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ERASMUS UNIVERSITEIT ROTTERDAM
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# Entry Strategy of the Transition Hub

## On the Price and Location of the Transition Hub

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**Abstract**

In this thesis the entry strategy of the new concept of the Transition Hub is discussed. The focus of this research thesis is on the entry strategy by means of pricing strategies and location strategies determining the prices of the Wheelie, OlegO and Flex Parking and the location of the Transition Hub. From a social perspective it is found that an economy pricing strategy is the best strategy with prices of €0.29 per kilometer for inter-city movements and €0.45 per kilometer for intra-city movements for the Wheelie and the OlegO. It is shown on the basis of mobility advantage that the Transition Hub has seven strategic locations at the edge of the city and two strategic locations in the inner city with a price of €2.40 for the Flex Parking part of the Transition Hub.

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# 1. Introduction

Nowadays, the parking situation in most metropolitan cities is becoming a source of frustration for daily travellers by car. Especially during rush hours, one can experience a substantial part of the whole trip searching for a parking space in congested urban areas. One study claims that over half the cars driving downtown in cities with serious parking problems are cruising to find a parking space, thus resulting in unfavourable congestion (Arnott & Rowse, 2009). Despite the fact that such large and agglomerated cities have put certain effort in improving the efficiency of parking in their most traffic-crowded areas, new technological advances are yet to be placed (Van der Knaap & Van Wee, 2004). Evenmore, experts predict a stable increase in the population of densely populated urban cities (Centraal Bureau voor de Statistiek, 2013), which can be directly linked to the demand for transport and therefore the amount of cars.

These different problematic factors regarding the parking situation have led to the current study on increased efficiency of parkings.

This study tackles both the complication of inefficiency and inflexibility of current parkings simultaneously by offering a comprehensive and integrated plan. We build this research on the business ideas and product concepts of Van der Wijngaart's Engineering Services[1]. Van der Wijngaart's Engineering Services recognises the waste and pollution problem and aims to prevent these with innovation and change. The concepts of Van der Wijngaart's Engineering Services are based on a circular approach to product life cycles and the company uses creative processes to connect different industries. Van der Wijngaart's Engineering Services currently offers modular products in the farming industry and is lead by Mr. Aad van der Wijngaart.

The present thesis looks from a holistic angle at the mobility needs of the city of Rotterdam and introduces these business ideas and product concepts of Van der Wijngaart's Engineering Services. Van der Wijngaart's Engineering Services has designed a concept of Flex Parking, which we rephrase in a more sophisticated way to "Transition Hub", to solve Rotterdam's congestion and particulates problems and to create a new paradigm of mobility. This study aims to legitimate the use of the Transition Hub in the infrastructure of a city on an economic basis.

[1] For more information on Van der Wijngaart's Engineering Services see: http://www.wijngaart.nl/

But is this new business idea truly the right way to solve this issue?
The overall central question in this study, consisting of three separate but complementary theses, is:
*"How will Transition Hubs function in Rotterdam?"*
Although all three theses are researched and formulated separately, they do consist of a general part, which was jointly made. This common part consists merely of the introduction and the theoretic framework partially, specifically the pages 2 to 15.

The subcentral questions, indicating a clear distinction between the theses, to this central question are:

- *"Is the Transition Hub economically feasible for implementation in Rotterdam?"*
- *"What is the best entry strategy for the Transition Hub in Rotterdam?"*
- *"What other functions can be performed by the Transition Hub in Rotterdam?"*

In the present thesis, the emphasis will be placed upon the *entry strategy* of the Transition Hub and the mobility components, which are interconnected to this.
Therefore, the central question in this study is:

*"What is the best entry strategy for the Transition Hub in Rotterdam?"*

This Transition Hub will, besides parking, provide two different types of electronic means of dependent individual transportation, the OlegO and the Wheelie. This study legitimates the use of the Wheelie and the OlegO. These two means of transportation can increase efficiency for the traveler by reducing the time traveled between the Transition Hub and the final destination. In this way the total travelling time of an individual or group of individuals is shortened; a mobility advantage.

In this study, the main focus is placed upon the parking situation in the city of Rotterdam. Rotterdam, being commonly known as the 2nd largest city of the Netherlands, is very popular for its important core commercial activities, infrastructure, society and especially for its port. Whilst Rotterdam currently counts more than 25 'big' parkings (Rotterdam.nl, 2015), the congestion is seen as a serious problem, which could only get worse. Citizens of the neighborhood around

Winkelcentrum Keizerswaard experience increased problems with parking and are becoming furious at the municipality for not solving these issues after repeatedly discussing the issue (Roubos, 2013).

What is even more problematic is the fact that the existing parking is not considered flexible when it comes to the efficiency of the traveler. Most journeys require the use of multiple means of transportation and therefore a flexible connection between these. Parking nowadays usually consists of a less comfortable walk of at least 10 minute from the parking to the destination.
The existence of efficiently-operating parkings causes less congestion and undoubtedly stimulates the clustered areas important for business environment, thus positively influencing the regional economic growth (Arnott, 2005).Two main reasons contribute to this disturbing issue, being unavailable properties and technological inefficiency. Every square metre in the downtown of Rotterdam is essential for the companies located nearby, leading to minimal optimally located parkings. Also, the current existing parkings are claimed to take up more space than they should. A clear distinction at this point should be made between individuals with a long-term parking contract and just the simple 'shopper', who has no parking spot assigned to him in advance. Because of such diversity in businesses in the downtown of Rotterdam, it is quite difficult to predict what proportion of the total users of parkings are shoppers.

Besides the restricted mobility businesses and people face, another problem is embedded in the logistical system of a city. Goods and services are not optimally allocated in every neighbourhood for businesses and people. Goods and services are usually provided in fixed locations in the city from where business and logistical operations are conducted. Goods and services are transported from that point to the residents, such as the delivery of packages or letters. This causes additional unwanted traffic in urban areas of commercial freight and services (Crainic et al, 2004).

Another problem regarding the logistical system of a city is that people have to commute from home to their work destination, while in most cases the work place will not or cannot provide parking for their employees, forcing employees to travel longer and use more means of transportation than the optimal number of means needed. Research has shown that if an employer provides parking for their employees, 63 percent commute by car to their work. Only 16 percent commutes by car if the employer does not provide parking, which forces commuters to use public transport instead of individual transport (Jansson, 2010)

In addition to the scarcity of parking spaces, the parkings are located in the centre of the city. As for Rotterdam, most of the parkings concentrate in the centre of the city. Residents, commuters and tourists travel to these parkings, thus congesting the centre of the city. Besides congestion in the inner city, the highway around Rotterdam is one of the most congested infrastructures in Europe. According to INRIX Traffic Scorecard Rotterdam is the sixth worst congested city of Europe in 2011 (INRIX, 2012). Also the exits of the A15 near Rotterdam are considered to have the highest congestion costs in the Netherlands (TNO, 2008). Though the crisis and the stagnating economic growth has decreased the congestion in Rotterdam (INRIX, 2012), it is expected that congestion will rise again, since there is an expected rise in economic growth in 2015 (Centraal Bureau voor de Statistiek, 2015).

Rotterdam has relatively and absolutely the highest concentration of particulates in the air due to traffic and industrial and port activities. Rotterdam has tried to tackle this environmental problem, since particulates are the second most harmful factor for the lifespan of the average resident of Rotterdam (Burdorf, 2009). In 2008 several researchers published findings that particulates are even deadlier than previously thought, emphasizing the need of reducing particulates and particulate standards in the city (Ballester et al., 2008). The maximum allowed concentration, set by the European Union, of 25 milligram per cubic metre is often surpassed in the daily measurements of particulates in Rotterdam (Landelijk Meetnet Luchtkwaliteit, 2015).

To fight these particulates, the Transition Hub will also purposely function as a central hub for electric cars and other fully or semi-electric vehicles, which are being used more and more often (Adriaanse, 2013). The municipality of Rotterdam supports the use of electric vehicles by providing charging points on streets and offering a subsidy for an own charging point on privately-owned properties (Nederland Elektrisch, 2015). Also other subsidies are offered to incentify the use of 'cleaner' vehicles, resulting in improved environmental conditions through less $CO_2$ emission and less noise. So whilst the Transition Hub appears attractive for the standard daily traveller, it also contributes to society's push for more sustainability for the long term (Forbes, 2010).

It is shown in this study that the best entry strategy for the Transition Hub is to locate seven

Transition Hubs at the edge of the city where they reduce congestion and serve inter-city travelling. The Transition Hub should apply an economy pricing strategy to get the mass on board. The Transition Hub has an astonishing price advantage between €0.12 and €0.45 per kilometer depending on distance from the centre compared to public transport. On top of this price advantage there is a mobility advantage, measured as a distance, of 1.6 kilometer when taking a the average distance of a parking to a centre of 3.2 kilometer. Besides the seven Transition Hubs aimed at inter-city movements there are two Transition Hubs to be placed in the centre of Rotterdam that could be exploited commercially through premium pricing because of the high demand and the superiority of the Transition Hub's features.

After the introduction about the central problem in this thesis study, a theoretic framework follows. In this section, the main theories and concepts are discussed. Subsequently, the sources of the relevant data collection are discussed in the data and methodology section, along with the used calculation and assessment methods. In the following part, the results from the analyses are presented. In the final conclusion and recommendations part, the central question in this study is answered.

# 2. Theoretic framework

The theoretic framework covers several concepts as well as economic theories. The concepts are taken from literature and adjusted in such a way that they fit within this specific study.

## *2.1. Concepts*

### 2.1.1. Mobility

Mobility is the concept of moving from one point in space to another point in space at a certain cost of moving. Costs of moving are time, energy, money or something else such as comfort. In this research the focus lies on maximizing mobility in relation to time and money since these two are easily linked to the economic domain. Mobility of an individual is optimal when the individual can travel from point A to point B and minimizes the time costs.

For the sake of clarity, we define four different dimensions of mobility; these are the dimensions that are present in every day of our lives but that are not distinguished by their character. There are two categories and two levels to mobility. The two levels are: individual mobility i.e. travelling on one's own and mass mobility i.e. travelling in a group. The two categories are: independent mobility i.e. without a vehicle and dependent mobility i.e. with a vehicle or another instrument. An individual can choose to travel on an individual level or on a mass level and by independent means or dependent means. These dimensions have different strengths and weaknesses and thus shape the logistical system of a city; these strengths and weaknesses are outlined in different sections throughout this study.

#### 2.1.1.1. Mobility market structure

From an economic perspective, on the mobility market it may take people longer to reach their destination because of regulation, market imperfections or market failure. In practice, this means it could take people longer to reach their destination because of for example traffic lights, walking from train to metro or a traffic jam.

The points of delay can be categorized according to their nature. There are congestion points and transition points. A congestion point occurs within one means of mobility, a transition point occurs between means of mobility. Both congestion points and transition points can be expected or unexpected. Besides, both congestion points and transition points cause costs.

There are therefore expected congestion points causing expected congestion costs (e.g. traffic lights), unexpected congestion points causing unexpected congestion costs (e.g. traffic jams or detours), expected transition points causing expected transition costs (e.g. transfer time) and unexpected transition points causing unexpected transition costs (e.g. delay of train connection).

The market is assumed to be perfect besides the points of delay mentioned before. This means that there are no other costs of moving in this market besides those. There are no costs other than time related to the points of delay; costs such as rescheduling an appointment or missing a business deal are assumed not to incur. A perfect market also means for example that everyone drives at the same average speed and that every car uses the same average liters gasoline per kilometre.

#### 2.1.1.2. Travelling

Travelling by independent means is always necessary to reach a destination. However, the dependent individual dimension has an advantage in providing flexibility: the possibility to reach the destination in close proximity. The advantage of using dependent mass resources is the availability and shorter traveling time between two locations. These locations are however set. In practice there can be a lot of transition time changing from dependent mass resource to another dimension or dependent mass resource.

If a person wants to travel from A to B, that person has a decision to make regarding the mobility dimensions. This person can choose to travel independently individually, e.g. walking, but this action is not happening in the economic domain. For this research, this basic situation is taken as reference point. But people travel by more means than independent individual means.

An individual could use an individual means of transportation to reach his destination in close proximity, but it is likely that there are expected and unexpected congestion costs. Another option is to use public transport, which causes shorter traveling time between stations, but this option has transition costs and the possibility of high unexpected transition costs. The third option is combining both individual and mass transport.

An individual is usually confronted by fixed and variable traveling time when traveling. Since the market is perfect, it is assumed that an individual has no significant influence over the fixed traveling time. The variable traveling time is the expected congestion time and expected transition time incurred when traveling between point A and point B.

#### 2.1.1.3. Coping with market conditions

It is of public interest that unexpected congestion costs and unexpected transition costs are minimized. Minimizing these costs might be in the interest of private parties too but this is mostly not the case. This leads to moral hazard problems and inferior lock-in in innovation. Solutions to these situations can be found in integral approaches. These can be enforced by governments or offered by companies if the market situation gives room for innovation.

Transition time is minimized when there is no time between the use of one mean of transportation and the other mean of transportation in order to reach the destination. For example, a transition between a train and a bus is minimized when both stations are at the same location and both the train and the bus arrive at the same time. An individual tries to minimize his or her traveling time costs by reducing his or her transition time cost.

The inherent problem of the conventional means of transportation is that all means are limited in their flexibility in the city centre. In the city centre cars, motorcycles and bicycles need to be parked in designated areas, which are almost never directly connected with the destination or the transition location. Therefore, those designated areas pose an extra transition for the individual and causes the total traveling time cost to increase. For public transport a similar, but a more static problem arises. Most bus, metro, tram or train stations are located at the centre of their neighbourhood, but are not directly accessible for every individual, implying inefficient transition time.

The trade-off between time and money counts too when moving to the city centre which is reflected in the willingness to pay for mobility, in metre per second, given a certain location. This is the demand side of the mobility market.

The supply side of the mobility market is diverse in its approach to serving the market: parkings, car manufacturers, public transport etc. serve the market in their own way. This study looks at an integral way of serving the mobility market.

In order to serve the mobility market, the best parts of independent and mass transport have to be taken and have to be reconsidered in an integral way.

## 2.1.2. Elements of the Transition Hub

The Transition Hub is an innovative, automated parking, providing coherent and complementary travelling services to pursue one's journey. This section describes the key elements that make the comprehensive Transition Hub a well-thought solution for the current mobility market.

