

Master thesis

1-3-2018

## The use of Geographic Information Systems for optimal site selection in expanding companies in the retail sector.

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## Summary

### Introduction

The Netherlands is ranked among the top five countries in the world in terms of its levels of user adoption of geographical information (GI). Eighty percent of all available data contains a geographical component and can be handled with a Geographical Information System (GIS), which is an information system that is designed to work with data, referenced by spatial or geographic coordinates. The use of GI leads to increased productivity in several business operations, and to greater accuracy of information for both professionals and the general public. Therefore, GI can be useful for making the right choice regarding the best location. Although GI is nowadays being used on an increasing basis, not every company makes its location choices based on GI. This research determines the site selection work process of companies in the retail sector, and investigates which reasons could account for the potential of GIS not being fully utilised. The goal of this research is to evaluate the use of GIS in expanding retail companies in the Netherlands in order to identify the gap between what GIS contributes to a company at present, and what the potential value of GIS could be for expanding companies. The main research question that will be answered is:

*'To what extent are expanding companies in the retail sector using geographical information systems for their site selection and what could enhance its potential use?'*

### Sensitizing concepts from theory

According to the theory there are four factors which can be held responsible for the non-use or suboptimal use of GIS. These factors could partly explain why there is a gap between the use and non-use of GIS. The sensitizing factors were developed on the basis of these constraining factors.

- *Awareness* is the knowledge of the existence of data and GIS, and its potential added value.
- *Accessibility* is about the critical importance of a potential user of GIS having access to all data needed in order to correctly represent a particular site in its surroundings.
- *Accuracy* is about the usability, the type of the data, and is an important factor for knowing whether the data are of value to a company.
- *Knowledge* relates to specific technological know-how with regard to the GIS software.

## **Method**

The design of this research is explorative and qualitative. At present, there is scant knowledge as to why GIS is not widely used in the retail sector. Inductive research is needed to ask the companies in the work field why they do or do not use GIS. In order to identify these explanatory variables and concepts, the Grounded Theory method was used in this research. The Grounded Theory is a qualitative inductive method intended to seek and conceptualise latent patterns and structures – a substantive theory – through a process of constant comparison. Therefore, in-depth qualitative semi-structured interviews were held with 10 companies in the retail sector to gain new insights and new theoretical concepts about the possible gap between the practical and potential use of GIS, and to establish what would need to be done to accomplish the potential use of GIS. The sensitizing concepts were also used as a guideline for the interviews. The interviews were held with the companies' expansion manager or CEO.

## **Conclusion and recommendations**

The results have revealed that not all interviewed companies in the retail sector make use of GIS when searching for a new establishment. From the interviews it emerged that the work processes of the ten retail companies can be divided into three groups: Use GIS, Non-use GIS and External GIS. Not all three groups are using GIS, but two of them do. It appeared that, when the awareness about GIS in the company was high, the companies were using GIS already. The five most important factors for the use or non-use of GIS appeared to be: lack of knowledge, the processing of subjective data, strategy of the company, an alternative method or system, and the cost-benefit ratio. From the interviews it also emerged that there indeed is a gap between the contribution of GI to a company at present and the potential value. The most important conclusion emerging from this research is that insights into the possibilities of GIS is the key for enhancing the potential use of GIS. Therefore, awareness needs to increase, because awareness is a first step to getting greater insights. Furthermore, the subjective data remains of importance to every company and must always be taken into account when discussing the GIS analysis.

## **Preface & Acknowledgements**

I am pleased to present the final version of my master's thesis. The subject I have chosen – site selection – is one that has always interested me. At secondary school, and when doing my bachelor's degree in Human Geography and Planning, and my GIMA master's at university, I was always intrigued by what led companies to decide on where they should be situated. This thesis has provided me with a better insight into why and how such decisions are made, and has also allowed me to become familiar with the inner workings of several amazing companies.

I would like to thank my supervisor, Fred Toppen, for his guidance, enthusiasm, and constructive and quick feedback, despite his busy schedule. Furthermore, I would like to thank Nikkie den Dekker at Geodan for the advice and assistance she gave me in our daily conversations, which helped keep me going in the right direction. Also, I would like to thank the company Geodan for providing me with a workspace during the writing of this thesis and for providing me with a number of connections, which assisted me in identifying sufficient respondents.

I would also like to thank Rob Wittendorp, who has a background in GIMA, for his assistance in constructing a meaningful code tree, and assessing whether the information I had gathered made sense. His knowledge of geographical information assisted me greatly in writing this master thesis.

Last but certainly not least I would like to thank my girlfriend, Simone Plukkel, for her constant support and constructive feedback. With her knowledge in Educational Sciences she helped me in setting up and applying the right method for this research.

When writing this thesis I also collaborated with a number of companies in the retail sector, and I would also like to thank them for their cooperation.

This research gives you, the reader, an insight into the current usage of Geographic Information Systems within the retail sector in the Netherlands. This research is a basis for scientists to do further research in the field of the usage of GIS within the retail sector.

Enjoy the read,

Mark Bickel

Utrecht, 1-3-2018





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# 1. Introduction

## 1.1 Introduction and context

In 2017, Retailnieuws published an article about the opening of a new branch of the outdoor retail company Bever. This was their first shop in the province of Zeeland in the southwest of the Netherlands. The new Bever store occupies 700 square meters and was established in Zeeland because of the province's 'long shoreline and the popularity of walking and cycling, which makes Zeeland the 'perfect site' for the Bever retailer' (Retailnieuws, 2017). Bever used geographically bound factors in determining which site was most suitable for this purpose. The question is if Bever used geographical information to support their decision.

The Netherlands is ranked among the top five countries in the world in terms of its levels of user adoption of geographical information (GI) (Geospatial Industrial Outlook, 2017). GI is often freely available, and every year the amount of GI grows in an exponential manner (Wu, Chen, & Ren, 2010; Davis, 2003). However, while working as an intern at Geodan it occurred to me that companies were hardly using Geographic Information Systems (GIS) for their site selection. The literature sheds no light on why GIS are hardly used. There appears to be a gap between the practical and theoretical use of GIS. According to Geodan (2014), 80% of all available data contains a geographical component, which makes GIS pre-eminently a tool for site selection. However, are companies really using the potential of GIS?

### 1.1.1 *Geographical information in the retail sector*

The exact meaning of GI is broad and vague, as hundreds of definitions exist both in daily life and in the literature (Church, 2002; Sener, Süzen, & Doyuran, 2006; Tierno, Baviera-Puig, Buitrago-Vera, & Mas-Verdu, 2013; Wu et al., 2010). However, it is clear that GI is all about location. More specifically, GI is used to gain insights into the environment as a whole, or a particular part of the environment (Hernandez, 2007; Sener et al., 2006). According to the Geospatial Industrial Outlook (2017) and Wu et al. (2010), an important aspect of GI is its ability to assemble a range of geospatial data into a layered set of maps that allow complex themes to be analysed. Therefore, GI is a comprehensive concept that is used in developed countries as well as in emerging countries (Geospatial Industrial Outlook, 2017). GI can be handled with a Geographical Information System (GIS), which is defined as 'an information system that is designed to work with data, referenced by spatial or geographic coordinates' (Bhatta, 2010, p.56). A GIS therefore contains GI, and is both a database system with specific capabilities for spatially referenced data and a set of operations for working with the data (Zhang, 2009). Within a GIS, different tools are able to analyse and visualize the GI (Önden, Sen, & Sen, 2012). The ability of

such a system to handle spatial data means that it can be widely adopted in support of planning, agriculture, infrastructure maintenance, as well as in business- and service site selection. However, it cannot be said that the role of GIS is the same in every sector.

It would be beyond the scope of this research to investigate all the above-mentioned sectors. This paper will therefore concentrate on real estate within the business and services sector. The business and services sector is also known as the retail sector, as it includes both goods and services (CBS, 2012). In the retail sector, the value and the potential value of a property is determined by its location (Goodchild, 1984). Every retail company with one or more establishments could potentially undertake research with a view to identifying an optimal new site to open a new establishment. Waters (2017) states that the difference between selecting the wrong location site and the right site could be the difference between business failure and success. Therefore, GI can be useful for making the right choice regarding the best location (Malczewski, 2004; Brown, 1994). The literature demonstrates how useful GIS is, and it is very interesting to investigate why companies are making minimal use of this information.

### ***1.1.2 Work processes of site selection within the retail sector***

Although GI is nowadays being used on an increasing basis, not every company makes its location choices based on GI. Choosing a retail location involves considerations such as costs, city regulations, visibility, competition, etc. (Waters, 2017). Multiple fast-growing retail companies, such as Decathlon and Action, are searching for the best locations in the big cities to establish themselves. For example, the originally French Decathlon intended to open stores in the industrial sites of the four largest cities in the 'Randstad'. However, Decathlon's expansion manager saw potential in opening Decathlon outlets in the city centres (Cazander, 2017). The Action, an international discount store, for example, states that the Dutch market is quite saturated (Rijlaarsdam, 2016). For companies it is of importance to know the potential value of a certain area. This paper determines the site selection work process of companies in the retail sector, and investigates which reasons could account for the potential of GIS not being fully utilised.

### ***1.1.3 The potential value of GI***

For the retail sector, GI is definitely an important enhancement in the final outcome of site selection (Crossland, Wynne, & Perkins, 1995; Hernandez, 2007; Sener et al., 2006). The use of GI leads to increased productivity in several business operations, and to greater accuracy of information for both professionals and the general public (Thrall, 1998). As the full potential of GI is realized, the market as a whole will move to higher levels of efficiency, which may ultimately lead to better decision-making regarding real estate transactions. Although the GIS literature is replete with case studies of how GIS

applications can be indirectly used for decision-making, few empirical studies focus on how retail businesses directly use GI for site selection (Nyerges et al., 1997). I was unable to find any recent empirical studies of importance to this subject after this research of Nyerges et al. (1997).

The above-mentioned studies related primarily to non-European surroundings and were often executed in a specific branch, which provides a dispersed overview of the question whether GI is widely used within the retail sector site selection process. The scientific value of this research can be found in its examination of the extent in which GI is used within the retail sector regarding site selection. At present, there is scant knowledge as to why GI(S) is not widely used in the retail sector. Inductive research is therefore needed to ask the companies in the work field why they do or do not use GIS. In order to identify some of these explanatory variables and concepts, the Grounded Theory method was used in this research. Therefore, in-depth qualitative interviews were held with companies in the retail sector with a view to gaining new insights and new theoretical concepts about the possible gap between the practical and potential use of GIS, and to establish what would need to be done to accomplish the potential use of GIS.

## **1.2 Reading guide**

This master's thesis is written according to the following structure. Starting with this introduction, Chapter 1 introduces the topic and covers the problem definition. Chapter 2 describes the research objectives, including the formulation of the main research question and the associated sub-questions that will eventually answer the main research question. The second part of Chapter 2 deals with the scope of the research. Next, Chapter 3 contains the theoretical background, which includes a preliminary overview of the most important and relevant theoretical aspects important to this research. Chapter 4 explains the methodology used to perform this research, and includes a description of the steps that are required to answer each sub-question and, ultimately, the main research question. Chapter 5 provides a thorough analysis of the conducted interviews. A code tree is constructed and the various companies are classified on the basis of whether they use GIS or not. Chapter 6 contains a discussion of this research concerning the method and outcomes of this research. Finally, Chapter 7 contains the conclusions and identifies the factors that are most important in determining whether or not GIS is used. These factors are then compared with the theoretical background. The second part of Chapter 7 sets out recommendations for further research.

## 2. Research objectives

### 2.1 Research goal

The goal of this research is to evaluate the use of GIS in expanding retail companies in the Netherlands in order to identify the gap between what GIS contributes to a company at present, and what the potential value of GIS could be for expanding companies. This requires an appropriate investigation into the work process of expanding companies and their possible use or non-use of GIS, and what factors determine this. In order to close the gap, it is important to know what needs to be adapted or developed to achieve an increased use of GIS.

### 2.2 Research questions

The main research question that will be answered is: *'To what extent are expanding companies in the retail sector using geographical information systems for their site selection and what could enhance its potential use?'*

Four sub-questions are determined with a view to answering the main research question:

- What does the site selection process look like when companies are identifying a location for a new establishment?

