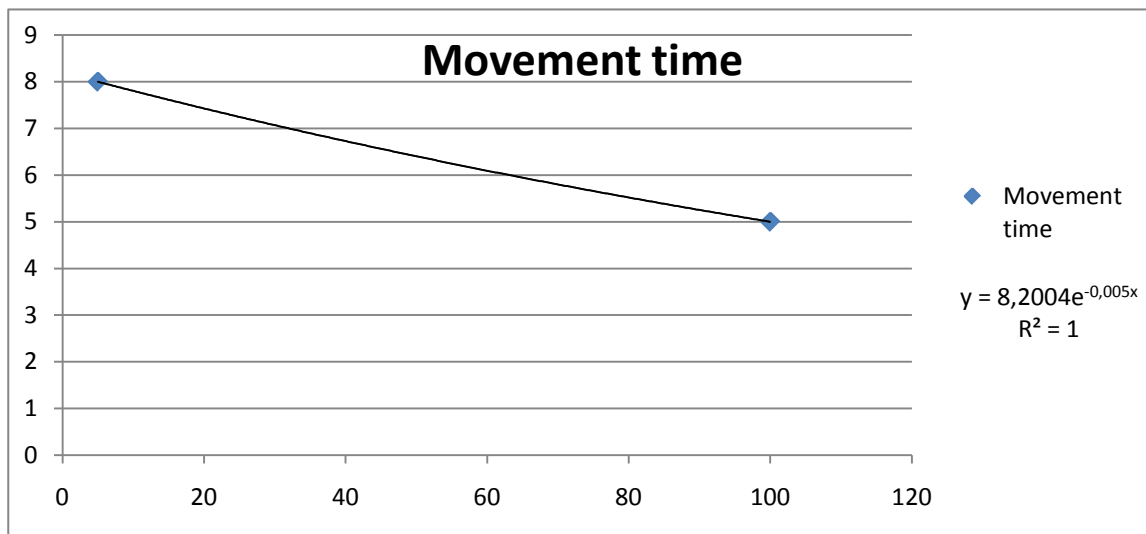


Figure 6-1: Exponential decrease of delivery van's movement time

Figure 6.2 shows another possible underlying distribution: a decrease expressed by a power function. The function of  $f_{dv}(n)$  is now equal to

<sup>6</sup> It should be mentioned that this average movement time is just an expectation and may be different when this market share will be realized.

$$f_{dv}(n) = 10,298 \cdot n^{-0.157}$$

Compared to the exponential function, the curve is stronger and thereby the estimated vehicle movement times decrease much faster in early increases of market share. Compared to the 50% of market share needed to mediate between the extreme movement times in the exponential model, using the power function an increase to 19% leads to the same result. Where the exponential function might underestimate the effect of duplication, the powerfunction may be too optimistic. Therefore a more nuanced function might be more appropriate.

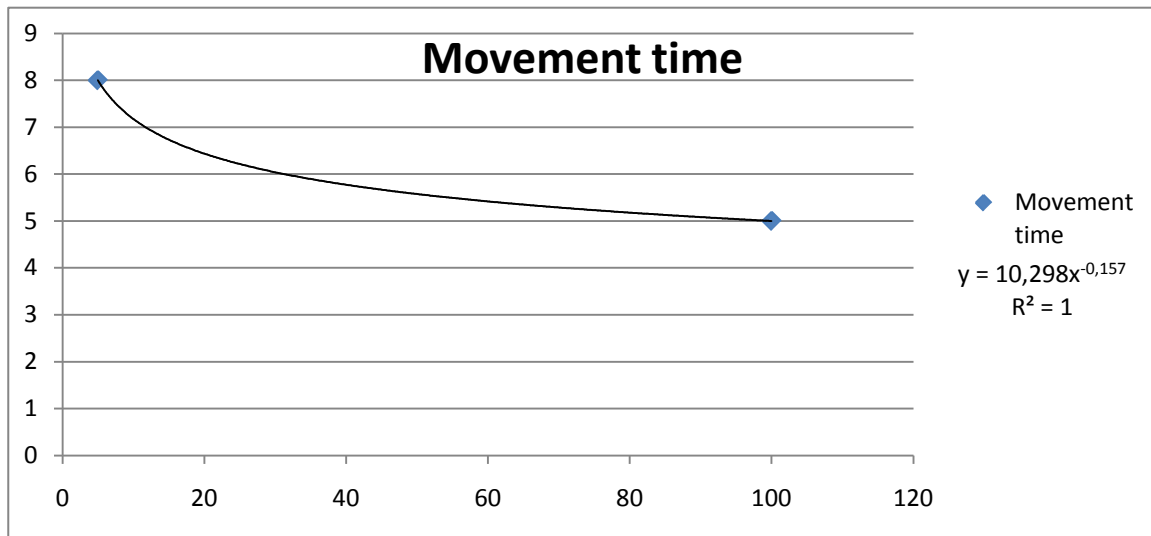


Figure 6-2: Power function decrease of delivery van's movement time

Figure 6.3 shows this more nuanced function: a logarithmic decrease of vehicle movement times. This function is less linear than the exponential function and less sharply curved than the power function. Between the extreme values, the logarithmic function  $f_{dv}(n)$  is fitted to be like this:

$$f_{dv}(n) = -1,001 \cdot \ln(n) + 9,612$$

To let the average vehicle movement times decrease from seven to five hours under the logarithmic distribution, an increase of market share to about 22% will be necessary.