**2.1.2.1. Flex Parking**

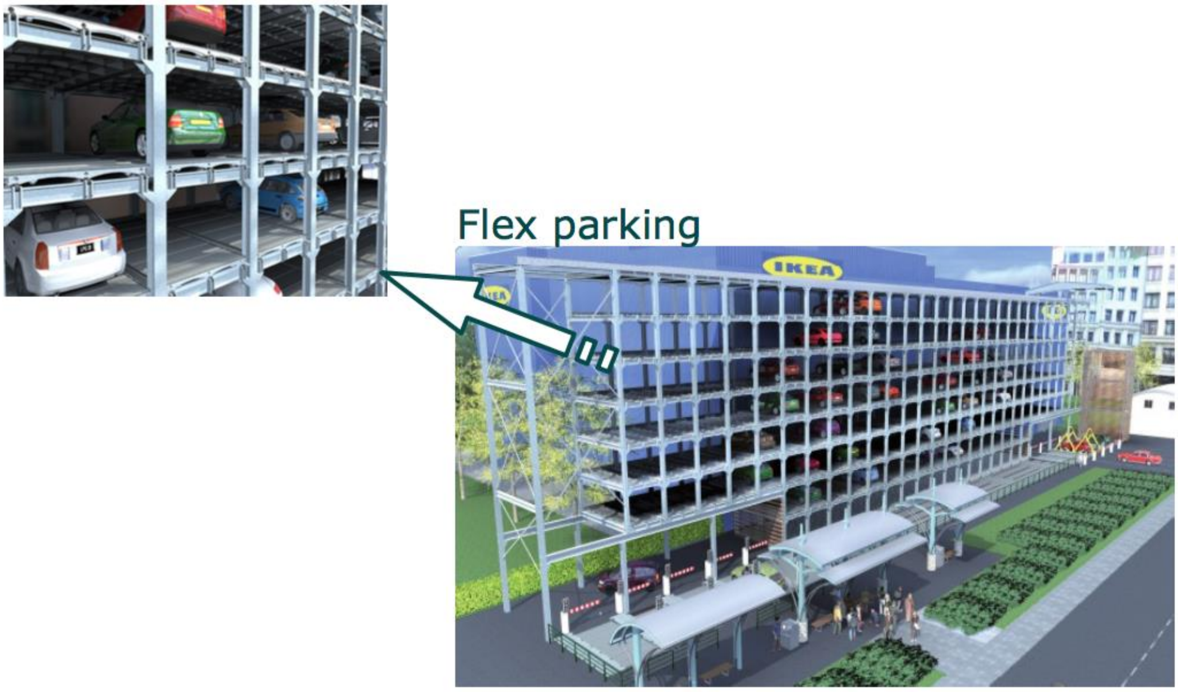



**Figure 1: Flex Parking**

Flex Parking can be explained as a sharply innovated version of existing parkings and can be viewed as beneficial for both the individual traveler as for the city as a whole. This idea basically requires less total size for the same amount of parking spaces, decreases total parking time and improves flexibility; these benefits will be briefly explained as follows.

Firstly, Flex Parking is able to provide at least the same amount of parking spaces of conventional parkings, by using significant less total space as a whole. This is possible because of the technologically advanced method of parking, which the Flex Parking adopts. Instead of the regular way of parking a car in a parking with multiple stories, the Flex Parking allows an automated, robotic crane to place the car in an empty parking space. This crane is highly technologically advanced and is comparable to the automated cranes used in the operations of the Haven of Rotterdam. Learning and adopting the way such advanced cranes are used and implementing this in a totally different industry, can be very beneficial and can deliver a direct boost to efficiency. The main idea behind adopting this technology is to save the individual a great deal of (valuable) time when travelling from point of departure to point of destination. One can simply drive up to this Flex Parking, place its car on the right spot and immediately pursue their journey. After the car is placed, the automated crane is supposed to finish the job of parking the car in a quick, safe method. This crane is designed and pre-programmed to purposely execute this order in an efficient way.

Also, making use of such an automated crane minimizes the probability of human errors/casualties. In the conventional way of parking, an individual uses its own driving skills, built through experience, to properly park a car in the for the car designated parking space. Also, it is safe to assume that not every car driver consists of the same level of skillfulness and focus. Because human behaviour is subject to human errors and other factors, the chances that an individual experiences a problem when parking is higher.

Another huge benefit of the Flex Parking is that it requires a considerable smaller total area for the same amount of parking spaces. In conventional parkings, an individual needs to be able to make turns, drive up to parking space, drive up to the different stories and be able to perform manoeuvres when necessary. A normal car requires at least a width of 6 meters to be able to make normal turns, which are usually necessary to make when parking the car. By making use of the Flex Parking and its services, all this 'wasted' space is removed and every single parking space is optimally utilized.

The Transition Hub combines all dimensions of mobility shaping an integrated mobility market. With regards to the competitors, taxi, train, bus, tram, metro, private car usage, carpooling, parkings, private bicycle usage, bicycle renting it is important to note that the Transition Hub aims to combine all of these in this integrated mobility market. The Transition Hub is a unique as well as a superior service when looking at all these competitors separately. As mentioned earlier, the market is shattered with high costs in time or money when going from one part of the supply chain to another.

**2.1.2.2. Wheelie**

**Figure 2: The Wheelie**

The Wheelie is a compact, light-weight (<10 kg), electric vehicle suited for one person to cover distances not greater than 10 kilometres per day. Its speed is maxed at 25 kilometres per hour and will be the equivalent of the scooter with a blue number plate in the Netherlands, which speeds is also capped at 25 kilometres per hour. It is designed to have a length of 0.8 meters, a width of 0.3 meters and a height of 1.2 meters in its normal situation. It is also designed for flexibility and manoeuvrability so that one can carry the Wheelie on either the back or by pulling it at the front. This mean of transportation can prove to be incredibly handy when moving from point to point within the inner-city, so called intra-city movements. This enables the traveler to quickly switch from a mean of transportation to a dependent individual mean. The Wheelie should be allowed in both traffic and public transport as it will increase the efficiency and reduce transition time cost for travelers. It will also be possible for both consumers and businesses to customize their Wheelie's, as seen in figure 2, by adding logos or texts. Consumers may desire to personalize their wheelies, while businesses could benefit from brand exposure. As soon as the number of travellers making use of this new and flexible mean of transportation increases, others will undoubtedly be positively influenced and probably follow this hype. Possibly, the Wheelie can also be used for fun-riding.

**2.1.2.3. OlegO**


**Figure 3: The OlegO**

The OlegO is a modular, small, one-manned, electric vehicle which can be used for a variety of activities. It has a range of approximately 25 kilometres and can reach speeds up to 45 kilometres per hour. Though unsuitable for highways, the OlegO is a mobile and fast vehicle to transport one in a city and thus improves overall city mobility. It is especially transport from a centre to the edge of the city that is suitable for the OlegO; so called inter-city movements. The OlegO is a motorised quadricycle, which are allowed by law on bicycle lanes and do not require a driver's licence. Just as in the case of the Wheelie, It will also be possible to customize the appearance of the OlegO for businesses and customers for branding or personal purposes. Also, it is plausible that individuals will make use of the OlegO to do daily grocery shopping. By introducing this smaller and more flexible vehicle, the current stream of traffic can be spread.

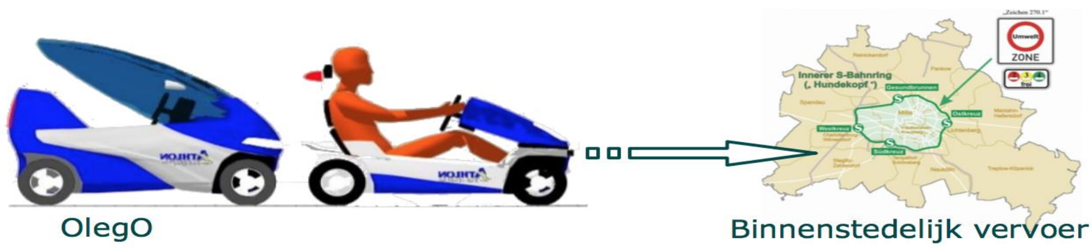



**Figure 4: Mobility of the OlegO**

## 2.1.3. The function of the Transition Hub

The Transition Hub allows travelers to quickly switch between means of transportation. As said above, a parking is almost never directly connected to the destination of the traveler, thus by parking, a traveler has to travel an additional distance from the parking to the destination. The Transition Hub minimizes the time needed to travel this additional distance by providing the Wheelie and the OlegO. This makes traveling via a car a flexible way of transportation. By lowering the barriers to travel without a car in a city, the Transition Hub provides a platform where environmental and congestion friendly vehicles are used in the city. Both health and pleasure of life will increase due to less environmentally hazardous fumes and less congestion.

#### 2.1.3.1. Modular usage of the Transition Hub


**Figure 5: Flexible real estate**

The Transition Hub is designed in a way that allows private or public parties to locate their operations in or next to the Transition Hub. The modular design enables parties to quickly build and insert an office, storage, logistical, living or other commercially used space (hence mentioned as a module) into the modular structure of the Transition Hub. The main advantage of the modules is the flexibility of properties. The module is easy to add and remove to and from the Transition Hub. The Transition Hub is therefore multifunctional and can be repurposed in a small amount of time to something entirely else. When there is a dire need of living quarters for students, the municipality or the university can add several living quarters in or next to the Transition Hub. If the need for extra living quarters for students is lower the next year, the modules can be easily removed to be replaced by either additional parking spaces or other modules. This multifunctionality will revolutionize the way cities think about the use of properties and land. Locating parking, goods and services in exactly the same places increases efficiency, reduces congestion and unnecessary emissions and adds value to the Transition Hub.

#### 2.1.3.2. Environmental benefits of Transition Hub

The Transition Hub enables travelers with electric and semi-electric vehicles to charge their vehicle whilst parked in the Flex Parking. The ground level of the Flex Parking is reserved for the charging electric and semi-electric vehicles, since charging requires the driver to insert the charging socket manually. With electric mobility is meant all vehicles for which an electric motor is the primary source of propulsion (Mckinsey, 2014). The Transition Hub could provide parking for electric and semi-electric vehicles for up to 20 percent of the total parking spaces, considering the growing trend of car-users. It has been shown that by increasing the supply of electric charging stations, the demand for electric cars increases profoundly (Sierzchula et al, 2015). The Transition Hub will function as the new centre for such environmentally neutral vehicles and will contribute to the stimulus that the Dutch government wishes to achieve. The Transition Hub gives the opportunity to solve the environmental challenges Rotterdam is facing regarding carbon dioxide and particulates.
Since it is possible to combine modules with parking, the amount of traffic in the city centre is restrained to the Transition Hub, which frees other, densely populated parts of the city of its congestion issues. Therefore the amount of emissions and sound generated by car traffic can be reduced to improve overall living quality. Because governments increasingly aim to keep their major cities cleaner and more peaceful, the costs this brings for society is growing. Realizing a reduction of these, which is the one of the objectives of the Transition Hub, would imply accomplishing various direct and indirect environmental benefits.

## *2.2. Entry strategy*

In this research the entry strategy of a Transition Hub consists of two parts. The first part is the location strategy and the second part is the pricing strategy.

### 2.2.1. Location strategy

The strategy for locating the Transition Hubs is narrowed down to Rotterdam. Rotterdam, as came forth in the introduction, is one of Europe's most congested cities (INRIX, 2012). Within this predetermined strategical area there are strategical locations to locate a Transition Hub. There are several reasons why a location can be strategically located, in the case of the Transition Hub compared to currently existing parkings. The reasons are improving speed and mobility, offering need satisfaction at a lower price, decreasing congestion and using land in an efficient way.

In this strategy approach the end goal is to let travellers reach destinations; these destinations are spread across Rotterdam, but there are centres in Rotterdam to be distinguished. This study uses centres to assess what the most optimal locations for the Transition Hub will be. The distances and prices for public transport are calculated between the conventional parking and the centres.
There are work and consumer centres. The following centres in Rotterdam are distinguished in this research.
The consumer centres are:

- Koopgoot/Coolsingel
- Shoppingmall Zuidplein
- Shoppingmall Alexandrium

The work centres are:

- Weena
- Kop van Zuid
- Work centre Alexandrium

### 2.2.2. Pricing strategy

The pricing strategy is a crucial part in answering the question what the best entry strategy is for the Transition Hub in Rotterdam. A pricing strategy is crucial for a new business or new product when entering the market (Kokemuller, 2015). Which pricing strategy to go for is in this research based on traditional pricing strategy determination. According to Economic Times a pricing strategy takes into account segments, ability to pay, market conditions, competitor actions, trade margins and input costs amongst others. A pricing strategy is targeted at the defined customers and against competitors (Economic Times, 2015). In the following section there is an enumeration of the different pricing strategies, an introduction to the later important distinction between social and commercial optimum and an overview of the most important aspects in this research of a pricing strategy for the Transition: competitor actions, trade margins and input costs.

#### 2.2.2.1. Pricing strategies

In this research there are four initial, general pricing strategies distinguished. These pricing strategies are: premium pricing, penetration pricing, economy pricing and skimming pricing

(Economic Times, 2015).

Premium pricing strategies works in segments with a strong competitive advantage for the product or business and sets a high price as a defining criterion. Penetration pricing strategies are applied when a new product is being launched and prices are set artificially low to gain market share quickly after which prices of the product go up. Economy pricing strategies are used to target the mass market and high market share and are applying no-frills price because overhead costs are low. Skimming strategies aims at getting high margins until competitors join the segment and profits diminish.

**2.2.2.2. Commercial and social optimum**

In mainstream economics there is a distinction made between private optimum and public optimum (Turvey, 1963).

Since the Transition Hub affects many economic agents, also those only affected by externalities, there is a distinction to be made between private and public optimum. For the Wheelie and the OlegO this distinction between private and public optimum is rephrased into social optimum and commercial optimum respectively. These words cover the essence in a better way, namely from the perspective of the company.

The Transition Hub is a superior need satisfier and has positive externalities for society; thus an increase in usage numbers would lead to an increase in public welfare. This is reflected in the pricing strategy where in a social optimum the price is set lower to let more people afford the product or service. In a commercial optimum however the pricing strategy may be such that prices are set higher in order to reap higher profits. For the difference between social and commercial optimum the pricing strategy is a vital means but this is also translated into the trade margin. Public parties operate with an aim at maximizing social welfare while private parties operate aiming at maximizing their own, commercial welfare which is not necessarily maximizing public welfare.

**2.2.2.3. Competitor actions**

Competitor actions differ because the competitors of the Transition Hub offer heterogeneous products and services for the same need; mobility. The only direct competitor which is not a contributor at the same time are the currently existing parkings. This competitor faces high initial investment costs but low fixed costs and low variable costs. The payback period for this competitor is high and therefore the currently existing parkings will have to innovate or lower their prices leading to losses with the probability of them going out of business.