This sub-question is answered by interpreting the outcomes of interviews with retail companies, focusing on how a manager underpins his or her decision to open a new establishment in a certain location. The expectation is that retail companies in general often do not make use of GIS to underpin their location decision, but use simple GI such as demographics.

- Which factors determine whether a retail company uses GIS to analyse geographic information?

This question is answered using literary research, focusing on the general practices relating to site selection and the use of GI within retail companies. Possible factors include accuracy of the data, technical knowledge, accessibility of data, and awareness of GIS (Malczewski, 2004). These possible factors will be examined in relation to several companies on the basis of semi-structured interviews.

- What could explain the possible gap between what GI contributes to a company at present and the potential value of GIS for expanding companies?

The outcomes of the interviews are used to answer this question. The expectation is that this gap does exist, and that multiple factors will have an influence on the use or non-use of GIS. Possible important factors could include a lack of awareness regarding the usefulness of GIS and the fact that it is easy to work with.

- What possible solutions could lead to an increased use of GIS?

This question is answered as a summary of all the other research questions and recommendations for companies.

## **2.3 Scope**

The research questions set out above address the various objectives of this research with a view to achieving the overall goal of the research. The focus is specifically on the use of GIS in retail companies that already have one or more establishments and want to expand with a new establishment. This particular group of companies is chosen because they are already established and want to make an optimal choice with regard to expanding their company. GI can be used and/or processed in different formats – for example in a complete GIS, or with use of simple tools, which can help identify or display GI.

Besides these overall objectives, it is important to note that the aim of this research was not to develop a new tool for site selection. Nevertheless, it is interesting to mention some possible solutions which lead to increased use of GIS-related tools.

This research will lead to the following deliverables:

- A theoretical overview of the factors that influence the site selection of retail companies.
- An overview drawn up on the basis of the interviews, which demonstrates the site selection work processes of the various companies.
- An explanation of the possible gap between the actual use and potential value of GIS.
- A possible solution to increase the use of GIS by companies.

### 3. Theoretical background

Site selection in general is a problem that has been fairly extensively studied since Alfred Weber's *Theory of the Location of Industries* published in 1909 (Önden, Sen, & Sen, 2012). Another term for the principle of site selection is 'location allocation'. Many research papers have been published on a variety of qualitative and quantitative methods used to find an optimal location – for example, questionnaires, operational research methods, geographic information and artificial intelligence systems (Önden, Sen, & Sen, 2012).

Before explaining the two basic tools that exist, in paragraph 3.1 I will explain how these GI models represent the real world. Paragraph 3.2 discusses the principle of location allocation and the two basic tools of GIS. Next, paragraph 3.3 explains which specific models companies in the retail sector use for their site selection. Since there is a wide variety of types of retail companies, it is difficult to identify one specific GIS approach. Paragraph 3.4 therefore compares the use of GIS in the retail sector to its use by the Dutch Government. Paragraph 3.5 examines the factors determining use or non-use of GIS according to the existing literature. Finally, the conceptual model of this research is explained and discussed in paragraph 3.6.

#### 3.1 Modelling the real world

A GIS is a computer system capable of capturing, analysing, storing, modelling, and visualizing geographically referenced information (Önden, Sen, & Sen, 2012). There are two basic data models within GIS to represent the real world – the raster and the vector models (see Figure 1). *Raster data models* describe the features as continuous phenomena distributed across space, such as land-use and elevation (Li, Ban, & Wechsler, 2017). Raster data are therefore subdivided into grid cells of predefined size. Each grid cell contains a number defining the attribute of that specific cell. *Vector data models* describe features within a certain area as discrete objects, such as customers, streets, and parcels (Li et al., 2017). Each object can be

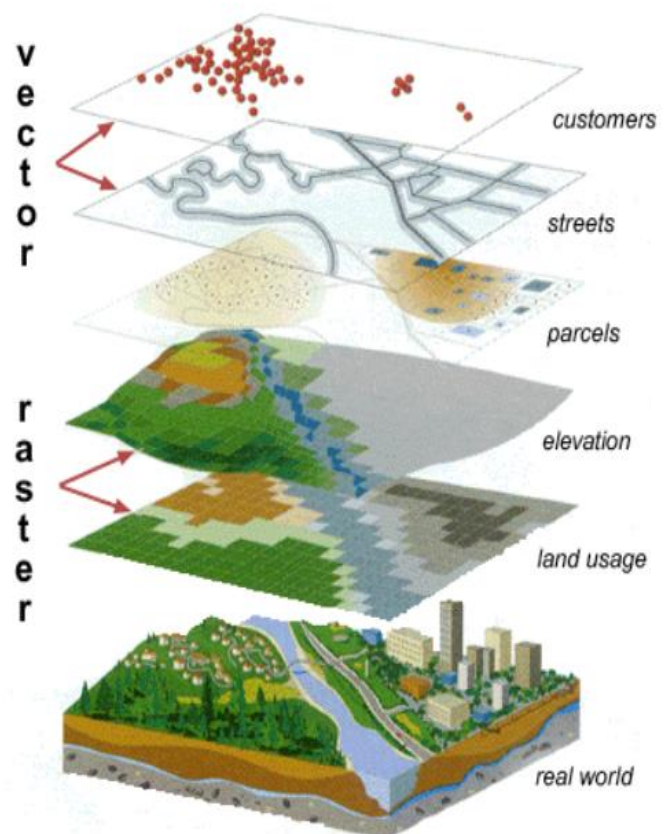


Figure 1. Vector and raster models of the real world (Geodan, 2014).



drawn by points or lines and have specific x and y coordinates, which are stored in a relational table and linked with the location of the spatial object. Both the raster data model and the vector data model are simplifications of the real world, but each model represents the world differently. After rasterization of the datasets, the maps can, for example, be integrated in the raster calculator of ArcGIS and multiplied by the weightage, after which a site suitability map of the real world can be modelled (Kumar, 2012).

### **3.2 Location Allocation representation in GIS**

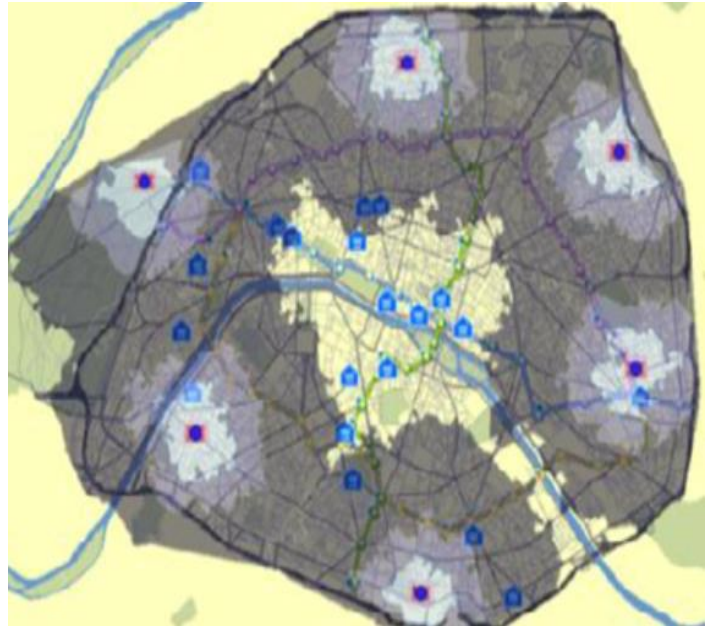
Within GIS there are different tools to analyse and visualize the suitability of retail location sites (Önden, Sen, & Sen, 2012). The first tool, *network analysis* (paragraph 3.2.2) is a functional GIS tool for location selection problems, which works with vector data. *Spatial analysis* (paragraph 3.2.3) is a second suitable tool, which includes abilities to recognize spatial distributions and spatial patterns, and works with raster data. Both tools will be discussed, but paragraph 3.2.1 first examines how these analyses are an important part of location allocation.

#### **3.2.1 Principle of location allocation**

Location allocation is a principle that is frequently used in the retail sector, and can be defined as locating a new establishment in such a way that the transportation costs from establishment to customer are minimized, and the optimal number of establishments is placed in an area of interest to satisfy the customer demand (Tafazzoli & Mozafari, 2009). There are two factors that play an important role in location allocation. The first is the number of new establishments a company wants to create. The simplest case is when the company wants to create one new establishment. It is more often the case that a company wants to create more than one establishment at the same time. The second factor, in addition to the number of facilities, is the type of the newly created establishment is important. In the simplest case all the establishments to be created are the same with respect to their size and type of service. However, this is often not the case, and establishments frequently differ from each other. An example in this regard is Albert Heijn, which has various different concepts – for example, Albert Heijn XL versus Albert Heijn To Go. These two establishments follow different concepts and therefore serve a completely different kind of public. To represent eligible locations for possible new establishments, two possible representations are examined in paragraphs 3.2.2 and 3.2.3.

### 3.2.2 Network Analysis

A GIS is capable of mapping the reachability of certain places by means of vector data. In general, this is done with a network analysis tool (Farrow & Nelson, 2001). Reachability maps are drawn up with the use of the network analysis tool. These maps are made by drawing isochrone lines, which consist of a set of points and are placed at the same distance around a pre-determined location. All points within the isochrone area are reachable within a certain pre-determined amount of time. An isochrone map is also suitable for displaying the distinct areas that each

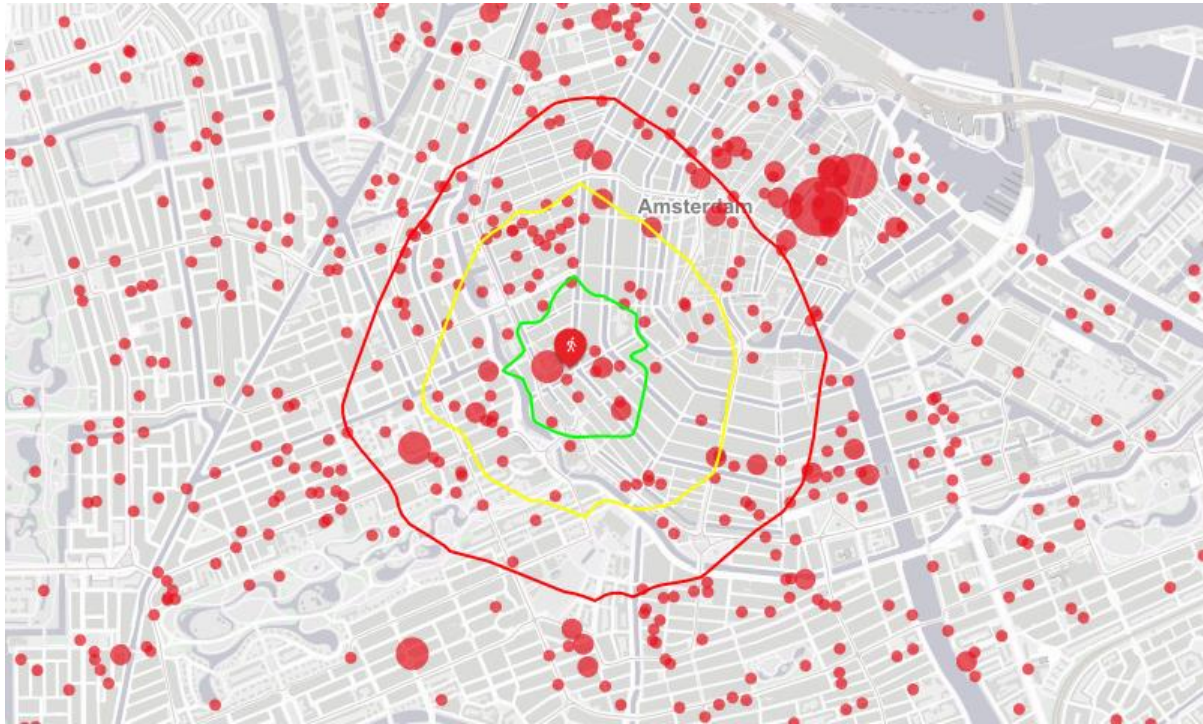


**Figure 2. An example of a reachability map (Önden, Sen, & Sen, 2012).**

retail company is able to cover within a certain amount of time, which makes a network analysis particularly suitable for making the best site selection analysis (Geodan, 2018; Önden, Sen, & Sen, 2012).