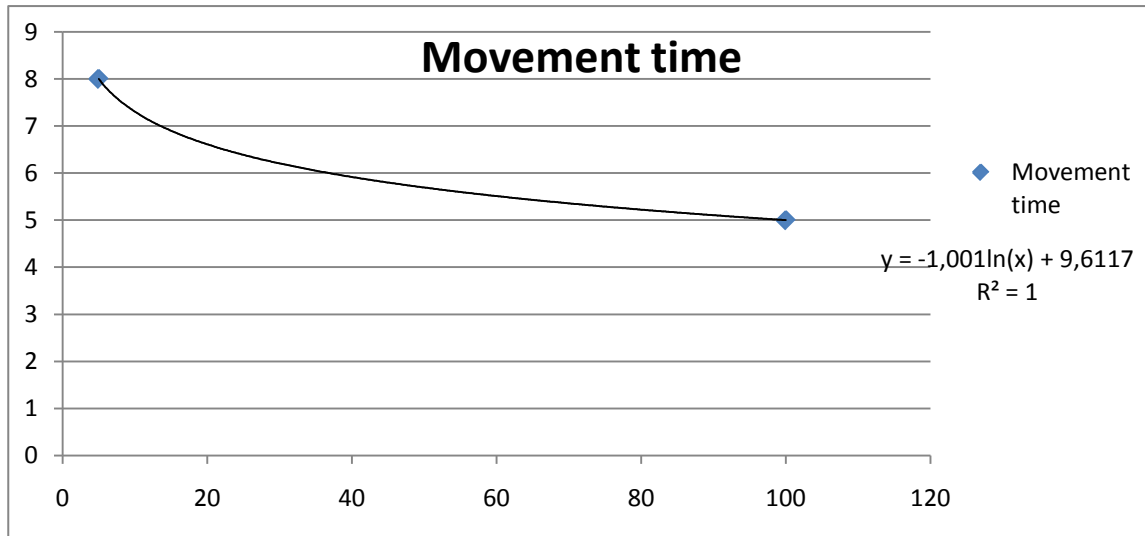


Figure 6-3: Logarithmic decrease of delivery van's movement time

In my opinion, the logarithmic curve seems to be the best alternative to describe the decreasing average movement times when the number of cooperating national carriers increases. It compromises between the exponential and the power function and besides that it is the most logical choice to describe a decreasing trend. Exponential functions are mostly used in situations with increasing values and power functions are not typically used to model either increasing or decreasing trends. Therefore, the logarithmic function might be the best alternative, albeit that it is far from proven to be right. It is out of the scope of this project to prove its correctness. Nevertheless for calculations it can be used to illustrate the effect of market share.

As the decrease of movement times for delivery vans can be described by a logarithmic function, also for small trucks this is possible. In figure 6.4, the logarithmic function for the decreasing movement times for a small truck is fitted. The fitting is based on two estimated values (as in the case of the delivery van): an estimated average movement time of 2,5 hours at 5% market share which can decline to 1,5 hours in case of full market share. The decrease of a small truck's movement time can be expressed as  $f_{st}(n)$  and is described as follows:

$$f_{st}(n) = -0,334 \cdot \ln(n) + 3,0372$$

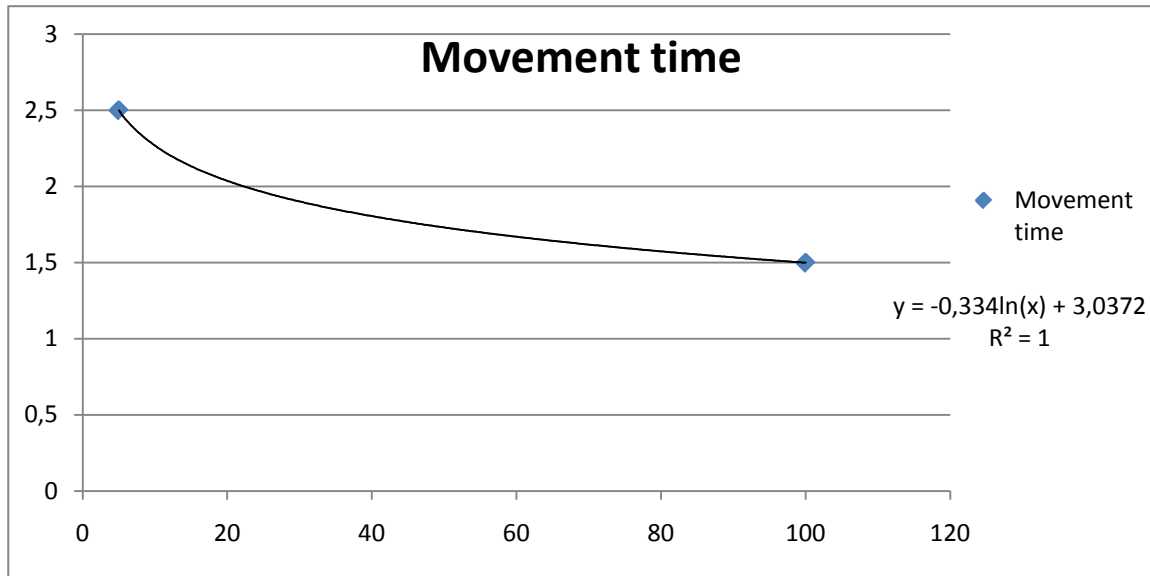


Figure 6-4: Logarithmic decrease of small truck's movement time

### 6.3. National carriers surveyed

To be able to use the model to get an impression of the potential savings, profiles of national carriers are necessary to calculate their potential savings. A national carrier's profile consists of the different sorts of input data needed for the model (as described in section 4.2). To acquire these data (and some other sorts of data that could be used for other purposes) Jesse Hoekstra<sup>7</sup> and I set up a survey. The survey has been sent to the members of TLN (Transport en Logistiek Nederland). Most of the Dutch transportation companies are members (about 6000) of TLN, so the survey could have been filled in by almost the total population of transportation companies in the Netherlands. To stimulate a high response rate and easy to implement results, the survey was a web-based one. The complete survey is attached in appendix II. In the next section, the results of the survey will be discussed with respect to potential cost savings due to the efficiency of the GCD concept. Section 6.5 is also based on this survey, but on different questions in it.

### 6.4. Illustrating examples from survey

Based on the results from the survey it should be possible to calculate the average variable cost savings of an average transportation company. Unfortunately, the survey was not filled in satisfactory by all respondents. Therefore, data from only 11 out of the total 61 respondents could be used. The results from these 11 respondents are given in table 6.3 and are based on the average vehicle movement times in case of a market

<sup>7</sup> Jesse Hoekstra also did his bachelor thesis at GCD, but the focus of his project was on window times.

**Table 6-3: Several carrier profiles and their potential variable savings (at 5% market share)**

respondent	Average weekly volume of goods for city (per loading unit)					Weekly amount of vehicles used for city (per type of vehicle)				Average time of vehicle movement (per type of vehicle)				Calculated costs of national carrier	Calculated costs of GCD	Potential savings	percent
	r	p	c	b	u	dv per week	st per week	mt per week	tt per week	dv	st	mt	tt				
1	10	4	0	0	0	0	0	2	0	0	0	2	0	€ 200,00	€ 88,89	€ 111,11	55,6%
2	1	10	0	150	0	10	5	0	0	2	1,5	0	0	€ 800,00	€ 276,39	€ 523,61	65,5%
3	0	80	0	75	0	5	15	5	0	3,5	7	2	0	€ 5.137,50	€ 760,42	€ 4.377,08	85,2%
4	10	20	0	500	0	1	0	6	0	0	0	5	0	€ 1.500,00	€ 847,22	€ 652,78	43,5%
5	5	50	0	200	0	1	4	0	0	2	2	0	0	€ 370,00	€ 694,44	€ 324,44	-87,7%
6	1000	0	0	0	0	0	0	5	0	0	0	2	0	€ 500,00	€ 5.555,56	€ 5.055,56	-1011,1%
7	0	30	0	0	0	0	0	0	16	0	0	0	1	€ 960,00	€ 250,00	€ 710,00	74,0%
8	0	1	0	0	0	1	0	0	0	3	0	0	0	€ 75,00	€ 8,33	€ 66,67	88,9%
9	5	0	0	0	0	0	0	1	0	0	0	3	0	€ 150,00	€ 27,78	€ 122,22	81,5%
10	3000	350	0	0	0	0	0	0	12	0	0	0	2,5	€ 1.800,00	€ 19.583,33	€ 17.783,33	-988,0%
11	20	0	0	0	0	1	5	0	0	2	6	0	0	€ 1.250,00	€ 111,11	€ 1.138,89	91,1%

share of 5% (so 8 hours per movement of a delivery van and 2,5 hours per movement of a small truck).

Three sorts of input data are used per company to compute the estimated costs of a national carrier and the estimated costs for GCD for the given volume of goods. These calculations are the same as those described in section 6.1. No decreasing vehicle movement times for GCD due to increasing market share have been taken into account within the calculations in table 6.3.

Looking at the results, it is conspicuous that not for every respondent the GCD concept will result in savings. For example, respondents 6 and 10 are currently operating much more efficient than GCD can do, but their companies' profiles explain why this is not totally surprising. Both companies only deliver roll containers (and pallets) and they both use larger trucks than GCD uses. These companies do not belong to the foreseen clients of GCD. The data of these respondents do not seem to be realistic, because respondent 6 for example needs only 5 midsize trucks to deliver 1000 roll containers. This simply cannot be true or the question in the survey should have been misunderstood.

Company 5 however, seems to be using comparable vehicles as GCD uses itself, but needs far less time for vehicle movements. This might be possible in case of just a few common delivery addresses for company 5, otherwise the movement times needed by this company should be questioned to be realistic.

For all other respondents the GCD concept will result in significant savings in variable costs. Some of these companies are delivering a small volume of goods to the city and need a single truck for these goods. GCD on the contrary, can cluster those goods with the goods of other GCD clients and will be more efficient.