**2.2.2.4. Trade margins**

The trade margin, also known as profit margin, is the amount by which the revenues exceed the costs of the business. The costs are stated in the financial analysis of the Transition Hub and the revenues are calculated as the product of the times the service is used and the price of the service. In the financial analysis there are estimations of the times the service is used. The price of a new innovative product can be calculated in different ways which is subject of the pricing strategies. The lower bound of the price is reflected in the willingness to accept and the upper bound of the price is reflected in the willingness to pay. These two concepts are explained further on.

**2.2.2.5. Input costs**

Input costs are all costs allocable to the output (Business Dictionary, 2015); it is the costs of overhead items such as labour and material used to produce the Transition Hub and deliver its services. This aspect is covered in the financial analysis of the Transition Hub.

### 2.2.3. Willingness to pay

The willingness to pay is the amount of money an individual is willing to give at the most in exchange for a good, service or avoiding something undesirable (Hanemann, 1991). Calculating a willingness to pay is extremely difficult for a new product because of the subjective nature of the willingness to pay. In order to find a proper willingness to pay, it is possible to take the price of competitors solving the same need and compare it to the new products' need satisfaction level. In this process it is assumed that people are rational and that preferences are reflected in their actions; revealed preference (Sen, 1971).

### 2.2.4. Willingness to accept

For the sake of clarity, the owner of the Transition Hub is taken as the seller of parking spots at the Transition Hub. The seller has a certain point at which he wants to sell; this point is referred to as the willingness to accept. The willingness to pay is the amount of money a person is willing to accept to abandon a certain good, service or to put up with something negative.

## *2.3. Theories*

There are several theories which are used throughout this study for either calculations or as assumption and way of reasoning.

### 2.3.1. Agglomeration theories

This study is embedded in the theory of the Consumer City Hypothesis. The Consumer City

Hypothesis states that people want to consume luxury goods and make use of amenities which are typically found in bigger cities (Glaeser et al., 2001).
The trend, therefore, is that more and more people will either live in the city centre or travel to the city centre. Due to spatial limitations not everyone will be able to live in the city centre. Therefore an increasing number of people will travel to the city centre; this makes mobility an even more important policy topic.

### 2.3.2. Mobility advantage

The location of a parking is a core factor in the need satisfaction of the customer. Higher need satisfaction of the customer can give way to higher pricing or reducing costs by offering a product of lower quality. Determining the optimal location is therefore a tradeoff between pollution and congestion reduction and higher revenues.

The Transition Hub should be placed on efficient locations. To reduce environmental damage and congestion in the centre of the city, the Transition Hub has to be located at the gateways of Rotterdam, where congestion tends to be high. This allows travelers to park their cars at the edge of the city centre. The traveler can use the Wheelie, OlegO or public transport from the Transition Hub to reach his destination without congesting the centre of the city. Since the Wheelie, OlegO and public transport, except the bus, is electric, less particulates and $CO_2$ and a healthier environment for both residents and commuters in the city is the result if more travelers use these means of transportation.

In order to compare the different mobility dimensions a few assumptions have to be made.
For the dimension of independent individual mobility walking is taken; to be more specific: walking at a constant pace of 4.7 kilometres per hour. This number is also used by Google Maps, an important tool in this research. By taking 4.7 kilometres per hour, the data represents the relationships between dimensions correctly.

To find the place where the Transition Hub can be placed, the circles in the drawings represent the radiuses, as shown in figure 7 and 8. The inner circle represents the average distance a parking is located right now from a centre; the original radius. The outer circle represents the average distance at which the Transition Hub can be located; the new radius. This outer circle is based on the distance at which the time saved by taking the public transport is equal to the time saved by the

Wheelie.

The area between the original radius and the new radius marks the places where a Transition Hub is strategically located. It is strategically located from a public point of view because the Transition Hub reduces congestion and pollution at an earlier stage in the journey to a destination than existing parkings. This itself does not justify the area between the 'original radius' and the 'new radius' being the places where the Transition Hub is strategically located. From an individual, user point of view the Transition Hub also needs to be strategically located in the sense that it offers its users superior mobility. It was earlier defined that costs of moving are time, energy, money or something else such as comfort. A strategic location is a location that is superior in saving time, energy and money for its users.

To sum it up in a concrete way, the Transition Hub is strategically located from a user point of view and a public point of view because:

1. the time saved by taking the Wheelie is at least that of time saved by public transport,
2. the willingness to pay is at most that of public transport and
3. the distance is at least the average distance of currently existing parkings to the centre.

The first reason explains the superiority in saving time, the second reason explains the superiority in saving money and the third reason gives pollution superiority.

# 3. Data and Methodology

## *3.1. Determining prices*

The prices are determined using pricing strategies but are based on the willingness to pay and willingness to accept. This is the case for the Wheelie and OlegO. For the transition hub data on parkings in Rotterdam have been gathered. The distinction has been made between publicly owned parkings and privately owned parkings. In this research the hourly tariff for vehicles in public parkings has been taken as a reference to determine the transition hub's pay-per-hour rate. For the subscriptions prices from a data source with averages on subscription prices is leading the price calculation for the subscription price of a parking spot at the Transition Hub.

To determine a rent price per day for the Wheelie or OlegO the product of the willingness to accept and the radius of the vehicle concerned give a safe minimum price. It should in that case be known to the renting party that he/she can only drive up to the radius. Almost all numbers leading to a price will be represented as price per kilometer since the nature of travelling is that distance and costs are related and that people are willing to pay depending on the distance covered.

With the willingness to accept and willingness to pay determined one of the four pricing strategies is taken to base the price on. The choice of pricing strategy will be discussed with the results of the data to wrap it up in a coherent structure. The choice of pricing strategy depends on the information gathered along the way in conversations with the CEO of Van der Wijngaart's Engineering Services combined with the information on pricing strategies in the theoretic framework. A clear explanation for why the other pricing strategies did not work out is also found in the results part.

For the Wheelie and the OlegO there are two distinctions; the distinction between the social and commercial optimum and the distinction between intra-city and inter-city movements. The pricing strategy for the social optimum could differ from that of the commercial optimum.

### 3.1.1. Willingness to accept

The willingness to accept is the lower bound of the possible price. The price leading to a break even point is the level of willingness to accept; they are the same if we assume that the seller does not want to lose money. In case of a governmental institution it can be argued that making a profit or not losing money is not the goal of the project. Calculations with the willingness to accept in this research are based on the break even point. For the Wheelie as well as for the OlegO the financial analysis of the Transition Hub presents this break even price given the assumptions on these two vehicles in the financial analysis. The break even price of the Wheelie and OlegO is calculated as a price per kilometer. This is done because the cost drivers of the vehicles are mostly fixed or relate to the distance travelled. This way of presenting price gives full and clear insight in the way the price of the Wheelie and OlegO is build up. Numbers are easily comparable and the costs are fully allocated to the usage. The willingness to accept or lower bound price is including VAT taxes and other tax related cost drivers.

### 3.1.2. Willingness to pay

People minimize the cost of moving but they have different preferences and budget constraints. Therefore the tradeoff between time and money for the subject of study for the willingness to pay, the Wheelie and OlegO, has to be compared relative to other options. It is based on revealed preference and transitivity axiom. This means that if it is known that a person chooses for example a 10 minutes time saving consumption bundle A of €2,- above the basic situation, the person will also choose a more than 10 minutes time saving consumption bundle of €2,- and the person will also choose a 10 minutes time saving consumption bundle of less than €2,-. It cannot be said, however, that this person values travelling shorter at 5 minutes in euros.
In the above situation the willingness to pay for 10 minutes is €2,-. The willingness to pay is the maximum amount a person is willing to sacrifice or pay to attain a good, service or avoid something undesirable (Hanemann, 1991).

The willingness to pay is calculated on the basis of alternatives. It is based on the independent individual dimension; walking and the dependent mass dimension; public transport. The first dimension is logical because it is the default situation and it is used to reach a destination. It is thus always applicable which makes it useful to include. The Wheelie and OlegO are both in the dependent individual dimension. It can be argued that comparing the Wheelie and OlegO to means of travelling in the same mobility dimension would make most sense; for example comparing them to bicycles. But the purpose of this research makes it more suitable to base the willingness to pay on the prices of public transport. The first reason is that the data on public transport is more useful for calculating purposes; prices are standardized and data is easily retrieved. Another reason is found in the characteristics of the Wheelie and the OlegO; they compete with dependent mass transport means on price and with dependent individual transport means on the ability to reach destinations in close proximity. The functional superiority of the Wheelie and OlegO make it less relevant for now to compare them to dependent individual transport means such as bicycles.

The data is a set of the currently existing public parkings in Rotterdam. For each parking a set of attributes is taken for the ranges 0-2 kilometer and 2-5 kilometer from a centre. This list of parkings within this certain distance has the attributes *distance to centre*, *price public transport*, *travelling time public transport*, *travelling time Wheelie*, *travelling time OlegO*, *willingness to pay per kilometer OlegO* and *willingness to pay per kilometer Wheelie* amongst others. The last two have the same numerical values since the willingness to pay is based on the same alternative.

The distance to centre has been calculated using Google Maps; it is the driving distance from the address of the parking to the centre as specified in the Location of Transition Hubs part.
The price public transport is taken from the RET for the distance of the specific parking to the centre. The travelling time public transport is also retrieved from the RET; it is the time it takes to get from the parking to the centre by public transport. The travelling time of the Wheelie and OlegO is based on their average expected speed times the distance. The average expected speed includes time to unlock the vehicle and get in. Everything else is not taken into consideration; e.g. getting groceries in OlegO or using an extra lock on the Wheelie. The willingness to pay per kilometer for the Wheelie and the OlegO is equal to the price of public transport divided by the distance to centre. This is in line with the revealed preference and transitivity axiom.

For the commercial optimum, which is standard, the willingness to pay is the average of the separate willingness to pay in the dataset. When looking at the social optimum, the social willingness to pay is set at the level of the minimum value of the values in the dataset. In that way the Wheelie and OlegO are strictly dominating public transport in price and need satisfaction because of the transitivity axiom. The positive externalities associated with the implementation of the Transition Hub are fully experienced when letting the price be at most this willingness to pay.

### *3.2. Location of Transition Hubs*

There are 6 defined centres for this study as shown in figure *6*. 3 consumer centres and 3 work centres.

As previously said, the consumer centres are:

-Koopgoot/Coolsingel

-Shoppingmall Zuidplein

-Shoppingmall Alexandrium

The work centres are:

-Weena

-Kop van Zuid

-Work centre Alexandrium

All centres are displayed with a star in figure 6.

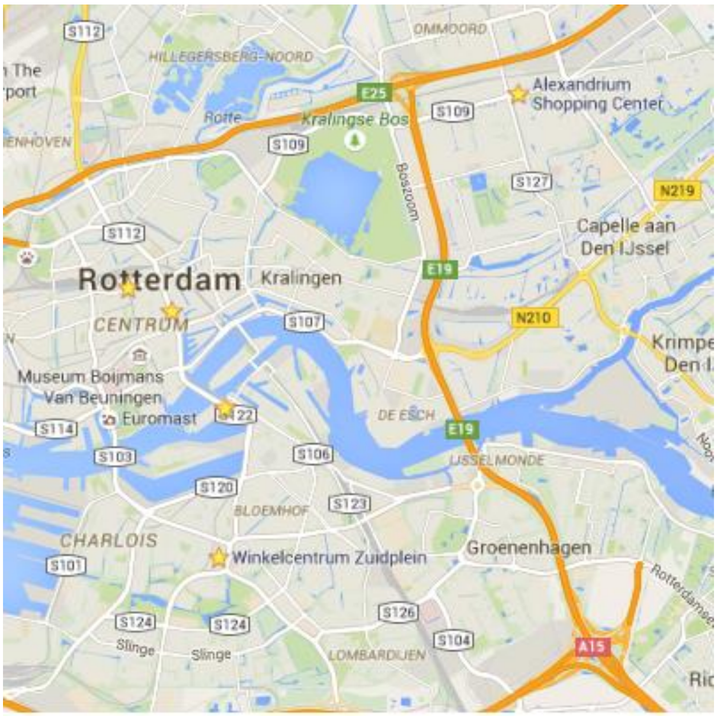



**Figure *6:* Centres of Rotterdam**

The key question is: What is the best entry strategy for the Transition Hub in Rotterdam?

The answer of the key question consists of three parts.

Firstly, the general area where a Transition Hub could be placed is generated on basis of distances between parkings and centres and on basis of the additional reach of a Transition Hub. Secondly, after the general area is appointed, the possible locations are narrowed down to congestion points within the general area. Finally, the zoning plans proposed by the municipality of Rotterdam are viewed and checked whether the chosen locations are consistent with the zoning plans.

### 3.2.1. Transition Hubs for inter-city commuters and travelers to Rotterdam

For locating the general area for the Transition Hub distances between parkings and centres are needed. The distance between each known parking in Rotterdam and the six centres are calculated based on maps of Google Inc. The locations of Transition Hubs are either located on congestion points outside the city centre or in the city centre on the most efficient locations.

To assess whether the locations outside the city are optimal a radius around each centre is drawn from 2 until 5 kilometres away from the centre as shown in figure *7*. If a parking has a distance between 2 and 5 kilometres away from the centre, then the distance will be included in the calculation.