When creating reachability maps, mapmakers are forced to make important choices. For example, mapmakers can choose that potential customers use the general road network with their own private transport (Ortega, 2003). One disadvantage here is that they are excluding a large group that travels by public transport – a group that is possibly even larger than the group with private transport. For example, Figure 2 displays driving times of 5, 10, or 15 minutes from a given location to a particular store. In this way a company can establish whether a certain person can reach one of their establishments by private transport. However, it could be possible that this particular person uses public transport, and that their establishment is not reachable within a 10- or 15-minute range. Another way to make this map is from the viewpoint of the establishment. In that way a company can identify how many people are within its range. In addition to reachability maps, which use the road map, mapmakers also draw up isochrone maps based on pedestrian networks, bicycle networks and even electric bicycle networks. In the case of isochrone maps based on pedestrian networks the map is much more precise, because more factors are taken into account (see Figure 3). This reachability map takes into account where a pedestrian can cross the street, where there are pavements and where there are small alleys, which make it possible for the pedestrian to take a short cut (Geodan, 2018). As can be seen in Figure 3, the isochrone reachability map provides a considerable amount of

detail – providing an indication of the reachability of Airbnb establishments in the city centre of Amsterdam. The map presented in Figure 3 answers the following question: ‘Which Airbnb establishments can be reached within a walking time of 5, 10 and 15 minutes starting from the Leidse Gracht in Amsterdam?’

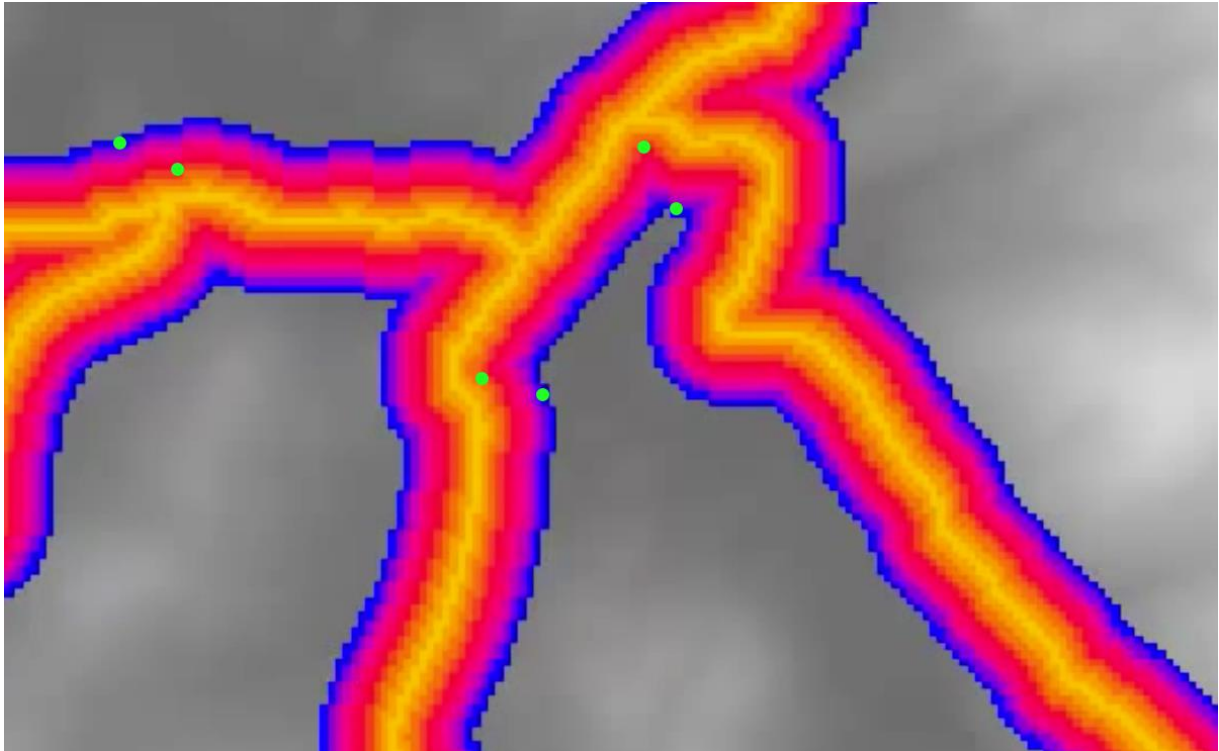


**Figure 3. Reachability map Airbnb, pedestrian network Amsterdam (Geodan Postcodescan, 2018).**

### **3.2.3 Spatial Analysis**

There are also other spatial analysis tools over and above the network analysis. A shared goal of GIS and spatial analysis is to improve capabilities for understanding geographic phenomena and solving geographic location problems (Önden, Sen, & Sen, 2012). Spatial analysis includes the ability to recognize spatial patterns and spatial distributions, to interconnect locations, associate and correlate spatially distributed phenomena, to understand spatial hierarchies, and to compare maps (Lee & Berdnarz, 2009). Together with a GIS, the *euclidean distance* tool can be used for many purposes, including spatial and network analysis. Many GIS users use the euclidean distance tool and its related analytical possibilities without realizing that it is a model with assumptions, and therefore a simplification of the real world (Önden, Sen, & Sen, 2012). The euclidean distance tool can be used to measure straight-line distance from a highway to a specific cell in a raster data set to determine the visibility of a sign of a retail company. For example, Figure 4 indicates the distance to a highway, where the colour blue represents a distance of 250 m to the highway, and the inner yellow colour is the

highway itself. Every sign that is placed within the red zone (50 m) is more likely to be visible from the highway than a sign in the blue zone.



**Figure 4. Example of visibility of signs from the highway up to 250 m (blue), euclidian distance (Arcmap 10.3, 2018).**

Another tool is the *weighted overlay* tool. This commonly used tool can determine where retail companies can or should open a new establishment. Factors such as type of roads, distance to travel, and maximum speed can be analysed and worked out in one or more different map layers, where each factor is visualised. The weighted overlay tool helps solve multi-criteria problems, such as the site selection problem of retail establishments. A weight can be given to each establishment factor, which will result in a weighted overlay map, where all the various maps with different criteria are put together, and the place with the lowest costs or the highest benefits is preferred. For example, if a wellness centre is searching for a beautiful green area with optimal reachability and visibility, a map can be made with four layers, which are combined in a weighted overlay (see Figure 5) to select the most suitable site for the wellness centre. This results of Figure 5 are the following. A low housing density is preferred (layer: Housing\_Density). The road needs to be nearby, for optimal reachability (layer: Road\_Prox). The perception of nature (layer: SA\_Prox) is also important to create a relaxed atmosphere conducive to wellness. Finally, it needs to be visible to everyone (layer: Visual\_Exposure). When these map layers are all weighted they can be combined into a new layer (layer: Weighted Average). The green colour in the final map layer means that it is a favourable location in which to



establish a wellness centre. When the colour turns yellow – and eventually red – it means that the location is less suitable for the establishment of a wellness centre.

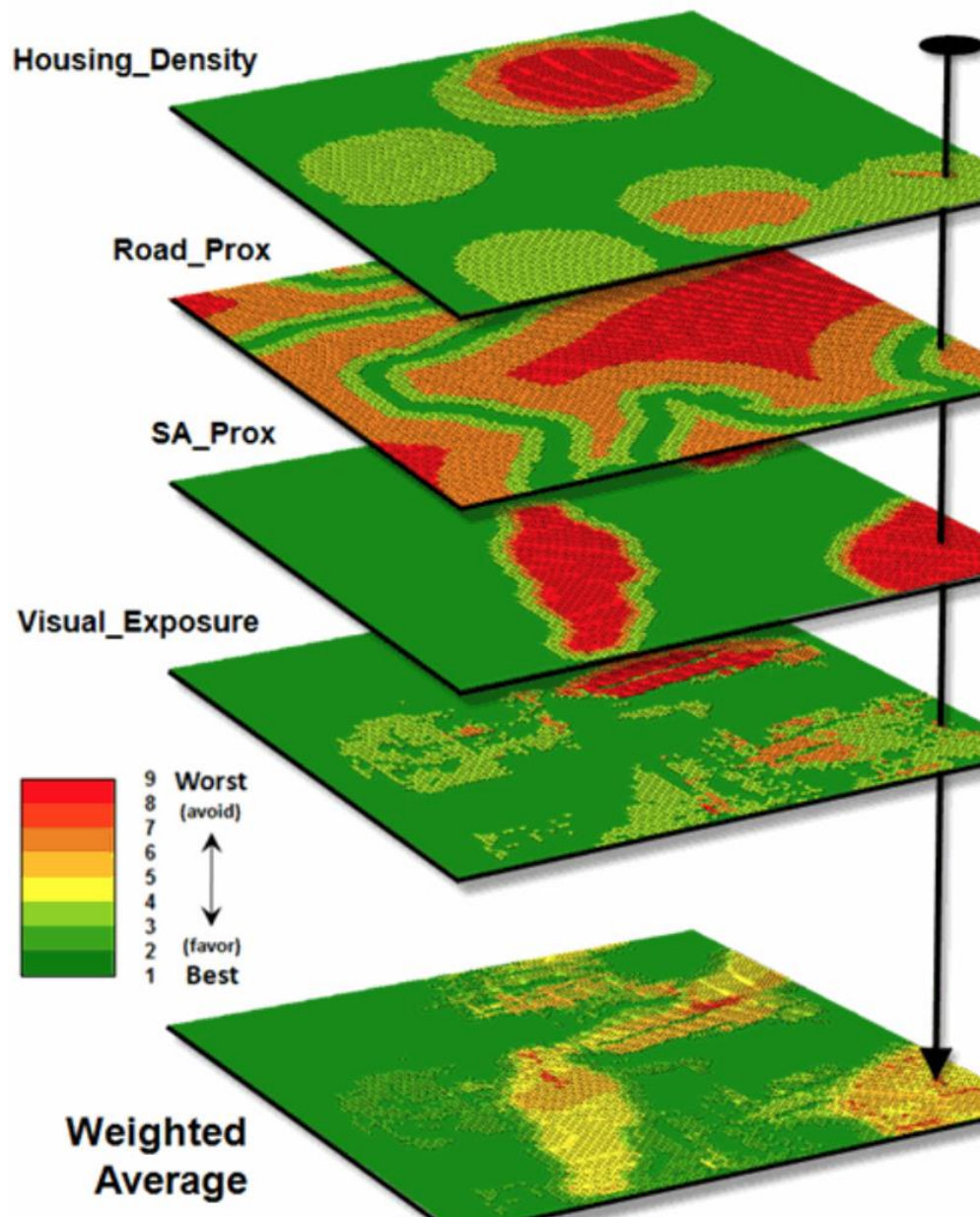


Figure 5. Weighted overlay optimal site selection, four factors resulting in weighted average (GeoWorld, 2003).

### 3.3 Location allocation for companies in the retail sector

Thanks to the long history of location allocation a wide variety of GIS tools – such as multiple network analyses and spatial analyses – can be used to solve locational site selection problems (Karamychev & Reeve, 2009; Nwogugu, 2006; Reimers & Clulow, 2004). Wu et al. (2010) state that researchers focus

primarily on building deterministic models for the optimization of site selection with pre-defined costs, profits, time and transportation costs from a supply chain management perspective. No randomness is involved in deterministic models. However, the retail location problem is more complicated than other locational problems, due to its sophisticated structure, its geographic micro focus, and consumer behaviour (Önden, Sen, & Sen, 2012; Tafazzoli & Mozafari, 2009). In addition to consumer behaviour, the retail sector has numerous factors – such as population density, demographic data, geographic constraints, specialties of the retail company, and specialties of the study area – that affect the problem structure and make it more complicated to select the best suitable location (Drezner, 2006). A GIS might not always present the ideal location, but it has already added value when a site suitability analysis contributes to the awareness of selecting the most suitable site.