In table 6.4, the same results as in table 5.3 have been calculated, but in this case a full market share of GCD is assumed (so an average movement time of a delivery van equals 5 hours and that of a small truck is approximately equal to 1,5 hours). The potential savings are of course larger than in the previous table, thanks to the opportunities of duplication.

**Table 6-4: Several carrier profiles and their potential variable savings (at full market share)**

	Average weekly volume of goods for city (per loading unit)					Weekly amount of vehicles used for city (per type of vehicle)				Average time of vehicle movement (per type of vehicle)				Calculated costs of national carrier	Calculated costs of GCD	Potential savings	percent
	r	p	c	b	u	dv per week	st per week	mt per week	tt per week	dv	st	mt	tt				
1	10	4	0	0	0	0	0	2	0	0	0	2	0	€ 200,00	€ 53,33	€ 146,67	73,3%
2	1	10	0	150	0	10	5	0	0	2	1,5	0	0	€ 800,00	€ 170,52	€ 629,48	78,7%
3	0	80	0	75	0	5	15	5	0	3,5	7	2	0	€ 5.137,50	€ 458,59	€ 4.678,91	91,1%
4	10	20	0	500	0	1	0	6	0	0	0	5	0	€ 1.500,00	€ 523,96	€ 976,04	65,1%
5	5	50	0	200	0	1	4	0	0	2	2	0	0	€ 370,00	€ 422,92	€ 52,92-	-14,3%
6	1000	0	0	0	0	0	0	5	0	0	0	2	0	€ 500,00	€ 3.333,33	€ 2.833,33-	-566,7%
7	0	30	0	0	0	0	0	0	16	0	0	0	1	€ 960,00	€ 150,00	€ 810,00	84,4%
8	0	1	0	0	0	1	0	0	0	3	0	0	0	€ 75,00	€ 5,00	€ 70,00	93,3%
9	5	0	0	0	0	0	0	1	0	0	0	3	0	€ 150,00	€ 16,67	€ 133,33	88,9%
10	3000	350	0	0	0	0	0	0	12	0	0	0	2,5	€ 1.800,00	€ 11.750,00	€ 9.950,00-	-552,8%
11	20	0	0	0	0	1	5	0	0	2	6	0	0	€ 1.250,00	€ 66,67	€ 1.183,33	94,7%

Note that these data will not allow us to estimate an expected percentage of variable cost savings in case of a national carrier cooperating with GCD. The number of respondents is simply too small and some respondents may have filled in numbers

which might not be totally reliable. Nevertheless, the data offers the opportunity to get an impression of what could be saved in terms of variable costs. The calculated cost savings only take into account the vehicle movement times of the national carriers and GCD. When a national carrier chooses to cooperate with GCD, the vehicle movement time will not diminish totally. Instead of the time needed in the city center, the national carrier will need some time (but far less than in its current situation) to unload its goods at a GCD warehouse outside the city center. Because of this and because of the assumption that GCD utilizes the full capacity of its trucks (which might sometimes be less in reality), the potential savings of the example companies in tables 6.3 and 6.4, are an upper bound of the real savings. In reality, the savings due to the efficiency of the GCD concept will be a bit less than suggested in tables 6.3 and 6.4.

## **6.5. Other cost savings**

Besides the cost savings caused by the efficiency of GCD's operations, as described in section 6.1, it may be possible for national carriers to save even more in case of a cooperation with GCD. First, several reasons for additional cost savings will be discussed in section 6.5.1. Then, based on the previously described survey, the expected savings on the different aspects of additional cost savings will be discussed in section 6.5.2.

### **6.5.1. Several opportunities for additional cost savings**

A national carrier may be able to save money, because the company no longer needs to invest in small environmental friendly vehicles used for city distribution. Several cities have limitations for certain types of vehicles that are not allowed to enter the city center. For example, such a limitation can be a Low Emission Zone (LEZ) which may not be entered by vehicles with too high emission levels. Another limitation may be based on a maximum axle load of a vehicle. Utrecht for example, is a city that has a lot of old bridges that are not able to carry very heavy trucks. Therefore larger trucks cannot reach each part of the city center. GCD uses relatively small and green trucks, which are ideal for city center environments and thereby are not affected by most of these limitations.

For a national carrier, less effort may be needed on planning and administrative activities. Planning efforts can decrease, because the complex part of the planning will be outsourced to GCD. A national carrier only needs to deliver their goods to a GCD warehouse instead of the separate shops in the city center.

The savings due to more efficient operations were based on the situation in one city. However, GCD will be operating in more and more cities. Cooperating in more than one city will lead to efficiency savings per city (as shown by Quak and de Ree (2009)), but might also result in extra savings, because the contact with GCD is already there. Less

effort will be needed to cooperate in the additional cities than for the first city to cooperate in.

The variable savings due to the efficiency of GCD may also be compatible with fixed savings. The vehicles of the national carriers can operate more efficient, because the inefficient part will be outsourced. Therefore, the size of their fleet of cars may decrease, or may not change and deliver more goods.

The same reasoning holds for the number of employees (drivers) who need to be hired. The total number of drivers who work for the national carrier may decrease or stays the same and can be used for an increasing amount of deliveries due to more efficient processes.