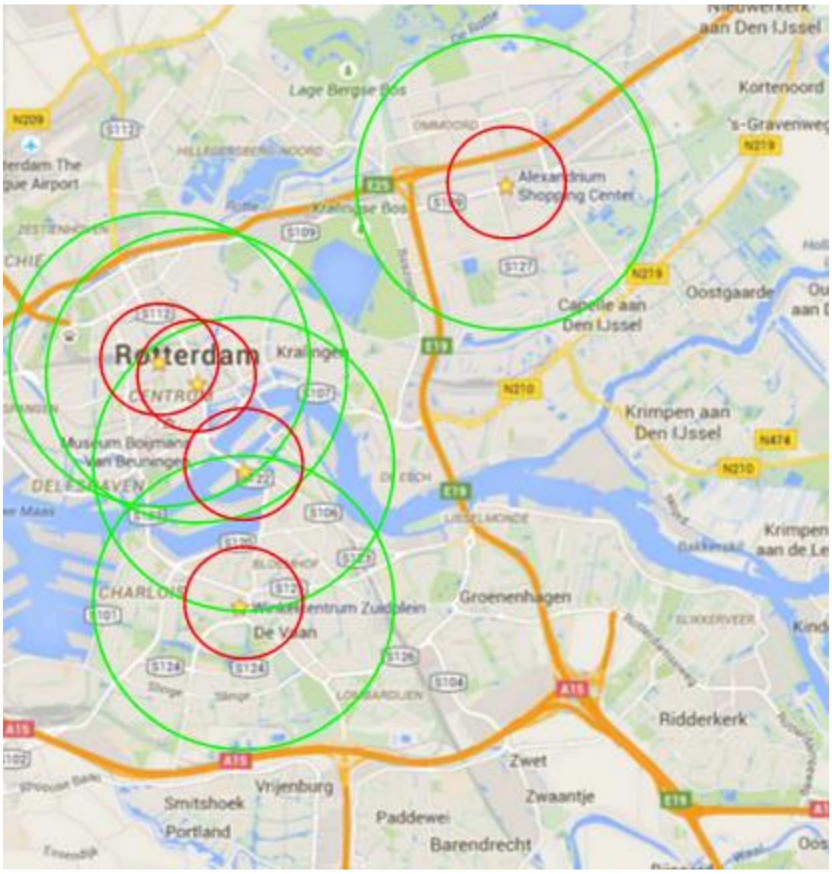



**Figure *7*: Average distance of parking to centres for inter-city traffic**

The calculation approximates a range in which the Transition Hub can be placed. Since one of the main goals of the Transition Hub is reducing congestion, the Transition Hubs should be placed outside of the centres. The average of the distance between the parkings and the centre should be, approximately, the lower bound of the location of the Transition Hubs (i.e. Transition Hubs should not be built closer to the city centre than the current parkings). The upper bound is the maximum reach of the Transition Hub, which is provided by the availability of the Wheelie and the OlegO, because both vehicles make it easier to travel from the Transition Hub to the location of the traveler than public transport does. The time it is needed to get from one parking to the centres is derived from the public transport provider RET. The time it is needed to travel with public transport is compared with the time needed to travel with the Wheelie and the OlegO. It is assumed that the average speed of the Wheelie is 20 kilometres per hour with a top speed of 25 kilometres per hour and the average speed of the OlegO is 35 kilometres per hour with a top speed of 45 kilometres. The time gain of the Wheelie and OlegO over public transport is multiplied with the average speed of the two vehicles. This mobility advantage in kilometers is added to the average distance of current parkings (i.e. the lower bound). This equals to the extra reach of an Transition Hub, since the Wheelie and OlegO are faster and more flexible than public transport. A Transition Hub therefore can be placed at most at a distance of the current average distance plus the additional mobility advantage.

Based on research of TNO on congestion in Rotterdam in 2013 the (most) congested points in Rotterdam are located. Congestion points are points where there is significant loss of time due to structural and incidental congestion. When those congestion points are located it is important to point out where the Transition Hub should be placed. They should be placed in such a way that congestion will be reduced and that traffic will not continue to drive into the city centre instead. The locations must also be located within the the lower and upper bound previously calculated of the centre(s). This study provides a small area where Transition Hubs can be placed based on these requirements.

After narrowing the locations for the Transition Hub it is checked whether those locations are in line with Rotterdam's zoning plans. If so, then this study recommends precise locations for the small areas allocated to the Transition Hubs. If not, then it is assumed that a Transition Hub is not possible in that area without further discussion. If there is no zoning plan available for the specific area it is assumed that the Transition Hub can be placed in that specific area.

### 3.2.2. Transition Hubs for intra-city commuters and travelers in Rotterdam

To assess whether the locations of the Transition Hub in the city centre are optimal a radius around each centre is drawn from 0 until 2 kilometres away from the centre as shown in figure *8*. If a parking has a distance between 0 and 2 kilometres away from the centre, then the distance will be included in the calculation.

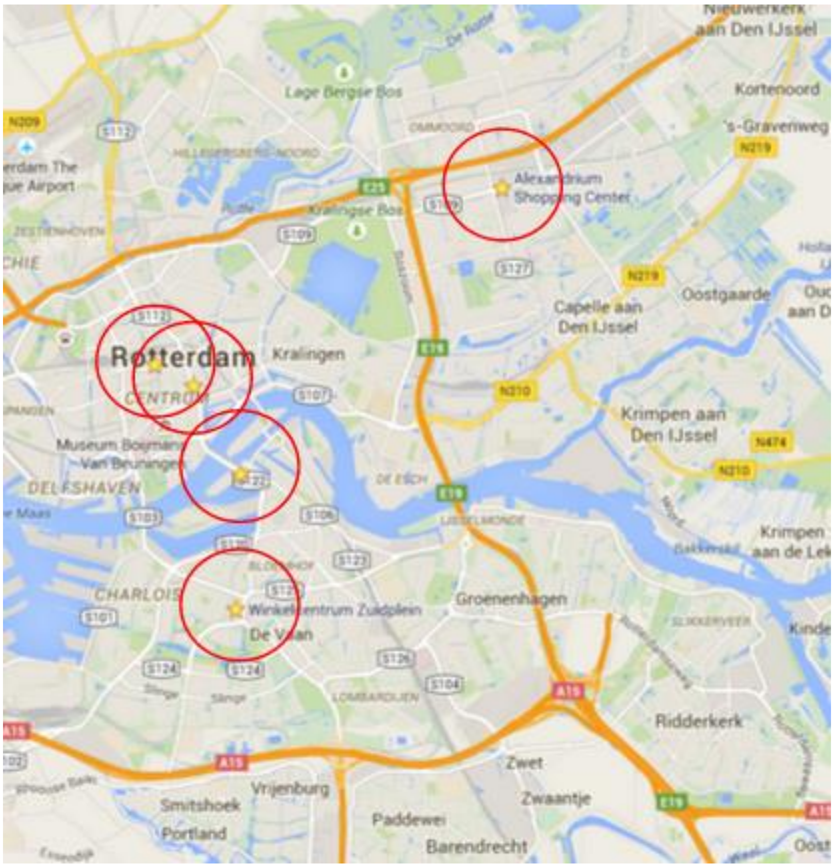



**Figure *8*: Average distance of parking to centres for intra-city traffic**

The lower and upper bound for the data between the radius of 0 until 2 kilometres are calculated in exactly the same way as for the data between the radius of 2 until 5 kilometres. The difference between this model and the previous model is that this model focuses on intra-city traffic (i.e. commuters and travelers who also live in the city centre). Since this city has a relative small size, 0 until 2 kilometres distances between parkings and centres are intended for intra-city traffic. Data corresponding with distances higher than 2 kilometres are not considered for intra-city traffic, because the concept of Transition Hubs is that with larger distances to travel, travelers should park their cars at the border of the city instead of in the city, thus reducing congestion and emissions.

When the lower and upper bound are calculated it can be shown within which general area a Transition Hub could be located.

Radii are drawn around each centre corresponding the lower and upper bound. The areas which have the most overlap with each radius are chosen as the most optimal locations for the Transition Hub, because the areas with the most overlap have the most efficient reach possible for intra-city traffic. The areas with an overlap of two centres can have a minimum of zero Transition Hubs and a maximum of 1 Transition Hub. The areas with an overlap of three centres can have a minimum of 1 and a maximum of 2 Transition Hubs.

After narrowing the locations for the Transition Hub down it is checked whether those locations are in line with Rotterdam's zoning plans. If so, then this study recommends precise locations for the small areas allocated to the Transition Hubs. If not, than it is assumed that a Transition Hub is not possible in that area without further discussion. If there is no zoning plan available for the specific area it is assumed that the Transition Hub can be placed in that specific area.

# 4. Results

## *4.1. Wheelie and OlegO willingness to pay and willingness to accept*

Remember that for the Wheelie and the OlegO there are two distinctions, i.e. the distinction between the social and commercial optimum and the distinction between intra-city and inter-city movements. The results of the pricing data is split up into intra-city and inter-city movements.

### 4.1.1. Willingness to pay and willingness to accept intra-city movements

The Transition Hub for intra-city movements is located within a three kilometers radius of the centres. The price per kilometer for intra-city movements of the Wheelie and OlegO lies between the intra-city willingness to accept per kilometer and the intra-city willingness to pay per kilometer. The intra-city willingness to pay is the same for the Wheelie and the OlegO. The intra-city willingness to accept is different though due to the nature of the two vehicles.

The intra-city willingness to accept for the Wheelie is equal to the price at break-even point. This break-even price per kilometer of the Wheelie for intra-city movements is calculated given a fixed acquisition price of €1700.-, with a given life expectancy of 5 years. The fixed acquisition cost of a wheelie, first divided over the 5 years and subsequently divided by the amount of days in a year, results in € 0.93 per day. By assuming an average daily usage of 15 kilometers, the daily energy costs are approximately € 0.30. At last, the fixed daily maintenance costs are derived from the yearly maintenance costs for the Wheelie and estimated at € 0.23 per day. Thus, summing up both the daily fixed investment, maintenance and the energy costs, results in € 1.464. Equivalently, the break-even price of the Wheelie for intra-city movements is €0.10 per kilometer. Therefore the intra-city willingness to accept for the Wheelie is €0.10 per kilometer.

The intra-city willingness to accept for the OlegO is equal to the price at break-even point. This break-even price per kilometer of the OlegO for intra-city movements is calculated given a fixed acquisition price of € 4,700.-, with a given life expectancy of 5 years. The fixed acquisition cost of a wheelie, first divided over the 5 years and subsequently divided by the amount of days in a year, results in € 2.58 per day. By assuming an average daily usage of 15 kilometers, the daily energy costs are approximately €0.60. At last, the fixed daily maintenance costs are derived from the yearly maintenance costs for the Wheelie and estimated at € 0.64 per day. Thus, summing up both the daily fixed investment, maintenance and the energy costs, results in € 3.82. Equivalently, the break-even price of the Wheelie for intra-city movements is € 0.45 per kilometer. Therefore the intra-city willingness to accept for the OlegO is €0.45 per kilometer.

The intra-city willingness to pay in the results ranges from €0 to €1.60; when correcting for locations at walking distance from a centre the intra-city willingness to pay ranges from €0.48 to €1.60 per kilometer. The intra-city willingness to pay is calculated on the basis of the price of taking the public transport at 43 currently existing parkings being at 0 to 2 kilometers from a parking to that city centre. The intra-city willingness to pay is the average of the price of public transport divided by the distance of the parking to the centre of these 43 instances. The average is at three decimals precise 0.736. The intra-city willingness to pay for the Wheelie and the OlegO is set at €0.74 per kilometer with a social optimum barrier at €0.48.

### 4.1.2. Willingness to pay and willingness to accept inter-city movements

When looking at the Transition Hub for inter-city movements, the Transition Hub is located at least 3 kilometers from the centres. The inter-city price per kilometer lies between the inter-city willingness to accept per kilometer and the inter-city willingness to pay per kilometer. The inter-city willingness to pay is the same for the Wheelie and the OlegO. The inter-city willingness to accept is different though due to the nature of the two vehicles.

The inter-city willingness to accept for the Wheelie is equal to the price at break-even point. This break-even price per kilometer of the Wheelie for inter-city movements is calculated given a fixed acquisition price of €1,700.-, with a given life expectancy of 5 years. The fixed acquisition cost of a wheelie, first divided over the 5 years and subsequently divided by the amount of days in a year, results in € 0.93 per day. By assuming an average daily usage of 10 kilometers, the daily energy costs are approximately € 0.20. At last, the fixed daily maintenance costs are derived from the yearly maintenance costs for the Wheelie and estimated at € 0.23 per day. Thus, summing up both the daily fixed investment, maintenance and the energy costs, results in € 1.36. Equivalently, the break-even price of the Wheelie for inter-city movements is € 0.14 per kilometer. Therefore the inter-city willingness to accept for the Wheelie is €0.14 per kilometer.

The inter-city willingness to accept for the OlegO is equal to the price at break-even point. This break-even price per kilometer of the OlegO for inter-city movements is calculated given a fixed acquisition price of € 4,700.-, with a given life expectancy of 5 years. The fixed acquisition cost of a wheelie, first divided over the 5 years and subsequently divided by the amount of days in a year, results in € 2.58 per day. By assuming an average daily usage of 25 kilometers, the daily energy costs are approximately € 1. At last, the fixed daily maintenance costs are derived from the yearly maintenance costs for the OlegO and estimated at € 0.64 per day. Thus, summing up both the daily fixed investment, maintenance and the energy costs, results in € 4.22. Equivalently, the break-even price of the OlegO for inter-city movements is € 0.42 per kilometer. Therefore the inter-city willingness to accept for the OlegO is €0.17 per kilometer.

The inter-city willingness to pay in the results ranges from €0.29 to €0.73. The inter-city willingness to pay is calculated on the basis of the price of taking the public transport at 80 currently existing parkings being at 2 to 5 kilometers from a city centre to that city centre. The inter-city willingness to pay is the average of the price of public transport divided by the distance of the parking to the centre of these 80 instances. The average is at three decimals precise 0.414. The inter-city willingness to pay for the Wheelie and OlegO is set at €0.41 per kilometer with a social optimum barrier at €0.29.

## *4.2. Pricing Strategies*

Now that the lower bounds and upper bounds for the Wheelie and for the OlegO are known it is time to put them in the perspective of the pricing strategies mentioned earlier. The Wheelie and the OlegO are dealt with separately to give a clear product specific overview. The pricing of the Transition Hub is also done separately.

### 4.2.1. Pricing the Transition Hub - parking

Applying a pricing strategy for the parking part of the Transition Hub is done in the light of the goal of the Transition Hub. The Transition Hub aims to revolutionize city mobility; in order to reshape this market the mass has to be addressed. To do this the economy pricing strategy is applied to pricing the parking aspect of the Transition Hub. This way of pricing the parking part of the Transition Hub helps to boost the use of other aspects that are integrated in the Transition Hub such as the Wheelie and the OlegO.

With regards to the pricing of the Transition Hub it was found that for around 50 currently existing parkings in Rotterdam the short-parking hourly tariff is on average €2.40. With the functional superiority of the Transition Hub it is safe to ask the same price and capture market share fairly quickly. For the subscriptions the contract prices have been taken from Q-park data which is €180.- per month (Q-Park, 2013). Especially for big companies, one of the potential clients, it could be worth investing in spots at the Transition Hub for their employees. A contract price of €180.- is therefore a safe price to get enough market share in a relatively short time.

### 4.2.2. Pricing the Wheelie

The price of the Wheelie for intra-city movements must lie between the intra-city willingness to accept for the Wheelie of €0.10 and the intra-city willingness to pay for the Wheelie of €0.74. In a social optimum the price can be at most €0.48. The price of the Wheelie for inter-city movements must lie between the inter-city willingness to accept for the Wheelie of €0.14 and the inter-city willingness to pay for the Wheelie of €0.41. In a social optimum the price can be at most €0.29.

#### 4.2.2.1. Commercial optimum

The pricing strategy in the commercial optimum is the premium pricing strategy. For the Wheelie this means an intra-city price of €0.74 per kilometer and a inter-city price of €0.41 per kilometer. This price captures a lot of surplus while still being attractive on average for consumers because next to the price advantage there is a slight mobility advantage. The margin with these prices is respectively €0.64 and €0.27 per kilometer for intra-city and inter-city movements. In a commercial optimum it is better to keep this price discrimination than to abandon because of the great difference between the two margins.