### **3.3.1 Visualisation and site selection of retail businesses**

A GIS allows the user to deal with numerous databases consisting of large quantities of information and linking digital maps to relational databases (Tierno et al., 2013). In order to make a proper location choice with the use of GIS, it is important that the input of all original *objective* and *subjective* data is quantified, so that it can be processed in a GIS (Malczewski, 2004). A GIS is only able to process quantified data. Subjective data are often opinions, which in general are not quantified and therefore hard to process into useful map-based information on which an analysis can be done to select the optimal site for a new retail establishment.

According to Hernandez and Biasiotto (2002), and Waters (2017) retail organisations have access to objective quantified GI. The most common retail GIS applications include one of the seven spatial models (see Table 1). These models can be used to address the site selection problem (Hernandez & Biasiotto, 2002). In line with Hernandez and Biasiotto (2002), Waters (2017, p.1) states: ‘where you choose to locate your retail business will have major impact on everything your shop does. The difference between selecting the wrong and the right site could be the difference between business failure and success.’ It can therefore be said that location is important for every retail business, and that a thorough analysis of all the available data needs to be done. Moreover, Waters (2017) states that it is important that a company has a clear definition of what its business wants to achieve, before selecting the best site.

<b>Spatial models used in retail</b>	<b>Author</b>
Customer spotting	Hernandez & Biasiotto (2002) & Waters (2017)
Trade area analysis	Hernandez & Biasiotto (2002) & Waters (2017)
Customer profiling	Hernandez & Biasiotto (2002) & Waters (2017)
Competitor analysis	Hernandez & Biasiotto (2002) & Waters (2017)
Hot-spotting	Hernandez & Biasiotto (2002) & Waters (2017)
Sales forecasting	Hernandez & Biasiotto (2002)
Location costs	Waters (2017)
Consumer behaviour modelling.	Hernandez & Biasiotto (2002)

**Table 1. Overview of most commonly used spatial models used in the retail sector.**

### **3.3.2 The seven spatial models**

The theoretical spatial models set out in Table 1 are discussed below, and the extent to which Hernandez and Biasiotto (2002), and Waters (2007) have the same ideas about the spatial models used within the retail sector for optimal site selection will be examined. Hernandez and Biasiotto (2002) provide insight from a scientific point of view, while Waters (2017) does so from a practical point of view.

The majority of these spatially related models are supported by relatively rudimentary GIS-based analysis and mapping (Hernandez, 2007). According to Hernandez and Biasiotto (2002) a range of static maps are able to display the static models presented in Table 1. The models can be complemented, confirmed, or questioned on the basis of the research undertaken by Waters (2017), as is done in the next section.

*Customer spotting* is defined as the target group that can be found in a specific area (Hernandez, 2007). This principle is in accordance with Waters (2017) that the retail trade area for a given establishment is determined via customer surveys.

*Trade area analysis* focuses on locating and describing the target market, and analyses where the majority of one's potential customers live (Dramowicz, 2005). According to Hernandez and Biasiotto (2002), and Waters (2017) this information is critical for choosing a new retail location.

*Customer Profiling:* Hernandez and Biasiotto (2002) state that companies must decide which customers they want to attract, and collect demographic information about their potential customers in the potential area. Waters (2017) states that one also needs to add non-statistical information from other sources, such as local newspapers, and refers to the need to speak to other small retail businesses in the area. This is difficult to process within a GIS, due to the fact that these data can be regarded as subjective (Malczewski, 2004).

*Competitor analysis:* Mapping of other retail companies in one's potential settlement area (Hernandez & Biasiotto, 2002; Waters, 2017). This is described as an important model to implement before choosing a new site for the establishment of one's retail company. It is not difficult to visualize and map the location of one's competitors, based on objective data. However, it can be difficult to determine what the influence of the neighbouring retail company in the potential surroundings will be. For example, a high-end fashion store located next to one's fashion store establishment could possibly have a negative influence on one's sales. This effect is difficult to interpret from a model, however.

*Hot-spotting* is briefly mentioned by Hernandez and Biasiotto (2002), while Waters (2017) discusses this extensively. Hot-spotting relates to accessibility, visibility, and traffic. According to Waters (2017), it is important to understand that a lot of traffic around one's potential establishment does not necessarily translate into many customers for one's company. Retailers should only open an establishment in a specific area when the majority of shoppers meet the definition of their target market, analysed in terms of the trade area analysis mentioned above.

*Sales forecasting* is the process of estimating future sales. It is regarded as important by Hernandez and Biasiotto (2002), but is hard to predict within a certain area. It is difficult to determine which factors should be taken into account for reliable prediction. Waters (2017) does not specifically mention sales forecasting, but focuses on more objective data such as location costs.

*Location costs:* According to Waters (2017), in addition to the base rent of a certain establishment, all other costs involved need to be taken into account. In identifying whether a new establishment is a proper choice, companies have to take the condition of the building into account. The costs of remodelling and repair can have an influence on the site selection.

*Consumer behaviour modelling:* Hernandez and Biasiotto (2002) point out that people are constantly interacting with their environment. The environment influences the socio-economic behaviour of the customer. These data are gathered in city traffic research undertaken by a number of research companies, and can be used by retailers that are searching for a suitable location. However, it is difficult to distinguish what type of consumer is ultimately interested in one's retail company, and which consumers are only passing by one's company. In conclusion, it is important to know to what extent a particular street appeals to your potential customer. It can be hard to translate these data into objective figures that could possibly influence one's site selection.

The uses of GIS within the retail sector are extremely varied. There are many different types of retail companies. Every retail company has its own characteristics, interests and needs with regard to the use of GIS. It is therefore logical that there is no standard GIS procedure or approach to these



site selection problems within the retail sector. This could also explain the need for multiple spatial models in this sector.

### **3.4 Implementation of GIS within the Dutch Government**

Projects with the use of GIS started more than 20 years ago (see also Paragraph 3.1), and GIS projects have been successfully undertaken in the municipality of Amsterdam since 1996 (Lips et al. 2000). As there is no standard approach to the use of GIS in the retail sector, in this section it will be compared to the use of GIS within the Dutch government.

#### ***3.4.1 Implementation of GIS within the government***

The implementation and use of GIS is already at a relatively advanced stage within the government. The transition from traditional government to e-government was undertaken by the government in multiple stages. The first wave occurred between 1994 and 2006, when the government embraced the transformative potential of ICT-enabled projects (Bekkers & Homburg, 2007). The fast-moving ICT developments are expected to have major implications for governments throughout the Netherlands (Lips et al. 2000). The concept of e-government means that the government makes use of ICTs, especially internet and web technology, to support or redefine existing and future information, communication and transactions (Bekkers & Homburg, 2005).

In a broad sense, GIS covers a variety of spatially oriented IT systems and applications. Technologically speaking, it seems that there are hardly any limitations left for a broad effective application within the Dutch government (Lips et al. 2000). This statement by Lips et al. (2000) is confirmed by Stroeken and Willems (1995), who point to several successful GIS projects within Dutch local government. While it is certainly important that there is sufficient technological infrastructure, it is particularly important to take institutional and organizational aspects into account. This means the right people should use the full possibilities of GIS, and the workers must have the knowledge to draw the right conclusions from the output (Lips et al, 2000). It could be assumed that governmental organisations have undergone the same development as the retail sector, and these two sectors are, to a certain extent, in a similar position at present, in that they are both beginning to look at new ways of analysing site selection choices.

#### ***3.4.2 Different departments within the government***

A number of factors make it difficult to incorporate one specific GIS that can help all departments within the government. There are national, regional, and local departments, all of which work with different formats and types of data; and each department wants to achieve a different goal. In addition to differences in zoom level, there is another challenge with regard to the various municipalities at

local level. Each municipality collects data in its own way, and it is therefore difficult to make one GIS that can handle all the different types of datasets. Nevertheless, GIS is still more advanced in the government than in the retail sector, notwithstanding the fact that government departments are also very different from one another. Despite all these differences, it seems that they still have a clear approach to using GIS to address questions relating to site selection. However, within the retail sector the potential of GIS is still not being optimally utilised. The fact that there is no obvious approach to questions relating to site selection in the retail sector could be a reason for the non-use or suboptimal use of GIS.

### **3.5 Factors for use or non-use of GIS within the retail sector**

There are also other factors that can determine whether a company in the retail sector actually uses GIS for site selection. A study of the literature is useful with a view to identifying what possible other factors could contribute to the use or non-use of GIS. These factors are concisely described by Jain (2008) and Malczewski (2004). In addition to their research, this topic is very concisely described in the literature relating to the retail sector. The following factors are drawn primarily from the research of Jain (2008) and Malczewski (2004).

#### **3.5.1 Awareness of GIS**

The first step in using GIS is to be aware that something like GIS software is available. According to Malczewski (2004), it is important that there should be sufficient awareness about the existence of data and software. Without awareness of the existence of GIS it is difficult for a company to weigh up whether or not to use it. Moreover, it is important to be aware of the potential value that GIS and the use of all the available data can add. It could be possible that some companies in the retail sector are not aware of all the software possibilities, functionalities of GIS, and the large amount of available data relating to site selection. Awareness of these three areas must exist before one attempts to identify possible factors contributing to the use or non-use of GIS. This possible lack of awareness is also acknowledged by Jain (2008). In his research into the use of GIS in the retail sector in Canada it emerged that 58% of his respondents had never even considered using something like GIS technology. According to Jain (2008), this lack of awareness can partially be explained by the terminology used – with GIS technology being used for numerous configurations except within the retail sector. He also states that the retail sector is potentially one in which system vendors and academia should raise awareness of GIS, and further promote its potential uses within the retail sector.

### **3.5.2 Accessibility of the data**

A next step for potential users of GIS is to know if the data is accessible for them. GIS itself is available online, offline and on mobile devices. It can therefore be stated that the accessibility of the software is extensive. In addition to the accessibility of the software it is also of critical importance that a potential user of GIS has access to all the data needed in order to correctly represent a particular site in its surroundings. This is in line with the research of Malczewski (2004). Jain (2008) also came to the conclusion that data needs to be accessible – on average, companies in the Canadian retail sector used or purchased 10 data sets for site selection. The list of used datasets can be divided into those that are generated by another organisation, and those that are internally generated for strategic purposes. After successfully accessing and/or generating data, it remains uncertain whether a retail company knows what kind of results it needs in order to make an appropriate site selection based on GIS.

### **3.5.3 Usability and accuracy and type of the data**

When it is clear that a company can access the data, it is of importance to know whether those data are meaningful to them. Can the company use these data and are they of value to the company to help solve their problem? When a company have ascertained itself of the use of the data, the accuracy of the data can be an important factor in knowing how usable the data are. The usability, accuracy and the type of the data are put together in the concept 'accuracy'.

The accuracy of the data is important in determining whether an analysis can be used for site selection. The accuracy of the data is determined by which types of data are used. There are two main types of data: *objective data*, such as demographic data, and *subjective data*, such as social-economic, cultural, and political data (Malczewski, 2004). *Objective data* contain objects, such as lines, polygons and points along with attributes, which are easily quantifiable. However, *subjective data* are a form of reasoning and conceptualization of the mapmaker to construct a certain space. Reasoning and conceptualization are not necessarily entirely value-free and objective. Therefore, it might be possible for inexperienced GIS end-users to be misled into thinking that GIS is an entirely objective and value-free technology. Because of these different types of data, it is very important to know which data a company can use and needs to use for its optimal site selection. Malczewski (2004, p.57) also states: 'to correctly represent a particular land-use planning problem one has to focus on the right combination of both objective and subjective data/information.' This not only means that the objective lines, polygons and points are correct, but also that the interpretation and representation of opinions, preferences, values, priorities, and judgements are of critical importance for the accuracy of the data. A certain amount of technological knowledge of GIS is therefore required, as Hernandez (2007) points out in his research. In addition, knowledge about developments in the retail sector is important for the interpretation.

#### **3.5.4 Required technical knowledge**

Technical knowledge about GIS can be seen as the last of these factors. Once a company knows about GIS, can find and access all the relevant data, and if those data are of use and value to them, they can now start using the data. The difference between this factor and the three factors mentioned earlier is that a knowledge of GIS is not obligatory. If a company does not possess this knowledge, it can always hire a GIS company to do the analyses. Even though GIS has become more user-friendly, it has increased in complexity in recent years.