### 6.5.2. Results from the survey

Based on the answers of the respondents of the survey described in section 6.3, it is possible to check the importance of the opportunities of additional cost savings, according to the national carriers. Unfortunately, the number of respondents who filled in the answers belonging to the questions about additional cost savings was again not very large. 18 out of 61 returned surveys were useful in this perspective. Also some outliers should be considered to be realistic or not. Therefore, it is again not possible to draw strong conclusions for the population, but it gives a first impression of the expectations of the national carriers. The results of the 18 respondents are shown in table 6.5.

To determine the importance of the savings because no investments in small and environmental friendly vehicles are needed, the carriers have been asked to express their expectations on this in terms of percentages of operational costs. As can be seen in table 6.5, 8 out of 18 respondents expect no savings in this field. Nevertheless, on average (these eight respondents included) the carriers expect to save approximately 9%<sup>8</sup> of operational costs, caused by the cooperation with GCD. When only the respondents who expect savings are taken into account, the expected savings will even increase to 16%.

The importance of the savings due to less effort needed for planning and administration has been measured by expressing the savings in percentages of the current expenses on planning and administration. Within this field, 7 out of 18 respondents do not expect additional savings. Overall expected savings and the expectations of the respondents who expect to save, equal 15% and 25% of administration costs respectively.

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<sup>8</sup> To calculate the averages, the interval scores should be translated to expected scores. Therefore a score of 1 has of course been interpreted as 0% expected savings, 2 as 5% (average within the interval), 3 as 15%, 4 as 25%, 5 as 35%, 6 as 45% and for a score of 7 an expected saving of 60% has been assumed. This might not totally be correct, but it is not possible to do it more accurate with the given data.

**Table 6-5: Additional savings expectations by national carriers**

	No investments in small/green vehicles	Less planning/administration effort	More than one city	Smaller fleet of cars needed	Less drivers needed	
1	4	4	2	3	2	1 = 0%
2	2	3	3	1	2	2 = 0-10%
3	2	2	2	1	1	3 = 10-20%
4	2	2	2	2	2	4 = 20-30%
5	4	2	4	3	3	5 = 30-40%
6	1	1	1	1	1	6 = 40-50%
7	1	1	1	1	1	7 = >50%
8	1	1	1	2	2	
9	1	1	1	1	1	
10	1	1	1	1	1	
11	7	7	7	5	5	
12	4	5	4	1	1	
13	1	7	1	1	1	
14	1	1	1	4	4	
15	2	2	2	2	2	
16	1	1	1	1	1	
17	3	4	4	2	2	
18	2	2	2	2	2	

Additional savings due to the opportunity of easy extensions to other cities have been measured by expressing the expected savings in percentages of operational costs. 8 out of 18 respondents expect no savings due to this factor. The average expected savings equal 9% and 16% of operational costs respectively.

The possible savings because a smaller fleet of cars will be needed are expressed in terms of the size of the current fleet of cars. One half of the respondents do not expect additional savings because of the possibly decreasing size of its fleet of cars. Although, on average the respondents expect their fleet of cars to decrease by 6% and 12% respectively.

Comparable to the expected decrease in the size of a carrier's fleet of cars, most respondents expect comparable decreases in the number of drivers hired by their company (expressed in percentages of current number of drivers hired). 8 out of 18 respondents expect no additional savings, but on average the savings are expected to be equal to 6% and 11% of current number of drivers under contract, respectively.

## 7. Conclusions

Within this project, the main goal was to express the effect of the concept of GreenCityDistribution (GCD). GCD adapts to the problem that is faced in most cities in the Netherlands: supplying shops in city centers is currently organized too chaotically and uses too many vehicles. As has been indicated in several supply profile reports for different cities, the consolidation of goods of different transport operators will be beneficial in this situation. GCD is willing to be part of the solution of this problem by offering the service of clustering goods of several national carriers and by taking care of the last mile of the national carrier's deliveries. In this report, it has been shown that this concept can result in savings, both city-wide and carrier related.

The first part of the report focused on the city-wide effect of the GCD concept. A standard file has been created which is able to compute the potential savings in terms of decreases in number of vehicle movements needed to supply a specific city center, when GCD will totally take care of all branches that are interesting for GCD. These savings have been computed for Tilburg and Amersfoort and resulted approximately in a potential 60% decrease of vehicle movements needed for the distribution of goods into the centers of these cities. This is a large improvement for the current problem of city distribution and is thus beneficial for the city as a whole. Also, the calculated potential savings show that the current manner of city distribution by the national carriers themselves is very inefficient. Increased efficiency due to the GCD concept can also be advantageous for the national carriers.

The second part of the report focused on potential savings for national carriers due to a cooperation with GCD. The model offered a manner of translating the difference between the current inefficiency of national carriers and the efficiency of GCD into potential cost savings. Illustrations from the data that had been required via a survey on transporting companies showed large potential savings (up to 90%) for most companies (depending on GCD's market share).

Besides the potential savings due to increased efficiency, national carriers may also be able to realize additional savings when cooperating with GCD. This has marginally been investigated via the survey on transporting companies. Approximately one half of the respondents expect additional savings on for example administration expenses and investments in small and green vehicles.

All in all, it is shown that the GCD concept offers great opportunities for cities as a whole and for national carriers. Convincing national carriers to cooperate with GCD will be very important, because most carriers are not aware of the opportunities a city distributor could offer them.