#### 4.2.2.2. Social optimum

When looking at the social optimum it is better to apply the economy pricing strategy. The reason not to choose a penetration pricing strategy is that economy pricing strategy generates a higher cash flow which allows for expanding to other locations or other markets soon. The price is therefore set at the social optimum barrier of €0.48 for the intra-city movements and €0.29 for the inter-city movements. At these prices the Wheelie strictly dominates public transport. These prices correspond to margins of respectively €0.38 and €0.15 for the intra-city and inter-city movements. In a social optimum it is better to abandon this price discrimination to gain more market share and overall usage. Abandoning this price discrimination leads to a margin of €0.19 for intra-city movements and €0.15 for inter-city movements at a price of €0.29. At this price there is a price advantage of €0.45 per kilometer for intra-city movements and €0.12 per kilometer for inter-city movements when comparing the Wheelie to public transport.

## 4.2.3. Pricing the OlegO

The price of the OlegO for intra-city movements must lie between the intra-city willingness to accept for the OlegO of €0.25 and the intra-city willingness to pay for the OlegO of €0.74. In a social optimum the price can be at most €0.48. The price of the OlegO for inter-city movements must lie between the inter-city willingness to accept for the OlegO of €0.17 and the inter-city willingness to pay for the OlegO of €0.41. In a social optimum the price can be at most €0.29.

#### 4.2.3.1. Commercial optimum

The pricing strategy in the commercial optimum is the premium pricing strategy. For the OlegO this means an intra-city price of €0.74 per kilometer and a inter-city price of €0.41 per kilometer. This price captures a lot of surplus while still being attractive on average for consumers because next to the price advantage there is a huge mobility and high usage advantage. The margin with these prices is respectively €0.49 and €0.24 per kilometer for intra-city and inter-city movements. In a commercial optimum it is better to keep this price discrimination than to abandon because of the great difference between the two margins.

#### 4.2.3.2. Social optimum

When looking at the social optimum it is better to apply the economy pricing strategy. The reason not to choose a penetration pricing strategy is that economy pricing strategy generates a higher cash flow which allows for expanding to other locations or other markets soon. The price is therefore set at the social optimum barrier of €0.48 for the intra-city movements and €0.29 for the inter-city movements. At these prices the OlegO strictly dominates public transport. These prices correspond to margins of respectively €0.21 and €0.12 for the intra-city and inter-city movements. In a social optimum it would be better to abandon this price discrimination to gain more market share and overall usage. Abandoning this price discrimination would lead to a margin of €0.04 for intra-city movements and €0.12 for inter-city movements at a price of €0.29. At this price there is a price advantage of €0.45 per kilometer for intra-city movements and €0.12 per kilometer for inter-city movements when comparing the OlegO to public transport. The low margin for intra-city movements, however, does not protect the OlegO project against worse scenario's. A price of €0.35 is therefore to be taken in a social optimum without price discrimination. This is in the middle of the €0.29 of the social optimum and the €0.41 of the commercial inter-city willingness to pay. It leads to an acceptable €0.10 margin for intra-city movements and €0.18 for inter-city movements. At this price, however, the OlegO does not strictly dominate public transport anymore.

## 4.3. Location strategy for Transition Hubs

For the locations there are three distinctions:

-Socially optimal locations for inter-city traffic to Rotterdam

-Socially optimal locations for intra-city traffic in Rotterdam

-Use of conventional locations

### 4.3.1. Socially optimal locations for inter-city traffic to Rotterdam

Firstly, the lower bound of distance from the centres to the possible locations of the Transition Hub is calculated. Next, the additional reach of the transition hub due to the availability of the Wheelie and the OlegO is calculated and added up to the lower bound to calculate the upper bound.

The lower bound turns out to be 3.2 kilometres. This is the average distance between parkings and the centres within the range from 2 until 5 kilometres.

Using the Wheelie and OlegO is faster than traveling with public transport and ,evidently, much faster than walking. This time gain gives an additional reach for the transition hub. If a Transition Hub would be placed on the upper bound, it would make no difference in time with a normal parking. The additional reach of the Transition Hub is calculated and is 1.6 kilometres. The upper bound is therefore 3.2 + 1.6 = 4.8 kilometres.

Radii from the lower and upper bound are drawn to show which areas are to be considered as possible areas for the Transition Hubs. Figure *9* shows all the radii from each centre.

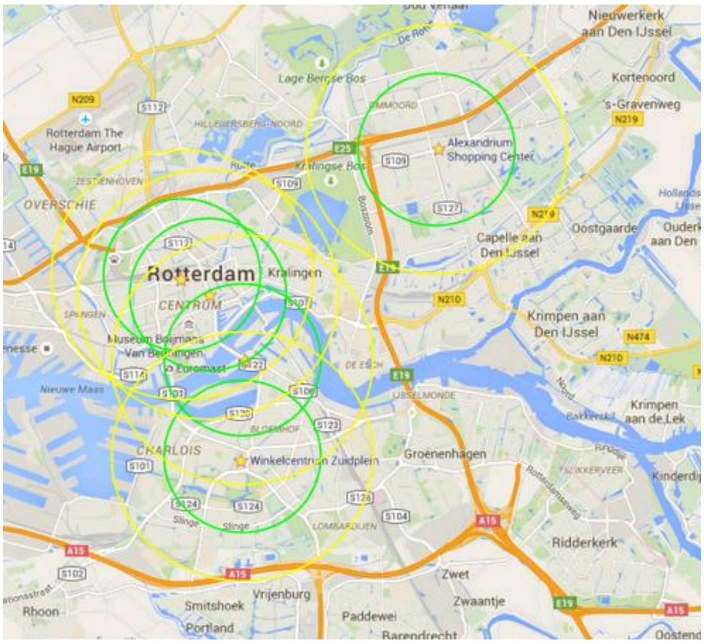



**Figure *9*: Lower and upper bounds range Transition Hub for inter-city traffic**

The green circles have a radius of approximately 3.2 kilometres and the yellow circles have a radius of approximately 4.8 kilometres. The optimal area for the Transition Hubs is within the yellow circles, because distances lower than the upper bound will always give a time gain for a Transition Hub over the conventional parking. The optimal area is, however, outside of the green circles, since the concept of the Transition Hub is to reduce traffic coming into the city centre. The optimal area is therefore between the green and the yellow circles. If the city places Transition Hubs in these areas, there will be both a time gain and a reduction traffic coming into the city centre. Four centres have a considerable amount of intersections and overlap. Shopping mall and working centre Alexandrium has no overlap with the other centres, because Alexandrium is too distant from the inner city of Rotterdam.

The general area, as shown in figure *9*, is too large to choose a valid location from for the Transition Hubs. Congestion points are found to narrow down the areas. According to a report from TNO there are seven main congestion points from the highway coming into the outer bounds of the city. In figure *10* is shown where those congestion points are. For simplicity we do not show the severity of congestion per congestion point, but the northern points are the most congested points in Rotterdam.

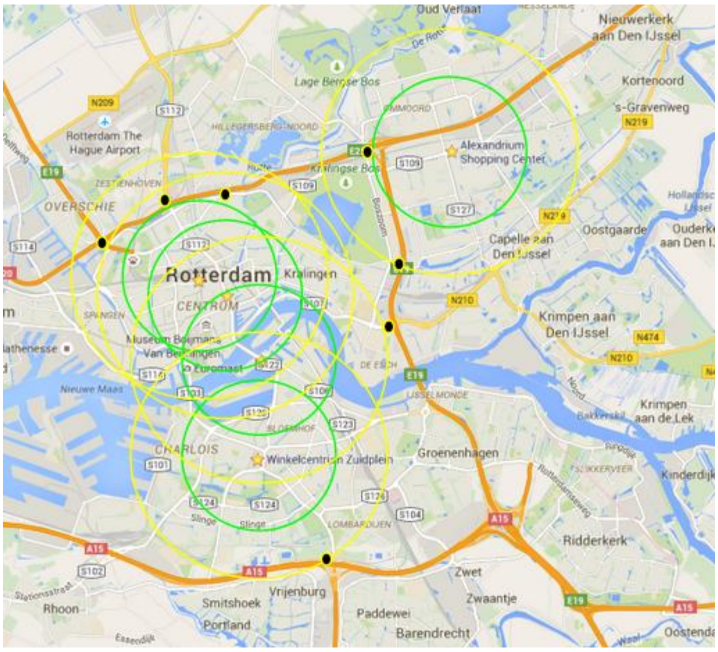



**Figure *10*: Congestion points**

As shown in figure *10*, the congestion point are placed on and within the upper bound radii and not within the lower bound radii. Therefore it can be concluded that all the congestion points are to be considered as possible locations for the Transition Hub. The Transition Hub will be most effective on those locations.

The potential areas for the Transition Hub are the areas around:
-Exit 19a A15
-Gordelweg, exit 15 A20
-Hoofdweg, exit 27 A16
-Knooppunt Kleinpolderplein, A13
-Jacques Dutilhweg, exit 26 A16
-Schieplein, exit 14 A20
-Abram van Rijckevorselweg, exit 25 A16

The next question is whether a Transition Hub matches the zoning plan proposed by the municipality of Rotterdam. In appendix A the zoning plans for all possible locations can be seen.

The zoning plan for exit 19a on the A15 shows that the surrounding area is designated for traffic (grey) and recreation (green). After consulting satellite images of the area, the possible locations for the Transition Hub are right next to the exit of the highway on both the northeastern and northwestern side of the exit. Further northwestern lies a cemetery, so the most wise location is on the northeastern side of the exit of the highway. From there travelers can park their cars and travel more towards the city centre and suburbs via other means, such as the Wheelie or OlegO.

The zoning plan for exit 15 A20 adjacent to the Gordelweg is not available for the western side of the exit. The eastern side has a zoning plan, but this area is also designated for and occupied by a cemetery, which rules out the possibility of placing a Transition Hub there. Since there is no zoning plan for the western side, satellite images are viewed. The images reveal two possible locations adjacent to the exit. The southwestern and southeastern side of the crossroads on which exit 15 ends are possible locations. The southeastern side is larger than the southwestern side and is therefore the most logical location for the Transition Hub.
It must also be said that a large parking space used by the police of the city is next to the exit, which may be used to build a Transition Hub for both employees of the police and other travelers from outside the city.

The zoning plan for exit 27 A16 adjacent to the Hoofdweg shows that both the eastern as the western side are designated for traffic (grey) and commercial activities (purple). Therefore, the zoning plan allows for a Transition Hub in the area of exit 27 A16. It is possible to build a Transition Hub right next to the exit of the A16. A small disadvantage is however that there are not any bicycle lanes build next to the exit. Either this has to be built along with the Transition Hub or this location is not suited for the functionalities of the Transition Hub. Another possible location, which has bicycle lanes, is the crossroads of the Hoofdweg and Boszoom to the west of the exit. The large crossroads is the ideal location to park cars thus reducing traffic into the city centre and the city suburbs. Finally, right next to the crossroads there is a large company terrain of TNT Post, which could also benefit from building a Transition Hub at their location, since they can use the multifunctionality of the modular design of the Transition Hub and be a central pickup-point for letters and packages for clients around the area. Building a Transition Hub there will therefore also reduce commercial traffic into the suburbs of the city.

The zoning plan for the end of the A13 at Knooppunt Kleinpolderplein shows that the northwestern side of the A20 has no zoning plan. This side is however not an option, since this is not in the direction of the city. The southeastern side of the zoning plan is partly designated for traffic (grey) and partly designated for companies (deep purple). The Transition Hub can be placed on both the northern and southern side of the exit of the A13. There is also a large parking area presence of the Zoo Blijdorp. This is right next to the exit and it would be a possible location for the Transition Hub. Travelers can use the Transition Hub to park their cars and travel further via the Wheelie or OlegO, while the Zoo Blijdorp can save precious space by building parking space up instead of using a large area to house the same amount of cars. By saving space the Zoo Blijdorp has possibilities to expand and the city can also use the space for other activities.

The area of exit 26 A16 adjacent to the Jacques Dutilhweg has no zoning plan. Therefore, satellite images are viewed to assess whether there are locations for the Transition Hub. The western side should be the best side, since that is in direction of the city centre. Satellite images show that there is a commercial area around the west of the exit. The commercial area can be designated as a location for the Transition Hub. The Kralingse Zoom is in the vicinity, which has a parking area and both a metro and a bus connection with the city centre. Besides public transport, travelers can use the Wheelie and OlegO from the Kralingse Zoom to reach their destination.

The zoning plan for exit 14 A20 or Schieplein shows that to the south of the Schieplein there is not a zoning plan. After viewing satellite images it can be concluded that this area is not suitable for the Transition Hub. The area is a residential area with a restricted amount of space left. The location of the Transition Hub should therefore be north of the Schieplein. To the northeast lies the hospital Sint-Franciscus Gasthuis, which has his own conventional parking. The parking could be renewed by replacing it with the Flex parking. The zoning plan designates the parking lot and hospital as mixed (peach), so it would be possible to replace the current parking or place an additional Transition Hub to meet the expected increase in demand for parking at the city borders. The rest of the area is unfortunately occupied by nature and, according to the zoning plan, it would not be possible to build a Transition Hub there.

The zoning plan for the exit 25 A16 Abram van Rijckevorselweg shows us that, except for the Erasmus University Rotterdam, there is no zoning plan for the northwestern side of the exit. According to satellite images, it is not possible to find a location in the nearby area of the northwestern side. However, a possible location is the Kralingse Zoom, which could serve as Transition Hub for both exit 25 and exit 26 of the A16.
Southwest of the exit there are two possible locations. The two peach colored segments show that these areas are designated as mixed, meaning a Transition Hub could be build here. The most southern area is however unavailable, because the whole area is already built upon. The long strip to the east of the area is a valid location for the Transition Hub. Though it is currently planted with trees, there is enough space to build a Transition hub on the north and on the south side of the strip.

Finally, in addition to all the current suggested locations, this study emphasizes on the need to make traveling more flexible. If a Flex parking for whatever reason could not be build, like in the case of the hospital Sint-Franciscus Gasthuis due to the already present conventional parking, it is recommended to store and rent out Wheelies and OlegOs on locations next to those conventional parkings.

### 4.3.2. Socially optimal locations for inter-city traffic to Rotterdam

Firstly, the lower bound of distance from the centres to the possible locations of the Transition Hub is calculated. Next, the additional reach of the transition hub due to the availability of the Wheelie and the OlegO is calculated and added up to the lower bound to calculate the upper bound.

The lower bound turns out to be 1.4 kilometres. This is the average distance between parkings and the centres within the range from 0 until 2 kilometres.