At first the role of GIS fulfilled routine supportive tasks, such as mapping and querying spatial data; and not much GIS knowledge was demanded. However, fundamental GIS functionalities such as mapping and querying spatial data have increased considerably over the years due to the introduction of map algebra. This, in turn, provided the building block for more sophisticated GIS-based modelling. GIS operations were extended to optimization, statistical, relational and simulation modelling functions (see Paragraph 3.3.2) to increase the GIS capability for exploratory, explanatory and predictive analysis (Jain, 2008; Malczewski, 2004). The basic GIS functions and possibilities became more extensive, and the technological knowledge required to create useful output increased. These advanced GIS models and functionalities are built on the basic GIS functionalities, such as mapping, querying, measuring etc. The advanced GIS models, in their turn, became building blocks for the new generation of GIS – for example, online applications such as web-GIS (Malczewski, 2004). These online applications entered the market as ‘easy-to-use’ products. Although the techniques behind the products are much more complicated than they were before, these products should be easier to use than their much simpler predecessor. However, knowledge about the basic principles of GIS is still required. All the factors mentioned above can be of importance with regard to the use or non-use of GIS in this research.

### **3.6 Conceptual model**

The conceptual model (see Figure 6) provides an overview of how this research is positioned. The model starts at the top, where the question of what the site selection process for companies within the retail sector looks like is addressed.

The left part of the conceptual model provides the practical implications of GIS, based on the literature and the longstanding experience of the Geodan GIS company. The 'data' described in the model can be various kinds of data from GI such as demographics and accessibility, to other information such as the simple availability of a building. The 'models' part of this conceptual model focuses on GIS. There are several ways of using a GIS for site selection. Two of the analyses are

mentioned (see Chapter 3.2), but other options could be possible as well. Moreover, in most analyses a number of different tools or models can be used.

The right-hand side of the conceptual model sets out the conceptual use of GIS, which is based entirely on the literature. The lower half of the conceptual model was arrived at following the conceptual use and practical implications of GIS. The sensitizing concepts are derived from the theoretical background (Chapter 3.2), and it is anticipated that other concepts can be created after the analysis of the interviews (see Chapter 4 for extensive process description). At the bottom of the conceptual model an answer is provided to the question of whether GIS is actually used within the retail sector.

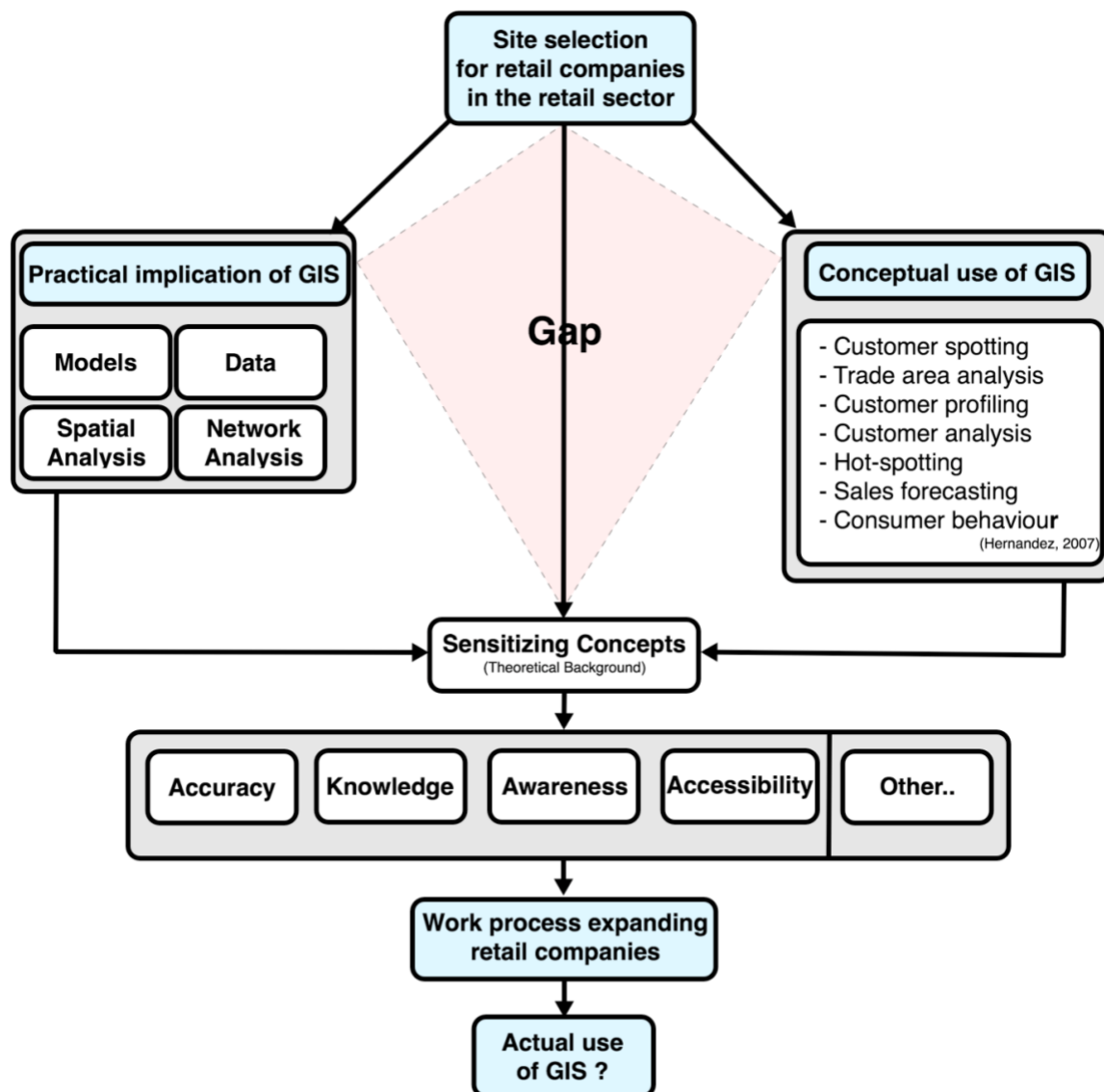


Figure 6. The conceptual model.

The diamond shaped red figure at the top of this conceptual model forms the goal of this research: to evaluate the use of GI in expanding retail companies, in order to identify the gap between what GI

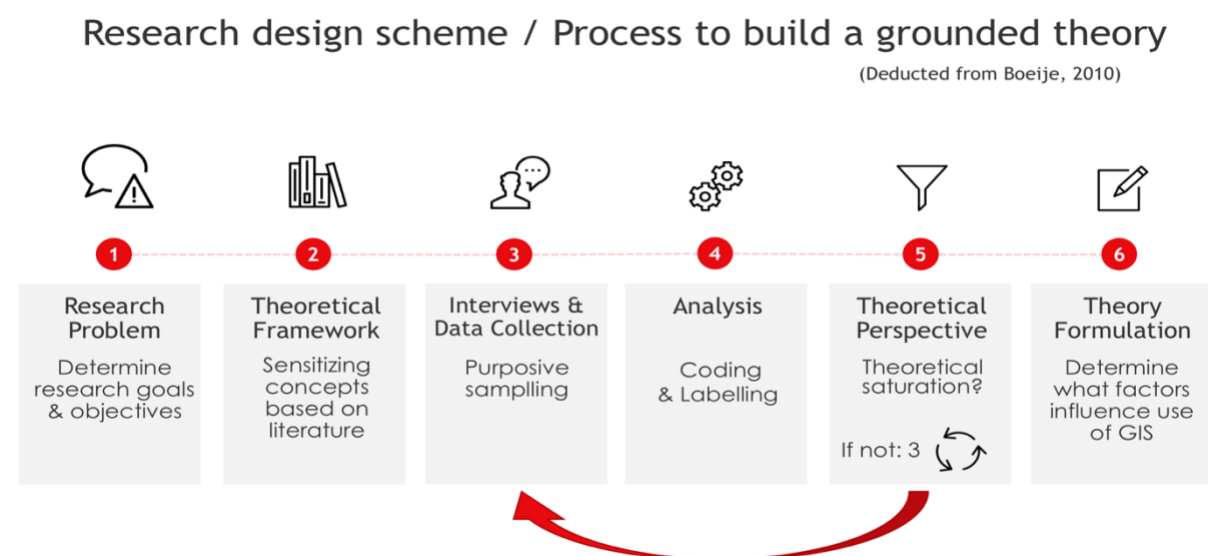
contributes to a company at this time and what the potential value (solution) of GI could be for expanding companies within the retail sector. The sensitizing concepts found in the theory will be checked and compared with the outcome of the interviews and further sensitizing concepts will be determined. Ultimately, once a gap is identified, the potential use of GIS and the outcome of the interviews may answer sub-question 4 and lead to a possible solution to increase the use of GIS within the retail sector. The essence of this research is the limited theoretical background. Therefore, the Grounded Theory is a suitable method to identify further factors that influence the use or non-use of GIS (See Chapter 4).

## 4. Methodology

### 4.1 Grounded Theory

The literature review referred to above revealed a shortage of theory on this topic, which is a challenge for this research. It appeared that factors relating to the use or non-use of GIS are described in the present literature in a very limited manner. A solution to this problem is to investigate what (other) factors can be of importance for companies in the retail sector. One way to do that is by undertaking qualitative research among retail companies. The Grounded Theory was chosen for this research.

The Grounded Theory is a qualitative inductive method intended to seek and conceptualise latent patterns and structures – a substantive theory – through a process of constant comparison (Boeije, 2010). It is very inductive because it is an open and flexible approach that analyses raw data. The process is cyclic and involves the following steps: data collection, analysis, and reflection (see steps 3, 4, and 5 in Figure 7). Once the data have been collected and analysed, there is a process of reflection to decide what the next step will be. This goes on until saturation of concepts is reached. The Grounded Theory consists of three important coding steps in the analysis: open coding, axial coding, and selective coding. These steps will be explained in Chapter 4.4, where the approach to the analysis is described step by step. A final important aspect of the Grounded Theory is constant comparison. This means that all data are constantly being compared – the first fragment of an interview is compared with the next, the first dataset or interview with the second, every possible concept or category, and the relation between these categories. This approach aims to deepen and obtain a variation of the possible concepts. The Grounded Theory has been applied in this study in order to bring to light new concepts and factors for this research. The various steps taken in this approach are set out in Figure 7.



**Figure 7. Research design scheme, deducted from Boeije, 2010.**

## **4.2 Participants and interview procedure**

This research was conducted at expanding companies in the retail sector in the Netherlands. At the outset the aim was to interview approximately 15 companies. The companies that were asked to participate were selected by purposive sampling (Neuman, 2009; Boeije, 2010). Purposive sampling aims to represent a wide range of perspectives and experiences in the sample of a research (Boeije, 2010). With this sample the aim was to provide insight into the extent to which GIS is actually used when retail companies are expanding. However, the interviews could obviously not be representative of the retail sector as a whole.

Expansion managers of retail companies were approached via LinkedIn and the network contacts of Geodan. A total of 79 InMails were sent via LinkedIn, and 25 connections were approached through Geodan in order to reach enough companies for the interviews. Furthermore, a message was posted on the researcher's LinkedIn page with a view to identifying the right people within the retail sector. Lastly, a message was posted on multiple real estate LinkedIn pages. In this way companies reacted to the requests, and interviews were planned. The interviews were held at the head-office of the company that was being interviewed, or by telephone. As already mentioned, all the companies were active in the retail sector. The interviews were held with the companies' expansion manager or CEO. The answers to the research questions are likely to be quite different for each company, due to the fact that each retail company has its own unique factors. Therefore, the interviewed companies differ as much as possible.