## 8. Limitations and future research

The calculations on potential savings suggest promising opportunities, but should be interpreted with caution, keeping in mind the underlying assumptions. The calculated potential savings will differ from the actual savings, because calculations were based on models that are a simplified version of reality.

Within the part of cost savings due to increase efficiency, the computed potential savings should be seen as an upper bound of real savings. The calculations namely did not take into account the extra time needed for unloading the goods of a national carrier and reloading these goods to vehicles of GCD. Time has been related to costs in the calculations, so also the time needed for the operations at GCD's warehouse will cost money. It may be an interesting topic for further research to extend the model in this report with the costs of the operations at GCD's warehouse. This will probably be not too complicated, because these operations will probably be very standard and may even be expressed in a fixed cost per vehicle movement of a national carrier. This fixed cost will then depend on the average time and resources needed at GCD's warehouse.

The illustrations on cost savings for national carriers were based on a small number of national carriers and will not represent the total population of distributors. The results from the calculations for these carriers should not be interpreted as average savings for an average company, but are just included to form a picture of the effect of the GCD concept. Future research could go further than the illustrative examples in this report by identifying several groups of carrier types (depending on the goods they deliver and the vehicles they use for deliveries) and by determining the average savings due to a cooperation with a city distributor such as GCD.

Another subject for further research could be related to the function of decreasing time needed for a vehicle movement, caused by the effect of duplication. In this report, three different functions have been fitted between two estimated points. The determination of the effect of duplication can be done better than in this report, by collecting more data on vehicle movement times of a city distributor.

## 9. References

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## 10. Appendices

### 10.1. Appendix I: Relevant branches for GCD

Branch codes	Branches <i>subbranches</i>	Interesting?
1	Levensmiddelen-supermarkt	No
1A	<i>supermarkten groot</i>	No
1B	<i>buurtsupers / avondwinkels</i>	No
2	Levensmiddelen-overig	(depends on sub branch)
2A	<i>Slager</i>	No
2B	<i>Bakker</i>	No
2C	<i>Delicatessen (jamin, multivlaai, etc)</i>	No
2D	<i>Reform</i>	No
2E	<i>Vis</i>	No
2F	<i>Noten en kaas</i>	No
2G	<i>Slijterij</i>	Yes
3	Persoonlijke verzorging (Douglas, Parfumerie, Etos, etc)	Yes
4	Warenhuis (Hema, V&D, Bijenkorf)	No
5	Kleding & Mode	Yes
6	Schoenen & Lederwaren	Yes
6A	<i>Schoenenwinkel</i>	Yes
6B	<i>Schoenmaker</i>	Yes
7	Juwelier, Optiek & Gehoor	(depends on sub branch)
7A	<i>Juwelier</i>	No
7B	<i>Opticien</i>	Yes
7C	<i>Gehoor</i>	Yes
8	Huishoudelijke & Luxe artikelen	Yes
8A	<i>Algemeen (Blokker, Kijkshop, Xenos, etc)</i>	Yes
8B	<i>Computers</i>	Yes
8C	<i>Telefoons</i>	Yes
8D	<i>Fotozaak</i>	Yes
9	Antiek & Kunst	No
10	Sport & Spel	Yes
10A	<i>Sport en kampeer</i>	Yes
10B	<i>Speelgoed</i>	Yes

11	Hobby (bijv. Muziekinstrumenten)	Yes	
12	Media	Yes	
12A	<i>Boeken</i>	Yes	
12B	<i>Muziek- en beeldragers</i>	Yes	
13	Plant & Dier		No
13A	D <i>Dierenwinkels</i>		No
13B	<i>Bloemenwinkels</i>		No
14	Bruin- & Witgoed	Yes	
14A	<i>Beide (algemeen)</i>	Yes	
14B	<i>Bruingoed (electronica, tv tec)</i>	Yes	
15	Auto & fiets		No
16	Doe-het-zelf		No
17	Wonen (Meubels, tapijt, keukens etc)		No
18	Detailhandel overig	Yes	
19	Horeca		No
19A	<i>Nachttenten (café, discotheek)</i>		No
19B	<i>Dagtenten (restaurants, lunchroom, etc)</i>		No
20	Horeca hotel		No
21	Horeca overig (Theater, Bioscoop, Catering, ..)		No
22	Diensten	Yes	
22A	<i>Reisbureaus</i>	Yes	
22B	<i>Uitzendbureaus</i>	Yes	
22C	<i>Kappers</i>	Yes	
22D	<i>Wasserij</i>	Yes	
22E	<i>Banken</i>	Yes	
23	Apotheek		No

## 10.2. Appendix II: The complete survey

### Enquête vervoerders

Geachte heer/mevrouw,

Voor een onderzoek naar stadsdistributie zijn wij op zoek naar vervoersbedrijven die een korte vragenlijst in willen vullen. Veel vervoerders ondervinden hinder van venstertijden, milieuzones en congestie bij het bevoorraden. Met behulp van dit onderzoek willen we onderbouwen dat stadsdistributie efficiënter en goedkoper kan, waarbij we uw hulp nodig hebben! Het onderzoek wordt uitgevoerd door de Technische Universiteit Eindhoven in samenwerking met TLN. De resultaten van de vragenlijst zullen uiteraard volledig anoniem verwerkt worden. Deelname kost slechts een paar minuten en de resultaten van het onderzoek kunnen een eerste stap zijn op weg naar betere regelgeving voor stadsdistributie.