Using the Wheelie and OlegO is faster than traveling with public transport and ,evidently, much faster than walking. This time gain gives an additional reach for the transition hub. If a Transition Hub would be placed on the upper bound, it would make no difference in time with a normal parking. The additional reach of the Transition Hub is calculated and is 1.6 kilometres. The upper bound is therefore 1.4 + 1.6 = 3.0 kilometres.

Radii from the lower and upper bound are drawn to show which areas are to be considered as possible areas for the Transition Hubs. Figure *11* shows all the radii from each centre.

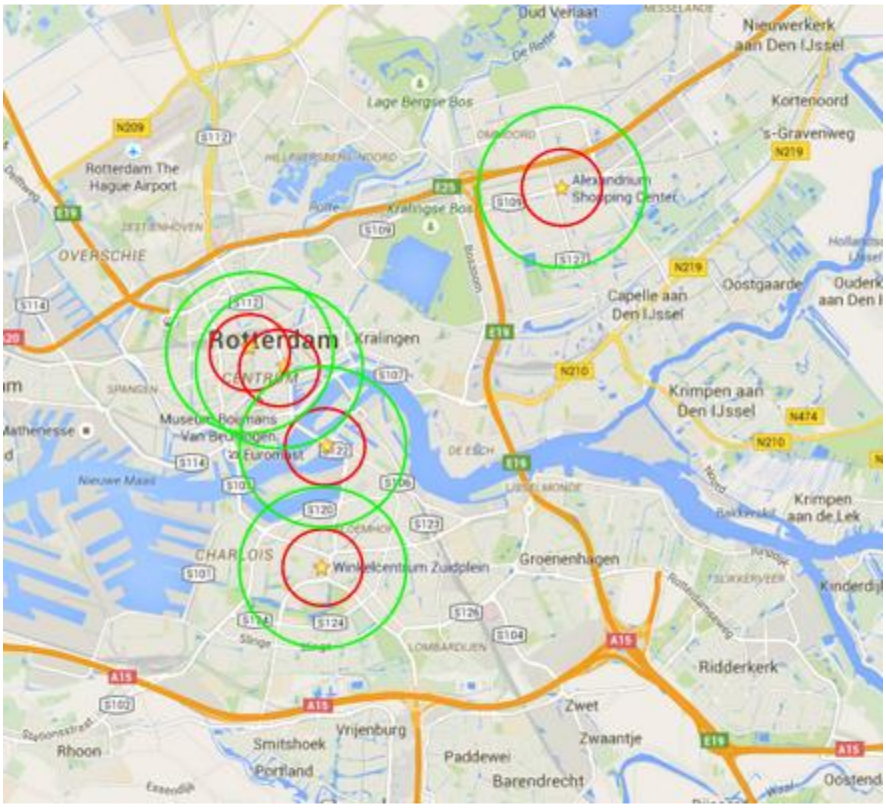



**Figure *11*: Lower and upper bounds range Transition Hub for intra-city traffic**

The red circles have a radius of approximately 1.4 kilometres and the green circles have a radius of approximately 3.0 kilometres. The optimal area for the Transition Hubs is within the green circles, because distances lower than the upper bound will always give a time gain for a Transition Hub over the conventional parking, but outside the red circles. The area with the most overlap is the area in which the Transition Hub has an effective range for the centres.

The area in the range of the three centres Weena, Koopgoot and Kop van Zuid must have at least 1 Transition Hub and a maximum of 2 Transition Hubs. Both Leuvehaven and Blaak are inside the area and possible locations for the Transition Hubs due to the central position of both locations and the availability of all sort of public transport. The roads at both locations are also suitable for the Wheelie and OlegO.

The area in the range of Kop van Zuid and the mall of Zuidplein can have a maximum of 1 Transition Hub. An ideal location could be on the Brielseweg near the Maashaven, which has several connections via public transport.
The other possible areas, namely the area joining Weena and Koopgoot and the area joining Koopgoot and Kop van Zuid, are not considered due to the fact that 2 Transition Hubs are already accounted for in these areas.

The next question is whether these three locations are in line with the zoning plans proposed by the municipality. Appendix B shows the three zoning plans for each area.

The zoning plan for Blaak shows that there is plenty of opportunities to build a Transition Hub. The area attributed to traffic (grey) is considerably larger than any other zoning plan. A Transition Hub could be placed nearby of the train and tram stations, next to the newly build Markthal. Not only will this be an effective way to park vehicles and offer travelers to explore the city via the Wheelie, OlegO or any other means of transportation, also this Transition Hub will be a addition to the city Rotterdam as a feat of engineering and flexibility. Since it is next to the Markthal, the new tourist attraction of Rotterdam, it could form the perception of Rotterdam of a clean, innovative city.

The zoning plan for Leuvehaven shows that this area has also a considerable amount of space attributed to traffic (grey). Leuvehaven would therefore be a excellent location for the Transition Hub. On the southeastern side of the crossroad at Leuvehaven there is an strip of land available according to both the zoning plan and satellite images. It is connected to public transport and a central point for traffic from both north and south in Rotterdam. Another possible location is along the waterside of the Maas on the street Boompjes. Due to the ample of space it is possible to build a Transition Hub there.

The zoning plan for Maashaven shows us that there is only a zoning plan for the northern side of Leuvehaven. According to satellite images, there is not enough space on the the southern side of the Maashaven to build. However, since the small size of the Transition Hub (about 2 car lengths long) it could be possible if some trees are cut down on the southern part of Maashaven.

The zoning plan for the northern side shows us that there are possibilities to build Transition Hubs, since some areas are attributed to traffic (grey). However, based on satellite images a valid location was not found. Building a Transition Hub would only be possible if some infrastructure of the tram rails were to be demolished or that the Hub would be integrated with a large building, such as the Maassilo. For now, we assume that Maashaven is not a valid option in the near future to build a Transition Hub, despite the need for a central Hub on that location.

### 4.3.3. Use of conventional locations in Rotterdam

The locations thus far mentioned are socially optimum locations of the Transition Hub for the municipality, its residents and its travelers. It needs to be emphasized that these are the locations this study recommends for socially optimum outcomes. These location would reduce congestion, emission of hazardous and damaging gasses and increase flexibility for the traveler. However, there are a number of conventional parkings already built in the city centre of Rotterdam. Since there is no immediate plan to revise these structures, it can play a part in the new flexible Rotterdam. The Wheelie and the OlegO should be rented out and sold at the conventional parkings. Although travelers are still confronted by a longer traveling time due to the inefficient concept of a conventional parking, they will have the benefits of using a Wheelie or OlegO instead of walking to their destination.

A small storage facilities for both the Wheelie and OlegO should be build near each conventional garage in each centre. Appendix C shows the five zoning plans for the centres.

The area of the Koopgoot is hardly suitable for such building. Since most of the area is either built upon or designated as a shopping area, it will not be possible to place storage facilities of Wheelies and OlegOs there. However, the west side of the Meent has a small strip of street specially reserved for parking cars and bicycles. Since we expect less traffic in the city centre due to placing of Transition Hubs outside of the centres, the parking spaces are arguably not needed there. The parking lot should be the new location for storage of Wheelies and OlegOs. The zoning plan of Meent supports this idea, because the strip of land is attributed to traffic (grey).

Kop van Zuid has no zoning plan. Satellite images show that there is plenty of space available on the north side of Kop van Zuid at the Wilhelminaplein. Kop van Zuid could therefore easily house a storage facility for the Wheelie and OlegO.

Shopping mall centre and work centre Alexandrium has, according to the zoning plan and satellite images, enough space to house a storage facility. Both centres are not in the direct vicinity of the other centres and have no extraordinary congestion problems as well. That does not derogate from the notion that the Wheelie and OlegO could possibly reduce traffic and emissions. A storage facility should be build there nevertheless.

Shopping mall centre Zuidplein has also enough space to house a storage facility according to satellite images. The zoning plan designates the area as either traffic (grey) or mixed (peach), so the zoning plan also allows the placement of the storage facility. Ideal locations would be next to the metro and bus station of Zuidplein.

Weena has not enough space to house a storage facility. The only possibility to include a storage facility in the nearby area is using a part of the new underground facility for bicycles at the Central Station of Rotterdam. This is however an uncertain location. Therefore this study does not provide a recommendation for a storage facility in the area of Weena.

## 5. Conclusion

This study started off with the situation description of metropolitan cities; parking is a growing source of frustration for daily travellers by car, especially during rush hours. Congestion is an enormous problem that will likely increase in the future due to demographic trends and insufficient societal and infrastructural adaptation. Congestion could be solved for a great deal by improving currently existing parkings in terms of efficiency and by building new, innovative and thus better parkings.

This study is embedded within the latest trends using business idea and products of Van der Wijngaart's Engineering Services, which are applicable to the city of Rotterdam. The research revolved around the question:

*What is the best entry strategy for the Transition Hub in Rotterdam?*

This study has dealt with the pricing strategies and location strategies for the Transition Hub. The previous chapters show the optimal entry strategy for the Transition Hub of which the location of the Flex Parking and the pricing strategies for the Wheelie and the OlegO were most extensively researched.

It is shown that the prices of the Wheelie and the OlegO differ when looking from a social or a commercial angle and when taking intra-city movements and inter-city movements. They differ because a public/social organisation aims to maximize the welfare of all potential stakeholders while the private/commercial aims to maximize its own welfare only. The difference in pricing between intra-city and inter-city movements originates from the difference in mobility needs between the two movements.

The most important results are from a social angle for the inter-city movements; the best price for both the Wheelie and OlegO in that case is €0.29 per kilometer. This price can also be applied to the Wheelie for intra-city movements but the OlegO should not be rented for intra-city movements at this price. The Transition Hub is best priced with an hourly tariff of €2.40 and a subscription contract price of €180.- per month.
This social angle makes use of the economy pricing strategy and the commercial angle makes use of

the premium pricing strategy. This results in different prices. The economy pricing strategy leads to a situation where the Transition Hub strictly dominates public transport. This is the preferred entry strategy to get the most positive externalities associated with the Transition Hub whilst not underpricing the superior products as would be the case with penetration pricing.

This study also shows that at least nine locations can be chosen to build a Transition Hub upon.

-Exit 19a A15

-Gordelweg, exit 15 A20

-Hoofdweg, exit 27 A16

-Knooppunt Kleinpolderplein, A13

-Jacques Dutilhweg, exit 26 A16

-Schieplein, exit 14 A20

-Abram van Rijckevorselweg, exit 25 A16

-Blaak

-Leuvehaven

The first seven locations have the same property and goal: to reduce traffic coming into the inner city. By choosing these seven locations at congested entry points into the city the municipality could profit from the reduction in congestion. There are two conditions on building a Transition Hub on these locations: there must be a facility for the Wheelie and OlegO and they must be easy accessible for every user of the Transition Hub.

The other two locations are located inside the inner city. Though the main goal of the Transition Hub is to reduce inner city traffic, it would be unwise to neglect the demand for flexible transport and parking in the inner city. According to the results there are two locations which have the optimal range to the most centres and have possible sites to be built upon.

Finally, this study emphasizes on building facilities for both the Wheelie and OlegO, regardless of the parking that is used. The Wheelie and OlegO are both vehicles which improve mobility for a relatively small price and gives individual travelers the possibility to use the Wheelie for the last mile or the OlegO for other activities instead of using a car or public transport.

# 6. Bibliography

Adriaanse, M. (2013, december 24). Elektrische auto's in trek. Retrieved from Elektrischeauto.nl: http://elektrischeauto.com/elektrische_auto_verkoop_2013/ (Accessed on 15 May 2015)

Arnott, R. (2005). Spatial Competition between parking garages and Downtown Parking Policy. Boston: Boston College.

Arnott, R., & Rowse, J. (2009). Downtown parking in auto city. Regional Science and Urban Economics Vol. 39, 1-14.

Ballester, F., Medina, S., Boldo, E., Goodman, P., Neuberger, M., Iniguez, C., & Künzli, N. (2008). Reducing ambient levels of fine particulates could substantially improve health: a mortality impact assessment for 26 European cities. Journal of Epidemial Community Health, Vol. 62, 98-105.

Burdorf, L. (2009). Ongezondste stad. Monitor Erasmus MC, no. 5, 15-18.

Business Dictionary. (2015). Cost input. Retrieved from Business Dictionary: http://www.businessdictionary.com/definition/cost-input.html (Accessed on 29 May 2015)

Centraal Bureau voor de Statistiek. (2013, January 4). Bevolking vier grote steden groeit tot 2040 met 333 duizend inwoners. Retrieved from Centraal Bureau voor de Statistiek: http://www.cbs.nl/nl-NL/menu/themas/bevolking/publicaties/bevolkingstrends/archief/2012/2013-bevolkingstrends-groei-grote-steden-art.htm?RefererType=RSSItem (Accessed on 15 May 2015)

Centraal Bureau voor de Statistiek. (2015). CBS Statline. Opgehaald van CBS: http://www.cbs.nl/nl-NL/menu/themas/macro-economie/nieuws/default.htm (Accessed on 15 May 2015)

Crainic, T. G., Ricciardi, N., & Storchi, G. (2004). Advanced freight transportation systems for congested urban areas. Transportation Research part C: Emerging Technologies Vol. 12, 119-137.

Economic Times. (2015). Definition of 'Pricing Strategies'. Retrieved from Economic Times Indiatimes: http://economictimes.indiatimes.com/definition/pricing-strategies (Accessed on 18 July)

Forbes. (2010, December 15). Consumers Overwhelmingly Want CSR. Retrieved from Forbes: http://www.forbes.com/sites/csr/2010/12/15/new-study-consumers-demand- companies-implement-csr-programs/ (Accessed on 16 May 2015)

Gemeente Rotterdam. (2015). Bestemmingsplannen. Retrieved from Rotterdam.nl: http://www.rotterdam.nl/bestemmingsplannen (Accessed on 5 June 2015)

Glaeser, E., Kolko, J., & Saiz, A. (2001). Consumer City. Journal of Economic Geography vol. 1, 27-50.

Hanemann, W. (1991). Willingness to Pay and Willingness to Accept: How Much Can They Differ? . The American Economic Review, Vol. 81, No. 3, 635-647.

INRIX. (2012). Files dalen wereldwijd: INRIX Traffic Scorecard geeft een onthullende blik op de worstelende economieën in Europa. Amsterdam: INRIX.

Jansson, J. O. (2010). Road pricing and parking policy. Research in Transportation Economics Vol. 29, 346-353.

Knaap, R. v., & Wee, B. v. (2004). Hoe te komen tot een transitie naar duurzame mobiliteit: een verkenning van theorieën. Zeist: Colloquium Vervoersplanologisch Speurwerk.