The interviews lasted for approximately 30 minutes, and were held from the beginning of September 2017 to 16 January, 2018. During the interviews the interviewees were first asked whether they agreed to the interviews being recorded and used for this research. If the interviewee did not want to be mentioned by name, it was possible to create *personas* or *user profiles* of the anonymous persons and/or companies (Garret, 2011). The creation of personas is useful when dealing with diverse users (Matthews et al., 2012). In total, 9 out of 10 interviewees agreed to have their details published in the appendices to this thesis. In the case of one company, we agreed to call it 'a company in the automotive industry'. This thesis will be sent to all the companies that participated in this research. In order to prevent conflicts of interest or any other form of possible contention, companies are referred to anonymously in this thesis, and will only be named in the appendices, which are not publicly available.

In the cyclic process of the analysis in terms of the Grounded Theory saturation was reached in the ninth interview. A tenth interview was subsequently held, but no new concepts emerged from

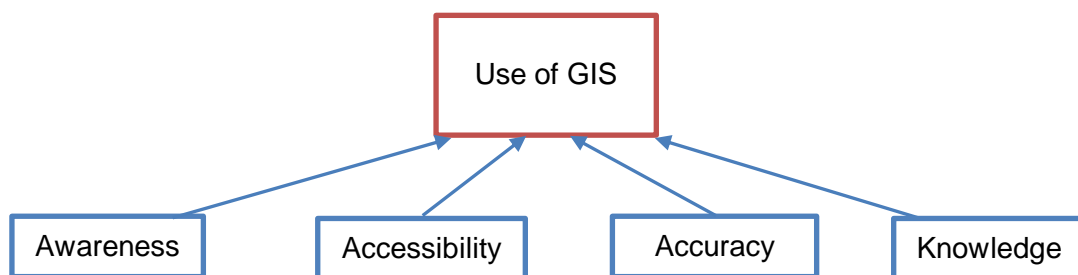


this interview. Moreover, due to time constraints it was not possible to conduct further interviews to confirm that the assumed saturation had actually been reached. In total 10 interviews were held.

### 4.3 Design

The design of this research is explorative and qualitative. As already mentioned, the research used the Grounded Theory to answer most of the research questions. Other sub-questions were answered by the literature study.

Following the steps of the Grounded Theory, *sensitizing concepts* were developed before conducting the interviews. These are relevant concepts from the literature that guide the researcher (Boeije, 2010). These concepts help to focus the researcher's view on relevant features in the interviews and to guide the analysis. This is done without disturbing the openness of the interviews. Based on the theoretical background of site selection a number of factors that limit the use of GIS were identified. These factors, according to the literature, partly explain why there is a gap between the use and non-use of GIS. The sensitizing factors were developed on the basis of these constraining factors, and are set out in Figure 8. *Awareness* is the knowledge of the existence of data and GIS, and its potential added value. *Accessibility* is about the critical importance of a potential user of GIS having access to all data needed in order to correctly represent a particular site in its surroundings. *Accuracy* is about the usability, the type of the data, and is an important factor for knowing whether the data are of value to a company. Lastly, *knowledge* relates to specific technological know-how with regard to the GIS software. These concepts were also used as a guideline for the interviews.



**Figure 8. Preliminary model consisting of sensitizing concepts which, according to the theory, determine the use of GIS for site selection within the retail sector.**

Semi-structured interviews were held to investigate the companies (Boeije, 2010). Interviews of this nature can provide insights into the experience, knowledge, and judgements of the expansion managers of the retail companies and the extent to which GIS plays a role in the selection of an

appropriate site. It is important that the interviews should be kept open. The exact content of the interview depends largely on the reaction of the person being interviewed (Boeije, 2010). A guideline that was used for the content, structure, and order of the subjects for the interviews is contained in Appendix II.

#### **4.4 Approach of the analysis**

This paragraph explains the approach adopted in terms of the Grounded Theory. Before being analysed, the interviews needed to be transcribed. The transcriptions of the interviews are included as an additional document (USB-drive) to this paper.

After transcription, coding of the interviews was undertaken. As mentioned in Chapter 4.1 there are three types of coding in the Grounded Theory: open coding, axial coding and selective coding (Boeije, 2010). For open coding the transcripts were exported to Excel, where field notes were made and added to the various fragments of the interviews. These fragments were divided into meaningful fragments, and temporary codes were matched. In order to guarantee the quality of these codes, an audit trail should be conducted (Anfara, Brown & Mangione, 2002; Boeije, 2010). The transcripts were therefore rechecked by another researcher, and the temporary codes were checked, discussed and criticised by the third parties. This was done by a researcher with a background in geography and a researcher with a background in educational sciences. In total, both other researchers checked 10% of all codes. After their check, the few existing differences in codes were discussed to make sure that there was a shared understanding and that objectivity was guaranteed as far as possible.

After open coding, the axial coding took place. In this phase, the temporary codes were clustered, and main categories were developed. This phase also provided the opportunity to review the transcripts of the interviews and to complement and change codes. The codes were actually changed in two instances. Thereafter, the codes were arranged into relevant categories, and a code tree was constructed (Appendix IV).

After the axial coding had been completed, selective coding started. In this phase the theory or explanation relating to the primary objective of this study was constructed. All categories were related to a single key concept. An attempt was made to identify linkages between different companies in the retail sector with a view to answering the research question and the sub-questions. These answers constitute the basis of explanation relating to the use of GIS in the retail sector, and are discussed in Chapter 5.

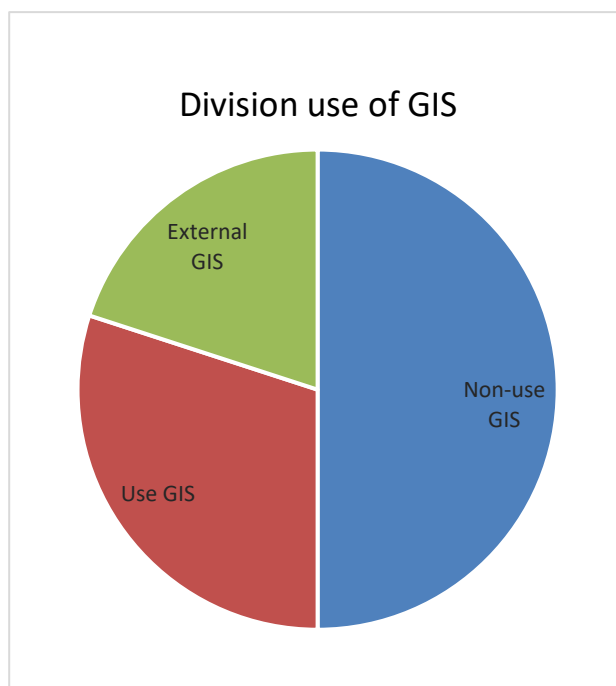
## 5. Analysis

In this chapter the interviews are analysed, and the sub-questions are answered. The 10 companies that were interviewed have been made anonymous and are referred to by alphabetic characters, as set out in Table 2. These are the same alphabetic characters that were used in the code tree (Appendix IV). The retail companies are grouped on the basis of the use of GIS. Three groups were identified in the interviews: companies that do make use of GIS, companies that do not make use of GIS ('Non-use of GIS') and companies that do make use of GIS, but do not use the software themselves.

Company	Use GIS
Company J	Non-use of GIS
Company M	Use of GIS
Company V	External use of GIS
Company B	Non-use of GIS
Company L	External use of GIS
Company E	Non-use of GIS
Company D	Use of GIS
Company S	Use of GIS
An automotive company	Non-use of GIS
Company A	Non-use of GIS

**Table 2. Overview Companies and Use GIS for site selection.**

These companies hire an external company to do their requested analyses, and are referred to in this paper as companies with 'External use of GIS' (see Table 2). A circle diagram has been drawn up (see Figure 9) in order to clearly illustrate the three different company categories. It becomes clear that 50% of the interviewed companies do not make use of GIS; 30% do make use of GIS; and 20% of the companies hire an external company to do the requested GIS analyses.



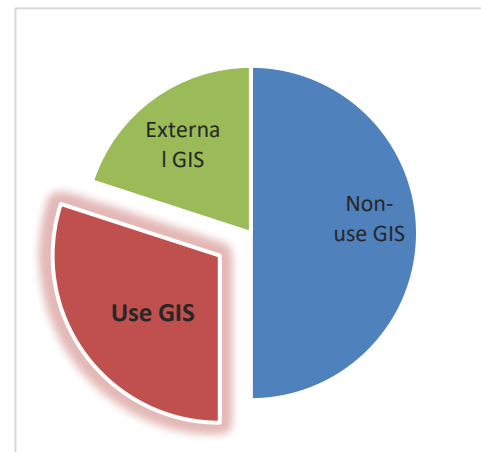
**Figure 9. Division use of GIS.**

## 5.1 Site selection work process

In the interviews the expansion managers or CEOs were asked to provide a detailed description of their work process with regard to site selection. The answers given by the various retail companies differed quite significantly. To create an overview of what the site selection work process looks like, this question is answered for every group (as showed in Figure 9). The site selection process will be described in Paragraphs 5.1.1, 5.1.2, and 5.1.3.

### 5.1.1 Site selection process of companies that do make use of GIS

Three of the ten interviewed companies do make use of GIS for their site selection process (see Figure 10). These three companies are also the largest of the interviewed retail companies, and have between 12 and 25 physical establishments in the Netherlands, and up to 1,000 establishments worldwide. In these companies, expansion managers often have a whole team working on site selection. This gives an indication of the importance that is attached to site selection in these companies. The three companies have a similar way of working when it comes to the site selection process, which consists of multiple phases.



**Figure 10. Three of the ten companies make use of GIS.**

First the companies determine what their strategy is. They examine whether they want to expand, how many stores they want to add, and in which part of the Netherlands. This is done in consultation with the head office, which may be located outside the Netherlands. Company M. stated that ‘the goal for the coming years is to add 60 to 70 establishments to our real estate portfolio in the Netherlands.’ After determining how many stores they want to build, they examine in what part of the country they want to create new establishments. According to Company D., this is in the top 20 largest cities:

‘We are searching for locations where our potential customers live. That is a specific target audience and we therefore need to focus on the top 20 largest cities in the Netherlands. We are establishing on sites that are positioned as close as possible to our potential customers.’

Thereafter the expansion managers and their employees come into play. They are constantly searching for the most suitable locations for new establishments. The expansion managers in this

group of companies make use of GIS themselves. Moreover, a very important factor is the use of the experience they have gained in the past, as well as their gut instinct. Company D. states: ‘We literally need to drive around; that is obligatory. Because when you walk through a city, you get to know how a city works and breathes. That has a lot to do with gut instinct...’. Gut instinct is not measurable or quantifiable. Company D. and M. also make use of the knowledge within their own company to underpin their gut instinct. Company D. states: ‘Our own sources are our employees who live throughout the Netherlands and can give us information about certain parts of cities and municipalities, which we then investigate further.’ However, the site selection of Company D. is not based just on gut instinct. Company D. states:

‘We use demographic data and other quantifiable facts in a GIS programme called ‘retail sonar’. That is a GIS programme which makes use of total revenue data, but also takes into account where and how many people live in a certain area, the accessibility, and so on’.

In addition to driving around following their gut instinct (subjective data), and executing GIS analysis (objective data) for determining the highest revenue potential, they also monitor similar sized companies in a different branch. Quite often, Companies D. M. and S. are located at places where similar sized companies are already situated. This often results in a win-win situation, as more customers are attracted. The final location decision is made by the head office, after they see the presented results of the above-mentioned steps. They ultimately decide whether to go ahead with the expansion or not. The process followed by Companies D., M., and S. is set out in Table 3.