Alvast bedankt voor uw medewerking!

Met vriendelijke groet,

Joeri Jansen en Jesse Hoekstra

## Enquête stadsdistributie

*De eerste vragen zullen gaan over bedrijfsspecifieke kenmerken. Wij begrijpen dat deze gegevens mogelijk gevoelige informatie zullen bevatten en daarom garanderen wij een vertrouwelijke behandeling van deze gegevens. De gegevens kunnen voor berekeningen worden gebruikt, maar zullen niet in combinatie worden getoond met uw bedrijfsnaam.*

Wat is de naam van uw bedrijf? (als u de vragenlijst anoniem wilt invullen, vul dan a.u.b. hieronder 'anoniem' in)

### 1a. Uit hoeveel van de volgende voertuigen bestaat uw wagenpark?

(1).  Bestelwagen (tot 3,5 ton)



(2).  Lichte vrachtwagen (tot 7,5 ton)



(3).  Middelzware vrachtwagen (tot 18 ton)



(4).  Zware vrachtwagen (boven 18 ton)



Voor welke branches verzorgt u de bevoorrading?

	Ja	Nee
Levensmiddelen-supermarkt	<input type="checkbox"/>	<input type="checkbox"/>
Levensmiddelen-overig	<input type="checkbox"/>	<input type="checkbox"/>
Persoonlijke verzorging	<input type="checkbox"/>	<input type="checkbox"/>
Warenhuis	<input type="checkbox"/>	<input type="checkbox"/>
Kleding & Mode	<input type="checkbox"/>	<input type="checkbox"/>
Schoenen & Lederwaren	<input type="checkbox"/>	<input type="checkbox"/>
Juwelier, Optiek & Gehoor	<input type="checkbox"/>	<input type="checkbox"/>
Huishoudelijke & Luxe artikelen	<input type="checkbox"/>	<input type="checkbox"/>
Antiek & Kunst	<input type="checkbox"/>	<input type="checkbox"/>
Sport & Spel	<input type="checkbox"/>	<input type="checkbox"/>
Hobby (bijv. Muziekinstrumenten)	<input type="checkbox"/>	<input type="checkbox"/>
Media	<input type="checkbox"/>	<input type="checkbox"/>
Plant & Dier	<input type="checkbox"/>	<input type="checkbox"/>

Bruin- & Witgoed	<input type="checkbox"/>	<input type="checkbox"/>
Auto & fiets	<input type="checkbox"/>	<input type="checkbox"/>
Doe-het-zelf	<input type="checkbox"/>	<input type="checkbox"/>
Wonen (Meubels, tapijt, keukens etc.)	<input type="checkbox"/>	<input type="checkbox"/>
Detailhandel overig	<input type="checkbox"/>	<input type="checkbox"/>
Horeca	<input type="checkbox"/>	<input type="checkbox"/>
Horeca hotel	<input type="checkbox"/>	<input type="checkbox"/>
Horeca overig (Theater, Bioscoop, Catering, etc.)	<input type="checkbox"/>	<input type="checkbox"/>
Diensten (zoals reisbureaus, kappers, banken, etc.)	<input type="checkbox"/>	<input type="checkbox"/>
Apotheek	<input type="checkbox"/>	<input type="checkbox"/>

In hoeveel steden levert u (ongeveer) goederen aan binnenstedelijke bedrijven/winkels?

0-10	10-20	20-30	30-50	50-70	70-100	>100
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Levert u weleens goederen in de binnenstad van Tilburg?

Ja  Nee

*De volgende vragen gaan iets dieper in op de beleving van een gemiddelde binnenstad.*

**(Indien <ja>)** Indien u van mening bent dat de beleving van de binnenstad van Tilburg door uw bedrijf, representatief is voor de beleving van een gemiddelde binnenstad, mag u voor de volgende vragen gegevens voor Tilburg invullen. Anders is het beter om voor deze vragen uit te gaan van een gemiddelde stad.

**(Indien <nee>)** U hebt aangegeven de binnenstad van Tilburg niet te bevoorraden. Daarom is het bij volgende vragen het beste wanneer u uitgaat van de beleving van een gemiddelde binnenstad door uw bedrijf.

Wat is de gemiddelde *wekelijkse* hoeveelheid goederen die u aan de *totale* binnenstad levert? aantal

- Rolcontainers:
- Pallets:
- Kledingrekken:
- Losse dozen/vaten:





- Onverpakt:

Hoeveel adressen in de binnenstad worden op een gemiddelde dag door u beleverd?

Met hoeveel van de volgende types voertuigen wordt de Tilburgse binnenstad gemiddeld (per dag van de week) bevoorrad?

	Ma	Di	Wo	Do	Vr	Za
Bestelwagen (tot 3,5 ton) 						
Lichte vrachtwagen (tot 7,5 ton) 						
Middelzware vrachtwagen (tot 18 ton) 						
Zware vrachtwagen (boven 18 ton) 						

Hoe lang verblijft een voertuig van uw bedrijf gemiddeld in Tilburg (de tijd vanaf aankomst bij rand van de stad, tot vertrek vanaf de rand van de stad (waartussen beleving van de binnenstad plaatsvindt))?