Kokemuller, N. (2015). Entry Pricing Strategy. Retrieved from SmallBusinesses: http://smallbusiness.chron.com/entry-pricing-strategy-61428.html (Accessed on 15 May 2015

Landelijk Meetnet Luchtkwaliteit. (2015). Actuele luchtkwaliteit fijnstof. Retrieved from Landelijk Meetnet Luchtkwaliteit Rijksinstituut voor Volksgezondheid en Milieu: http://www.lml.rivm.nl/index.php (Accessed on 29 May 2015)

McKinsey & Company. (2014). Evolution. Electric Vehicles in Europe: gearing up for a new phase? Amsterdam: Amsterdam Roundtable Foundation.

Nederland Elektrisch. (2015). Subsidies. Retrieved from Nederlandelektrisch.nl: http://www.nederlandelektrisch.nl/thema/bedrijf/regelingen-subsidies/ (Accessed on 29 May 2015)

Q-Park NV. (2013). Jaarverslag 2013 Q-Park. Maastricht: Q-Park NV.

RET. (2015). Reisproducten en tarieven. Retrieved from RET: http://www.ret.nl/service/reisproducten-en-tarieven.html (Accessed on 15 May 2015)

Rotterdam.nl. (2015). overzicht openbare parkeergarages. Retrieved from Rotterdam.nl: http://www.rotterdam.nl/overzichtopenbareparkeergarages (Accessed on 30 May 2015)

Roubos, L. (2013, March 7). Steeds meer parkeerproblemen rond Keizerswaard. Retrieved Rijnmond: http://www.rijnmond.nl/nieuws/07-03-2013/steeds-meer-parkeerproblemen- rond-keizerswaard (Accessed on 15 May 2015)

Sen, A. K. (1971). Choice Functions and Revealed Preference. The Review of Economic Studies, Vol. 38, No. 3, 307-317.

Sierzchula, W., Bakker, S., Maat, K., & van Wee, B. (2015). Worden door financiële prikkels meer elektrische auto's verkocht? Tijdschrift Vervoerswetenschap Vol. 51, 110-131.

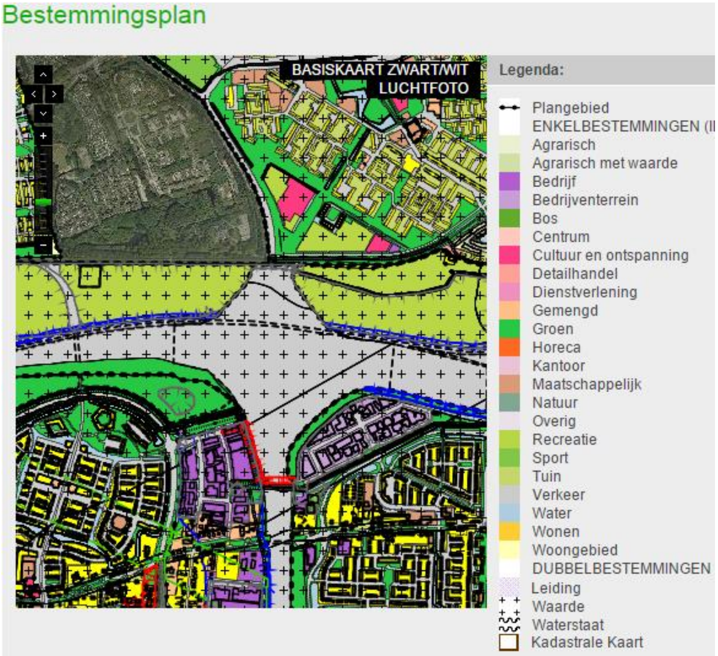
Turvey, R. (1963). On Divergences between Social Cost and Private Cost . Economica, New Series, Vol. 30, No. 119, 309-313.

TNO. (2008). De kosten van de kwetsbaarheid van het wegennet in de Randstad in 2008 en 2030. Delft: TNO.
TNO. (2013). Filegolven Rotterdam. Rotterdam: TNO.

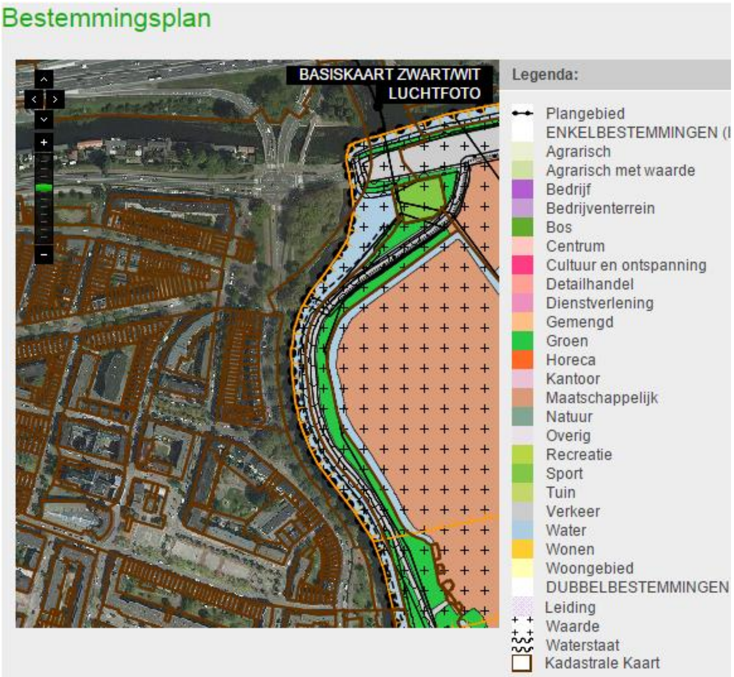
# 7. Appendix

## 7.1. Appendix A

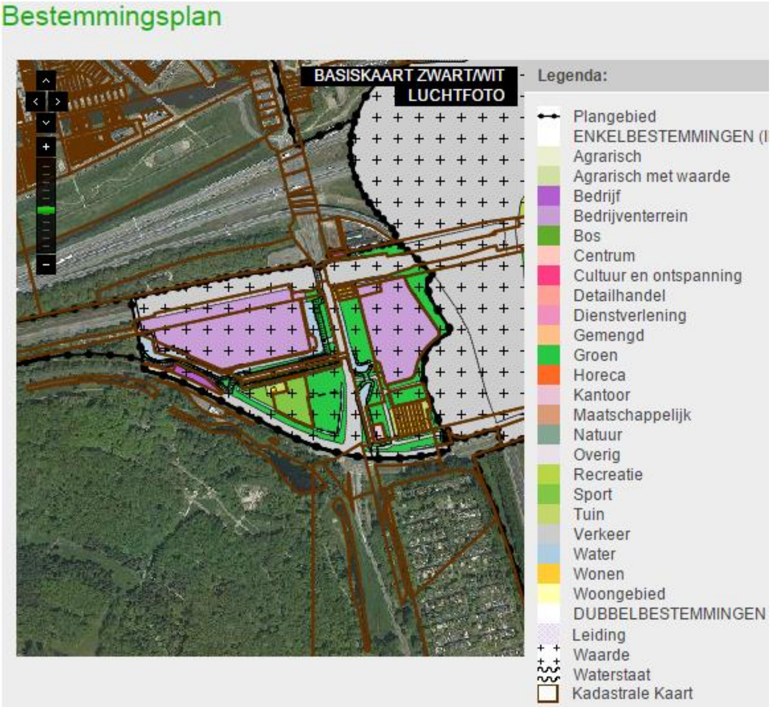
*Bron: Gemeente Rotterdam*




*Exit 19a A15*




*Gordelweg, exit 15 A20*

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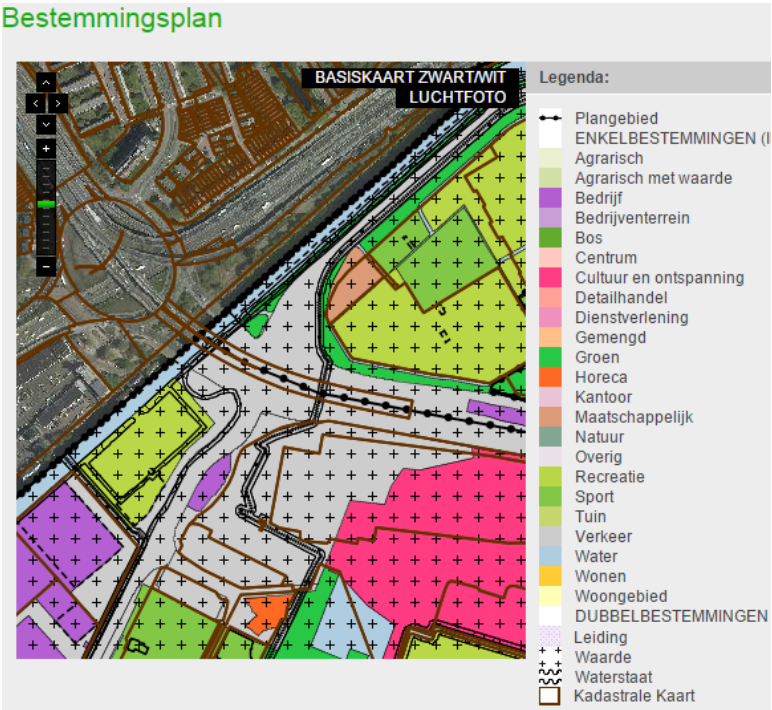
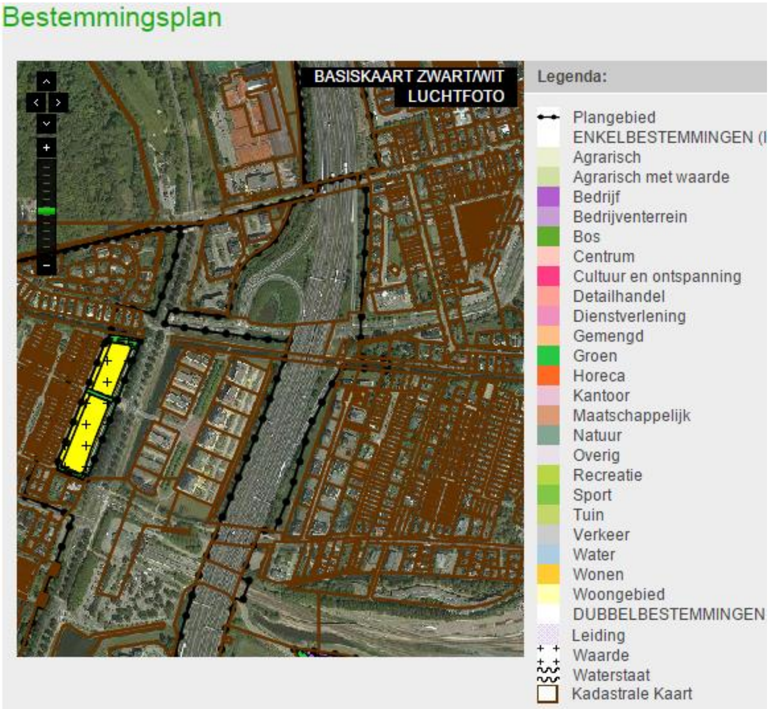
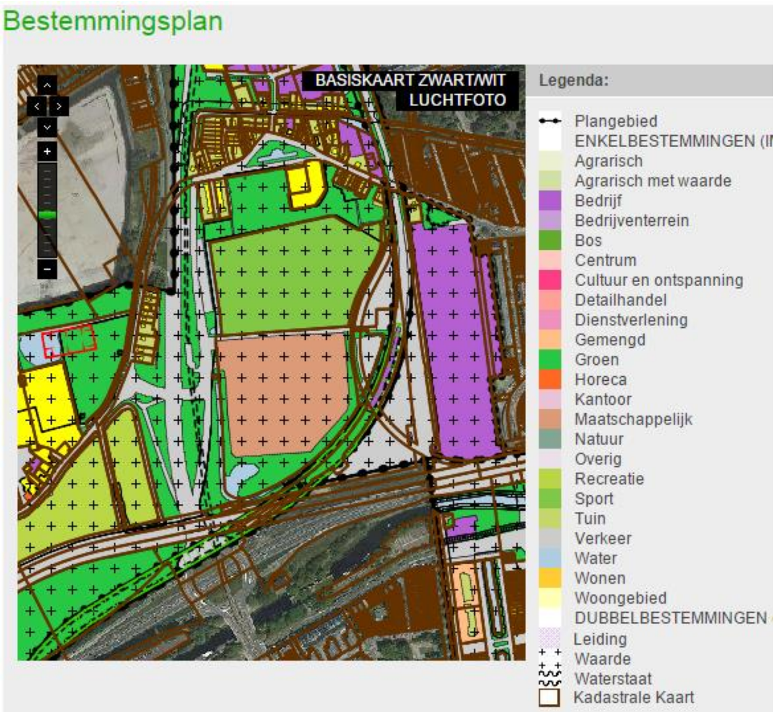


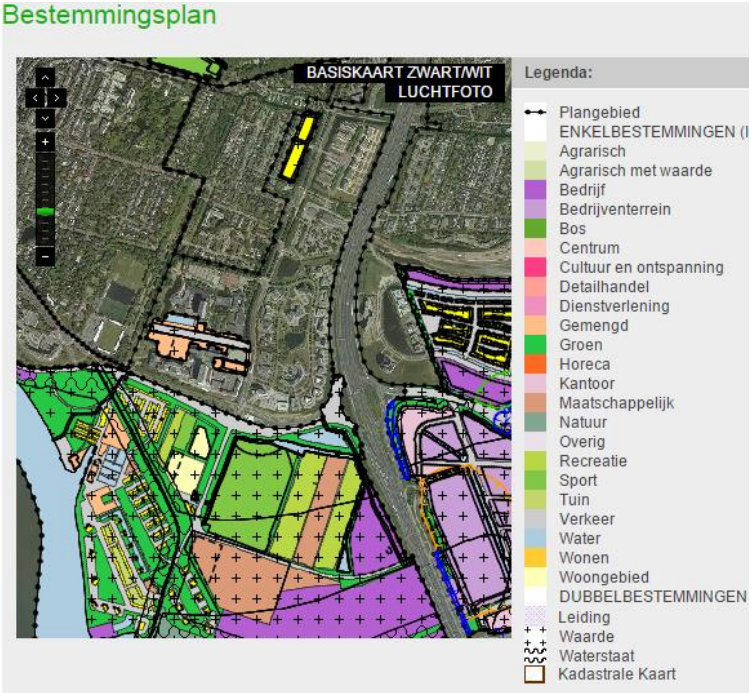

*Knooppunt Kleinpolderplein, A13*




*Jacques Dutilhweg, exit 26 A16*




*Schieplein, exit 14 A20*




*Abram van Rijckevorselweg, exit 25 A16*

## *7.2. Appendix B*

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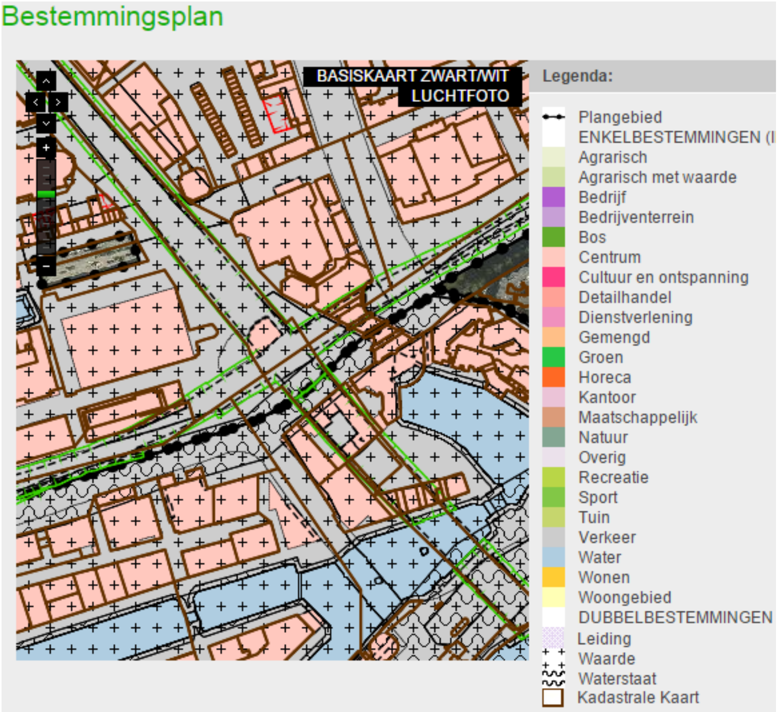