1. Determine if you want to grow
2. How many stores need to be added
3. Determine in big lines where you want to establish
4. Drive and ask around to process subjective data
5. Thorough GIS analyses with objective data on favourable places
6. Competitor analyses
7. Make final location decision
8. Presentation and defence at the head office

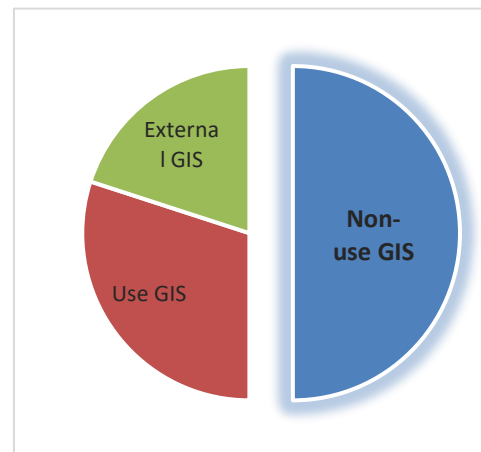
**Table 3. Procedure – site selection process of companies that make use of GIS.**

### 5.1.2 Site selection process of companies that do not make use of GIS

Five of the ten interviewed companies do not make use of GIS in their site selection process (see Figure 11). These companies have between 3 and 47 establishments within the Netherlands. But, if GIS is not used, what does their site selection process look like? In contrast with Companies D., M., and S., Company B. has only one person responsible for the expansion of the company:

‘At the moment, I am only able to check one postal code at a time and the only response I get is the estimated amount of revenue at one certain

location. I am not able to compare multiple locations or regions, and I also cannot add different factors. So we decide where we are going to establish purely on the basis of the estimated amount of revenue.’



**Figure 11. Five of the ten companies do not make use of GIS.**

Company B. therefore uses a model that makes use of multiple non-GI related factors to calculate what the revenue will be. The interesting part is that the interviewee did not know exactly which factors are used in the model, but stated that the outcome is quite accurate most of the time. The first three phases of the site selection process are the same as the first mentioned group companies (see Table 4). After the decision about where to establish, the process becomes less clear. Company B. relies on the input of its franchisers – on whether they have a good feeling about a certain location. That is an important factor in the site selection process. Thereafter, the location is inserted in the model of Company B., and a provisional location decision is made on the basis of this output together with the gut instinct of the franchiser. GIS does not play a role in the location decision-making of Company B.: ‘The tables with revenue are by far the most important factor and displaying is not important; that is just a matter of layout. We can reproduce it in Google Maps, for instance.’ Next, the provisional location decision is discussed with the management and business analyst of Company B., and the franchiser, and a final site selection decision is made (see Table 4).

1. Determine if you want to grow
2. How many stores need to be added
3. Determine in big lines where you want to establish
4. Location is inserted in a model which calculates the estimated revenue
5. Location decision is elaborated with relevant parties
6. Final location decision and go or no-go is shared by mail

**Table 4. Procedure – site selection process of Company B. that does not make use of GIS.**

The processes of the other ‘non-use GIS’ companies are even less advanced than the process of Company B. Companies J., E., A., and the automotive company are currently not using any model at all for their site selection process. Every year they consider whether they want to expand. If they decide to expand, they are thinking in terms of one or two extra establishments. Next, they simply ask: In which city can I optimally handle my customer needs? Company J. underpins that with the following:

‘We are simply looking at big cities throughout the Netherlands, and when a nice building crosses my path, it will be deliberated with the board, and then we will decide. It is all about human connections, that is how I found our latest establishment.’

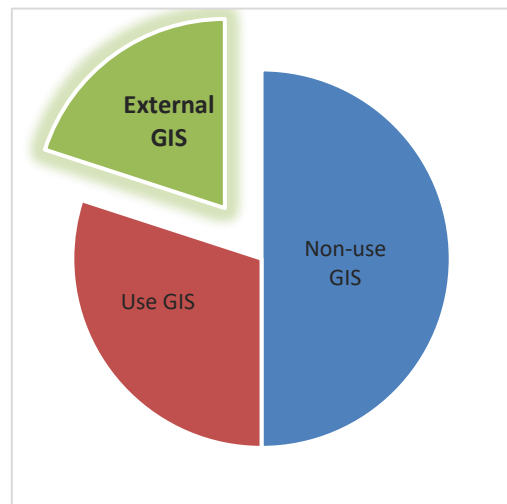
This statement is almost the same as the statement of Company E.: ‘We did not use GI, but we went to our human connections to help us search for the best location.’ These two statements are also in line with Company A. and the automotive company. This makes clear that not every company in the retail industry makes use of GIS for their site selection process. The process followed by Companies J., E., A. and the automotive company is set out in Table 5.

1. Determine if you want to grow
2. Determine in big lines where you want to establish
3. Ask your connections for possible locations
4. Location decision is elaborated with relevant parties
5. Final location decision and go or no-go is shared by mail

**Table 5. Procedure – site selection process of companies that do not make use of GIS.**

### 5.1.3 Site selection process of companies that make use of External GIS

Finally, two of the ten companies (see Figure 12) make use of the end products (output) of GIS, but do not undertake GIS analyses themselves. This category of users is called 'External GIS'. These companies do not belong to the companies that use GIS themselves, but they are aware of what GIS is and the importance of it. Their knowledge however, is not sufficient to do the analysis themselves, so they hire an external company, such as a consultancy firm in GIS or a real estate company to help determine the best possible location. The fact that these companies do not have the right knowledge is also stated by Company L.:



**Figure 12. Two of the ten companies have External use of GIS.**

‘We might be able to those GIS analyses ourselves. However, we absolutely do have a lack of knowledge to do a proper site location analysis and fully use the potential of the software. So, it is a lack of knowledge, but also a strategic decision. We prefer involving an external company who can provide us with the certainty about the most suitable location decisions.’

The expansion manager of Company L. recognises the potential of GIS, and he is using it to a certain extent. However, he states that GIS only constitutes a minor part in the location decision-making process. Company V. underpins this by the following statement: ‘The outcome of all the preparatory research and the making of all objective and subjective strategic choices beforehand is the most important part. GIS is just a crumb of the pie.’ The External users of GIS have a different procedure concerning their site selection (see Table 6).

1. Determine if you want to grow
2. Determine based on subjective and objective factors where you want to establish
3. Check with External GIS analyses of locations match with step 2.
4. Location decision is underpinned internal and external
5. Final location decision is communicated with the management

**Table 6. Procedure – site selection process of companies that make use of External GIS.**

First they determine if they want to grow at all. Second, they generate an idea about where they might want to establish. This is based on subjective and objective factors. Third, they are checking



their findings with an external company that can do a suitable GIS analysis for them. After reaching consensus, the location decision is underpinned by the external company as well as the involved internal departments and their location decision is communicated with the management.

#### **5.1.4 Conclusion site selection work process**

In general, it can be stated that all companies use some sort of gut instinct to decide which location site is the most suitable. Over and above this gut instinct, some kind of data analysis is also done. See Table 7 for an overview of the site selection work processes of the three groups. This could be the analysis of certain demographic data, but could also be as simple as determining whether there are sufficient parking places in the direct neighbourhood to facilitate parking for the customers. For some companies these basic analyses are enough to determine where they want to establish (e.g. Non-use GIS). For other companies, it is important that an extensive analysis is done on all kinds of data; as well subjective data, as objective (GIS) data. Therefore, these companies are using GIS (e.g. Use-GIS). The third group of companies (External GIS) want to underpin their ideas about expansion with a GIS analysis. They are aware of the possibilities GIS has to offer, but they do not have the knowledge to do the analysis themselves. They hire a third party to help them with their location decision.

<b>Category</b>	<b>Characteristics</b>
Use of GIS companies:	<ul style="list-style-type: none"> <li>- Objective data processing in GIS, always</li> <li>- Subjective data processing by expansion managers</li> <li>- Budget is no issue</li> <li>- Awareness is high</li> <li>- There is significant knowledge</li> <li>- Always the best location, no matter the costs</li> </ul>
Non-use of GIS companies:	<ul style="list-style-type: none"> <li>- Objective data processing in a non GIS model</li> <li>- Subjective data processing done by the owner, based on personal experience</li> <li>- Budget is scarce</li> <li>- There is little awareness</li> <li>- There is little knowledge</li> <li>- Best value for money location</li> </ul>
External GIS companies:	<ul style="list-style-type: none"> <li>- Make use of external companies for GIS analyses</li> <li>- Subjective and objective data processing done by the external real estate company</li> <li>- Budget is available, but not unlimited</li> <li>- Awareness is high</li> <li>- There is little knowledge</li> <li>- Location depends on internal findings and the advice of external GIS company</li> </ul>

**Table 7. Site selection process per category.**

## 5.2 Factors determining the use of GIS

In this paragraph an answer is provided to the second sub-question, which relates to which factors determine whether or not a retail company makes use of GIS to analyse GI. A code tree has therefore been constructed in order to do a thorough analysis (see Appendix IV). The code tree consists of factors that limit the use of GIS and factors that encourage the use of GIS. From the interviews it appeared that the factors limiting the use of GIS consist of three categories. The factors encouraging the use of GIS also consist of three categories. Below it will be explained how these categories are realised and how the multiple aspects relating to the use or non-use of GIS emerge.

### 5.2.1 Limiting factors for the use of GIS: Data

From the interviews appeared that seven of the ten companies think it is important to incorporate subjective data in the final location decision. Therefore, subjective data emerged as the most important limiting factor for the use of GIS within the category Data. Company D. is therefore a typical example, whose statement is shared by three other companies. Company D. states: 'We are also taking sentiment into account, and based on that feeling we take decisions. Unfortunately, there is no formula to process sentiment, but luckily we are allowed to use our gut instinct.' This could mean that the lack of subjective data processing is a factor that limits the use of GIS, because GIS is not suited to processing this kind of data.

Moreover, the availability of data came forward as an important factor. Not all data are available for everyone at any given moment in time. Three out of ten companies state that they wanted to use certain data, but they could not always get their hands on the data they preferred. For instance, the automotive company stated: 'To really make a decent overview of the sales potential we need local customer data and sales figures'. This is underpinned by Companies D. and B.

In addition to the processing subjective data, and the availability of the data, there is also a lack of awareness of available data. Companies do not know what data are available to do some kind of analysis to determine the most suitable location. This lack of awareness is shared by three companies and is underpinned by the following statement by Company A.: 'I did simply did not think about the density of airports in the neighbourhood. However, afterwards it was realised that it is an important factor concerning accessibility.' It stands out that the companies that do not use GIS are not aware of the existence of GIS – let alone the functionalities which GIS is capable of. Company E. states the following:

'We used Google Maps to approximately determine the travelling time from the viewpoint of our customers to our nearest establishment. And I think we used another document

containing schedules of rush hours around Amsterdam. No thorough analysis has been done on accessibility.'

This statement is explicitly underpinned by Companies J. and A.

### ***5.2.2 Limiting factors for the use of GIS: Alternative method***

This lack of awareness concerning data and GIS can also have something to do with the current site selection process of the companies in the retail sector (see Chapter 5.1). This was also pointed out in the Alternative Method limiting category.

It emerged that the site selection of companies is certainly not always based on GIS, but can also be based on other models. For example, Company J. stated: 'It is all about human connections – that is how I found our latest establishment.' This statement is underpinned by Company E. This demonstrates that a hampering factor could be that companies already have their own non-GIS method, and that they do not know why they should use GIS, as their method is sufficient. Another limiting factor on the alternative methods relates to the so-called 'A1 locations'. Following this method, the expansion manager of Company M. stated:

'If I am being honest, in our company we are acting pretty elementarily with regard to the location decision-making process. There are companies who are doing a thorough study on site selection. However, we are just focusing on the all-already determined A1 locations, as we call them. These locations have the highest footfall and that is the place to be for us. In general, we do not deviate from that, even when another place is cheaper. Eventually we will probably regret opting for the cheaper location. We need to locate our stores in the very best location.'

This quotation makes it clear that not all companies always analyse every location. Sometimes it is clear to them what the best location is – and certainly when decisions made in the past paid off.

### ***5.2.3 Limiting factors for the use of GIS: Company specific***

Cost is also mentioned as an important factor for not using GIS. This hampering factor could emerge out of the strategic choices made by a company. Company B. stated:

'The financial aspect of using GIS is really important. Last year a GIS consultancy company advised us on maximizing our revenue by means of using a GIS application. However, the

application was expensive and there were no clear prognoses about maximizing the revenue versus the costs we needed to pay.'

Moreover, Company J. stated:

'I think GIS can play an important role in selecting the most suitable site, and in some way it is also important for us. Nevertheless, it is not worth the financial and time investment of our company. The way we are selecting our new location at the moment is really effective, as it turns out.'