	Gemiddelde verblijftijd
Bestelwagen (tot 3,5 ton) 	
Lichte vrachtwagen (tot 7,5 ton) 	
Middelzware vrachtwagen (tot 18 ton) 	
Zware vrachtwagen (boven 18 ton) 	

*Afhankelijk van de bovenstaande gegevens van uw bedrijf, zou u kunnen besparen op bevoorrading van binnensteden bij een samenwerking met een bedrijf dat de binnenstedelijke distributie voor u verzorgt, vanuit een distributiecentrum aan de rand van de stad. Hierdoor zou u als vervoerder niet meer zelf in de drukke binnenstad hoeven te komen. Het volstaat hierbij om de goederen voor een bepaalde binnenstad aan de*

*rand van deze stad af te leveren. Van verschillende vervoersbedrijven, zoals de uwe, zullen deze ladingen geclusterd worden gedistribueerd in de binnenstad. Naast deze mogelijke variabele besparingen, zouden er voor u ook vaste besparingen mogelijk zijn. De volgende vragen zullen betrekking hebben op de mogelijkheid van deze extra kostenbesparingen.*

Een eventuele samenwerking met een stadsdistributeur zou ook andere besparingen kunnen opleveren voor u, als vervoerder. Hieronder volgen een aantal mogelijke besparingen. Hoeveel denkt u in deze gevallen te kunnen besparen?

- U hoeft misschien niet meer te investeren in kleine (en schone) voertuigen die geschikt zijn voor de binnenstad en grotendeels gebruik maken van grotere voertuigen. Hoeveel denkt u hierdoor te kunnen besparen (uitgedrukt in % van de operationele kosten)?

0%	0-10%	10-20%	20-30%	30-40%	40-50%	>50%
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Wat verwacht u hierop te kunnen besparen (opnieuw uitgedrukt in % van de operationele kosten), wanneer de samenwerking geldt voor meerdere steden?

0%	0-10%	10-20%	20-30%	30-40%	40-50%	>50%
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Een samenwerking met een stadsdistributeur kan leiden tot een eenvoudigere planning/administratie. Hoeveel denkt u hierdoor te kunnen besparen (uitgedrukt in % van kosten die u maakt voor planning/administratie)?

0%	0-10%	10-20%	20-30%	30-40%	40-50%	>50%
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Zijn er besparingen mogelijk doordat de omvang van het wagenpark kan afnemen (uitgedrukt in % van de grootte van het huidige wagenpark)?

0%	0-10%	10-20%	20-30%	30-40%	40-50%	>50%
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Zijn er besparingen mogelijk doordat er minder chauffeurs nodig zijn (uitgedrukt in % van huidig aantal chauffeurs)?

0%	0-10%	10-20%	20-30%	30-40%	40-50%	>50%
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Naar aanleiding van de voorbeelden hierboven komt u misschien zelf nog op ideeën voor mogelijke besparingen. Zou u op andere manieren kunnen besparen dan de voorbeelden hierboven?

Ja

Nee

(zo ja) en op wat voor manier(en)?

En hoeveel (uitgedrukt in % van operationele kosten) denkt u hiermee te kunnen besparen?

0%	0-10%	10-20%	20-30%	30-40%	40-50%	>50%
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*De laatste vragen gaan over de beperkingen die stadsdistributie voor u oplevert en over de invloed van venstertijden hierop.*

In hoeverre zorgt het bevoorraden van de binnenstad voor beperkingen bij de planning van uw bedrijf?

*(1 = geen belemmering, 5 = zeer grote belemmering)*

1.

2.

3.

4.

5.

*Venstertijden zijn bepaalde perioden tijdens de dag waarin het goederenvervoer toegang krijgt tot de binnenstad om te laden en te lossen.*

In welke mate vormen venstertijden een belemmering voor de planning van uw bedrijf?

*(1 = geen belemmering, 5 = zeer grote belemmering)*

1.

2.

3.

4.

5.

*Veel bedrijven ondervinden belemmeringen bij het bevoorraden van de binnenstad. Een mogelijke oplossing voor deze bedrijven is het transport uit te besteden aan een extern bedrijf met een distributiecentrum aan de rand van de stad. Dit bedrijf kan goederen aan de rand van de stad consolideren en vervolgens efficiënt naar de binnenstad vervoeren.*

Zou u overwegen het transport naar de binnenstad uit te besteden aan een extern bedrijf met een distributiecentrum aan de rand van de stad?

*(1 = niet overwegen, 10 = zeer sterk overwegen)*

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Zou u overwegen het transport naar de binnenstad uit te besteden aan een extern bedrijf met een distributiecentrum aan de rand van de stad **als er geen venstertijden zouden zijn?** (1 = niet overwegen, 10 = zeer sterk overwegen)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Kunt u toelichten waarom u wel of niet overweegt transport naar de binnenstad uit te besteden en welke invloed venstertijden hebben op deze overweging?

Wilt u op de hoogte gehouden worden van specifieke stadsdistributie initiatieven.

ja            nee

*Dit was de laatste vraag van deze enquête. Hartelijk bedankt voor uw medewerking!*