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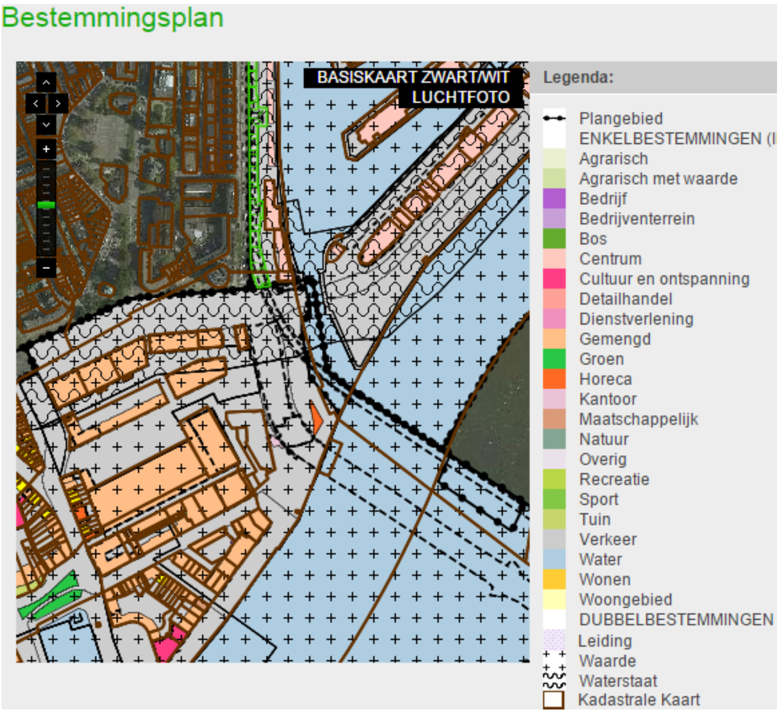
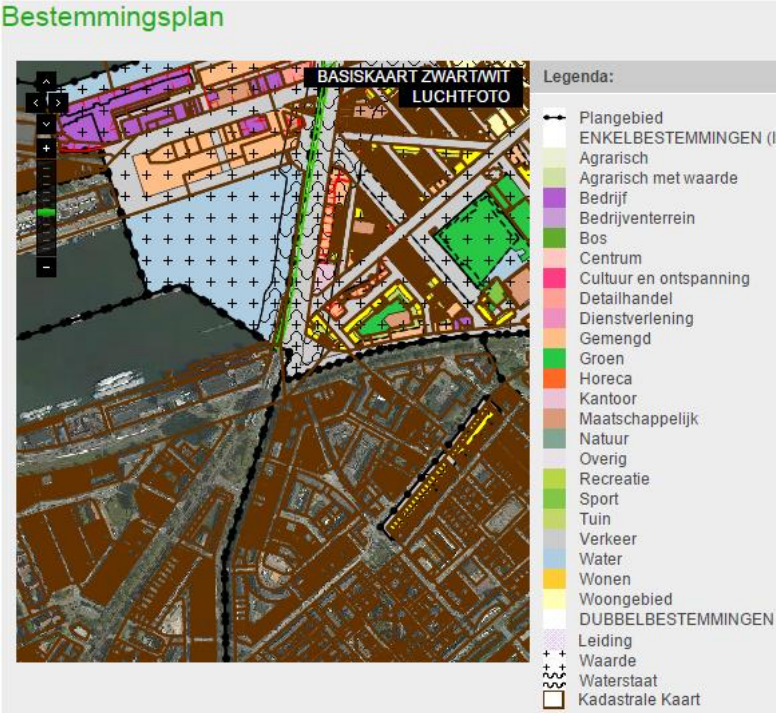



*Leuvehaven*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Dienstverlening
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Groen
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Kadastrale Kaart

*Maashaven*

## 7.3. Appendix C

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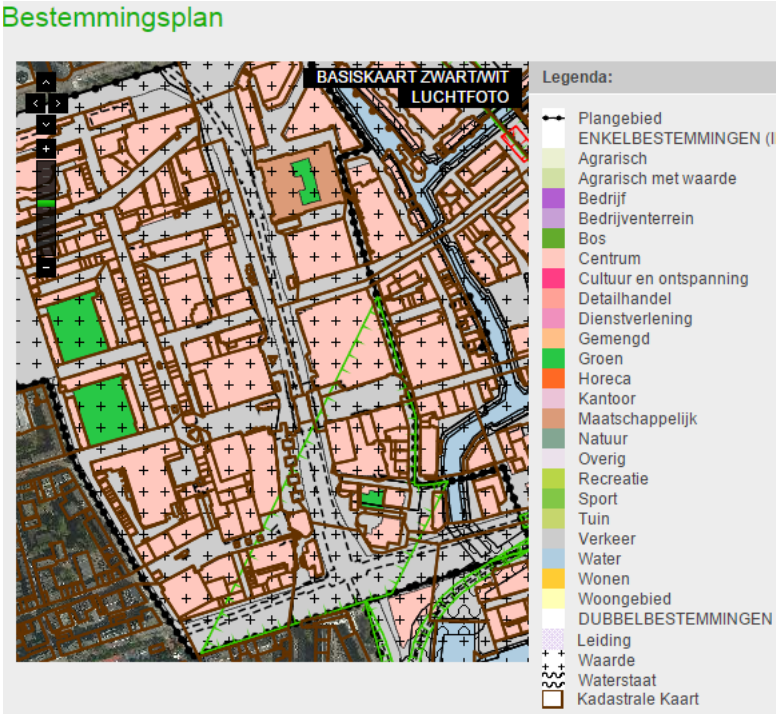
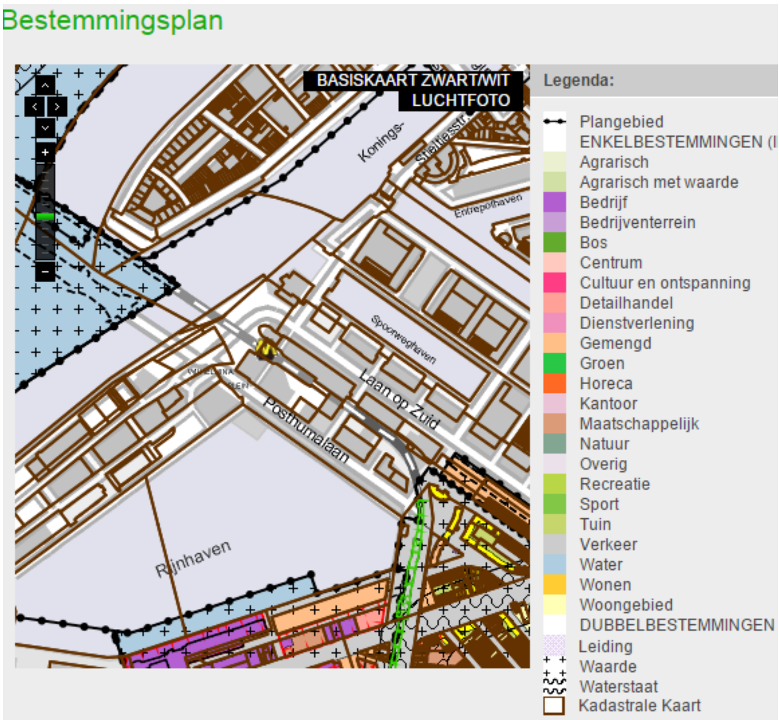
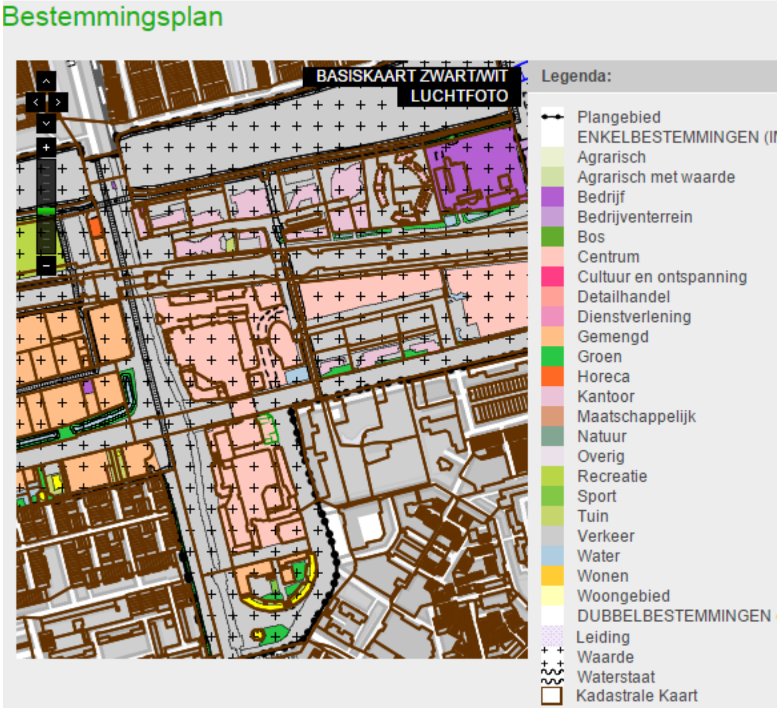


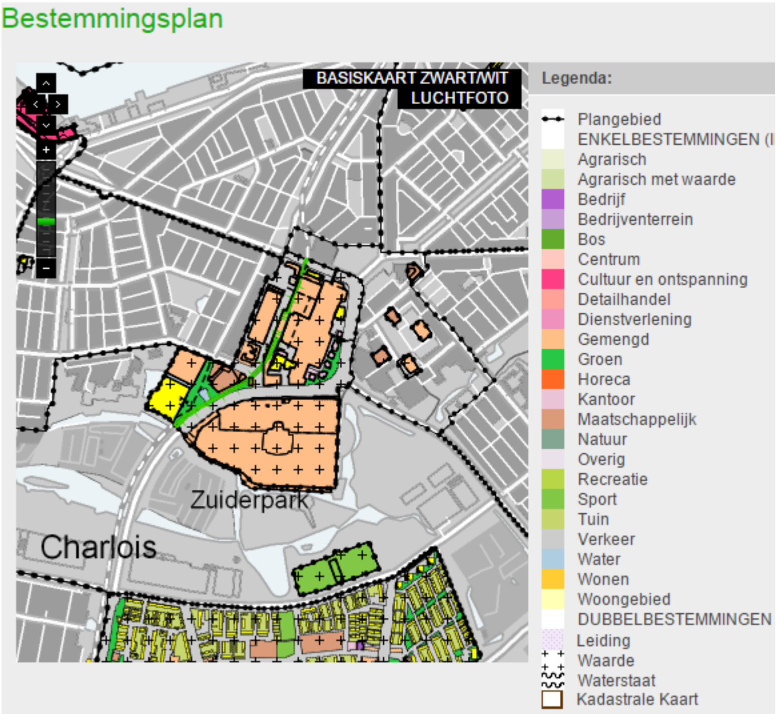

*Koopgoot*



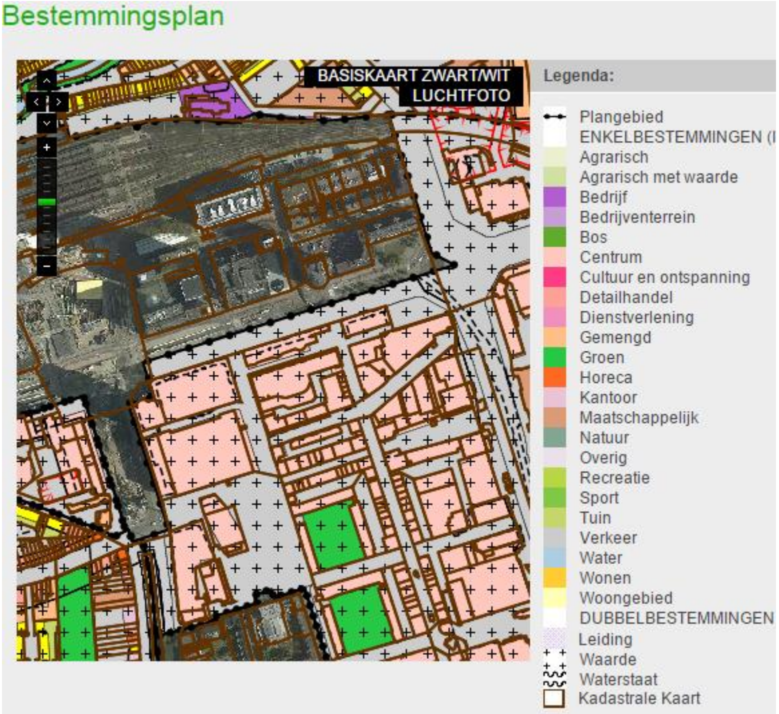

*Kop van Zuid*




*Shoppingmall Alexandrium*




*Shoppingmall Zuidplein*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Maatschappelijk
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Recreatie
Sport
Tuin
Verkeer
Water
Wonen
Woongebied
DUBBELBESTEMMINGEN
Leiding
Waarde
Waterstaat
Kadastrale Kaart

*Weena*