The two companies are limited in the use of GIS due to the expenses they do not want to incur, as they are not convinced of the additional value of implementing and using GIS. For these companies the cost-benefit ratio is of real importance. It also is a consideration concerning the usage. There is a difference between a retail company that is constantly expanding and looking for new site selection opportunities and a company that uses GIS occasionally. If the latter is the case, it might not be worth the expense. For example, Company L. stated: 'Moreover, it is incidental work, so we do not think it is worthwhile investing in GIS.' This means that it might not be worth investing in GIS. However, if a company is convinced of the added value of GIS, it could be an alternative to buy GIS knowledge or advice about GIS concerning site selection. This shows that awareness is an important first step for the use of GIS. A company first has to know about the existence the software of GIS, and then also about all the functionalities and the available data.

Often the companies do not want to invest in GIS, which can be ascribed to the lack of awareness and knowledge concerning GIS. Company B. underpins this: 'We actually do not really know how to use GIS and what kind of GIS analyses are available. That is why we need help, but unfortunately we did not find suitable help.' The lack of knowledge concerning GIS share common ground with the lack of knowledge concerning data (see Paragraph 5.2.1).

#### ***5.2.4 Encouraging factors for the use of GIS: Company specific***

On the other hand, the awareness and knowledge factor is also an encouraging factor for the use of GIS within companies in the retail sector. When companies have awareness and knowledge about the existence and capabilities of GIS, it can be a stimulating factor to buy a GIS or hire a GIS company. Company M. stated: 'I know about the GIS knowledge you can buy or hire.' Company J. also underlined the stimulating effect of knowledge: 'I know a lot of companies who deliver some kind of GIS service.' When a company has awareness and knowledge about the existence of GIS, it is also important that

they are aware of the capabilities of GIS and the possible added value for their company. One of the capabilities of a GIS, for example, is determining which location has the highest turnover.

This maximizing of revenue is a very stimulating factor for the use of GIS. GIS assisted in determining the most optimal location for Company L.: 'It pointed out that people in [city in the Netherlands] are prepared to travel for at least 30 to 60 minutes. That knowledge has strengthened our proposition concerning the offering of every single course at every single location.' Maximizing revenue and the existing knowledge of GIS is particularly important when companies are growing. It appeared that the companies that are growing strongly make more use of GIS. Company L. stated the following: 'This year we have 14 establishments. Next year we are aiming to be situated in 20 establishments.' It therefore could be important that such companies have a knowledge about GIS.

#### ***5.2.5 Encouraging factors for the use of GIS: Output***

Another encouraging factor for the use of GIS is output. It emerged from the interviews that GIS can be, and often is, used as a tool for practical reporting, generating a general overview, visual analysis and sharing datasets. It is also possible that companies do not use GIS themselves, but buy GIS analyses and use the output to support location decision-making.

Companies stated that they benefit from practical reports. For example, Company M. stated: 'I need to convince him [CEO of Company M] of my story. Therefore, I am presenting just simple facts and figures, which I am supporting with tables, maps, and the feeling I have about that specific location.' What becomes clear from this quotation is that practical reporting is important, but visual analyses and sentiment also play an important role. Visual analyses, the fact that the location decision is supported by GIS, and – in the case of Company M. – the processing of subjective data also play an important role. Perhaps the expansion manager of Company M. is acknowledging his subjective interpretation by means of the GIS output. The visual analyses component of GIS is not only important for Company M., but is also seen as an encouraging factor for the automotive company: 'By making use of an isochrone map the potential service area of the company becomes much more clear.'

The sharing of data also plays an important role. Company B. stated the following:

'At this moment, the sharing of the findings of a dataset is done simply by mail. However, when a final decision has been made, the management, the franchiser and I come together and discuss the particular outcome. Afterwards, the outcome is shared again by mail...'

The expansion manager made it clear that when a franchiser asked where all possible establishment sites were situated, he had to invite the franchiser to do the particular (non-GIS) analyses in his presence, because he was unable to share the entire dataset. The automotive company is facing the

same problem. There are a large number of dealers who are not able to quickly oversee where its partner dealers and suppliers are, and – more importantly – which one is fastest to reach.

### ***5.2.6 Encouraging factors for the use of GIS: Data***

The last encouraging factor for the use of GIS is the category data. Within this category it appeared that three factors have an encouraging influence on the use of GIS. While the ability to process subjective data is seen as a limiting factor for the use of GIS (see Paragraph 5.2.1), the ability to process objective data is seen as an important stimulating factor for the use of GIS. For example, Company D. stated:

‘We are searching for locations where our potential customers are located. That is a specific target audience, and therefore we need to focus on the top 20 biggest cities in the Netherlands. We are establishing on sites that are positioned as close as possible to our potential customers.’

To know which cities are the 20 biggest in the Netherlands, Company D. used objective data. For the companies it is also important that the data in the analysis can consist of multiple factors. So, not only the distance to the neighbouring municipalities of Company D. is important, but especially the combination of the demographic data and the neighbouring municipalities, which can indicate to the sales potential of a certain location. Company B. also believes it is important that a thorough analysis can be done on multiple factors at the same time. Company B. stated the following: ‘We preferably have a list with options we can check. Then I would like to see the ideal location with an optimal sales potential, with the checked boxes (different factors) in mind.’

The last encouraging factor for the use of GIS that emerged from the interviews was the ‘up-to-date’ factor. When the datasets in a GIS are complete and regularly updated, it is easy to create an up-to-date output at any place and at any given moment in time. This is definitely of use for Company L., and underpinned by the following statement:

‘Because we are offering a product with an extremely variable demand, we need up-to-date information on the demand. We are not location-bound with our products, so we are able to change course to locations where we are not active yet.’

This argument about up-to-date data is supported by Companies S. and M., which are also depend on recent data.

### **5.2.7 Conclusion factors determining the use of GIS**

This analysis of the interviews reveals that there are different encouraging and limiting factors relating to the use of GIS. In conclusion, from this research emerged that there are nine limiting factors and eleven encouraging factors for the use of GIS. Further on, these factors are displayed in Figure 14 and Figure 15. There are five most important factors mentioned which determine the non-use of GIS. First, the strategy of a company. The strategy of the non-GIS using companies remains the same when they are already satisfied with the current process. Second, the processing of subjective data. This is an important argument for companies for not using GIS. Their most important reason is that they are not able to process their gut instinct and the opinions they have obtained with respect to the potential establishment sites into a GIS. Third, the cost-benefit ratio of GIS. The non-GIS companies want to know what the added value of GIS is and if the investment is returned by the increasing sales potential. This could also be connected with the awareness of GIS. Fourth, the lack of knowledge. Some companies have no knowledge or awareness of the existence of GIS, what its value could be or how to use it. Last, the alternative system. Often, the non-using GIS companies already have a method. Sometimes this is based on static (paper) maps, and sometimes a model which does not include GI, but works for them.

### **5.3 Explanation of the possible gap between contribution of GI and potential value of GIS**

By analysing, categorizing, comparing and placing all factors in a diagram, a main factor emerged, namely, 'Insight into the possibilities of GIS'. This main factor is connected with all encouraging and limiting factors concerning the use of GIS (see Figure 13). This main factor means that a company is not just aware of GIS and its functionalities, but that a company has insight into what GIS is, what it can do for them, and how they can use it. Insight is a complete term that encompasses multiple components about GIS and the use of it. All factors – encouraging and limiting – are ultimately involved in the main category. Moreover, it becomes clear that many factors are mutually connected. For example, a lack of awareness concerning data is closely related to a lack of knowledge concerning GIS. This means that a lack of awareness concerning data might also cause a lack of knowledge concerning GIS, or vice versa. This does not necessarily mean that there is a relationship between these factors; it could also be due to the interpretation of the interviews. The limiting factors (left side of Figure 13) could explain the possible gap between the use and the potential value of GIS.

When the factors that are discovered in the analysis are compared with the theory, the factors *lack of awareness* and *lack of knowledge* match as possible factors for the non-use of GIS. Despite that lack of awareness and lack of knowledge are mentioned as factors, these are not the most often mentioned factors (see Figure 14). The limiting factor for the use of GIS that is mentioned most often

is *Strategy* (8 times). The strategy of the company often seems to be a factor that determines why GIS is hardly used for location decision-making. They do it in their own specific way, and GIS does not play a significant role in this decision-making process. Thereafter, the 'Processing of subjective data' is mentioned seven times. This does not necessarily mean that a company does not use GIS based on one limiting factor. But, it gives insight in what factors are mentioned most and could therefore be important for not using GIS.

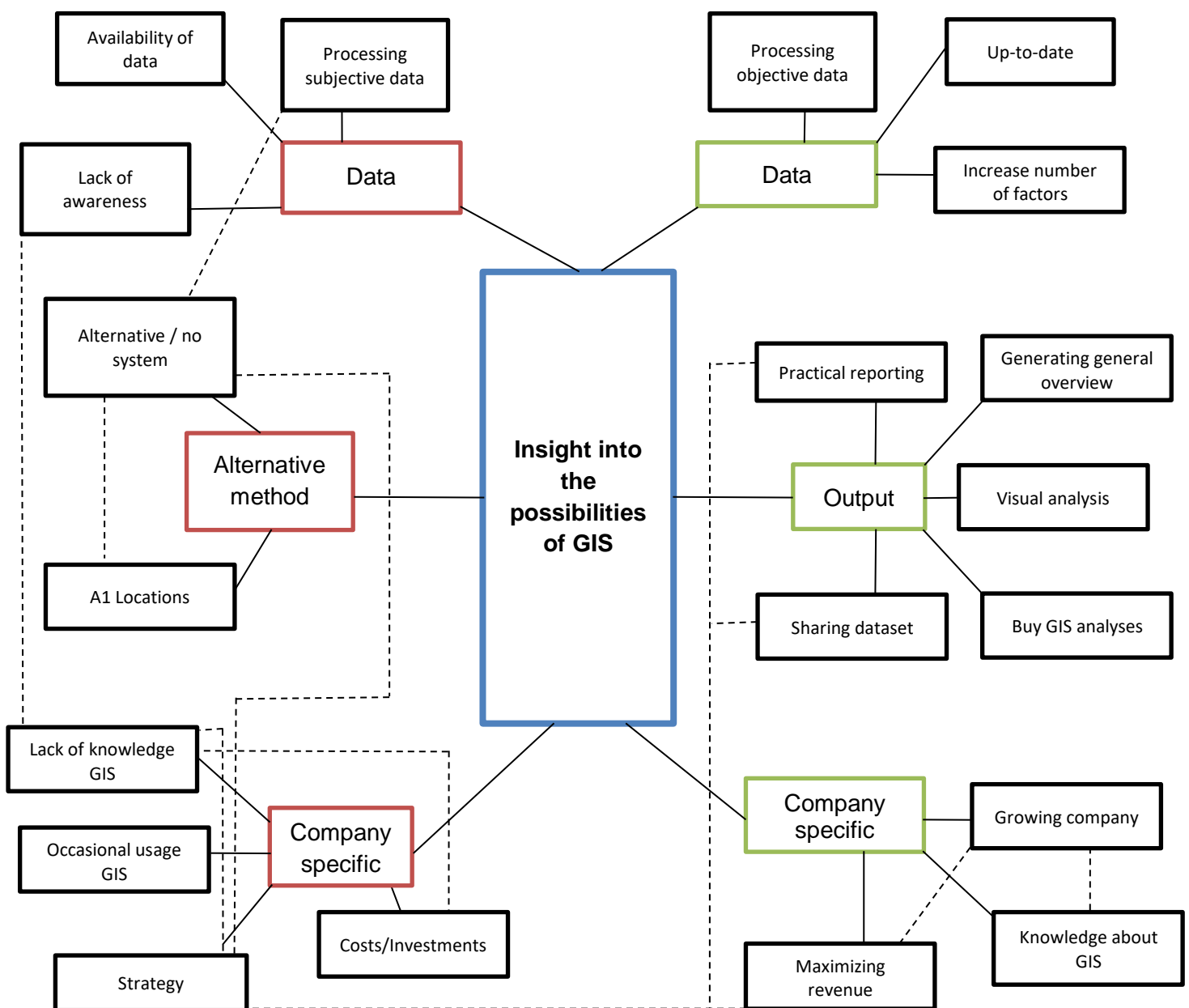
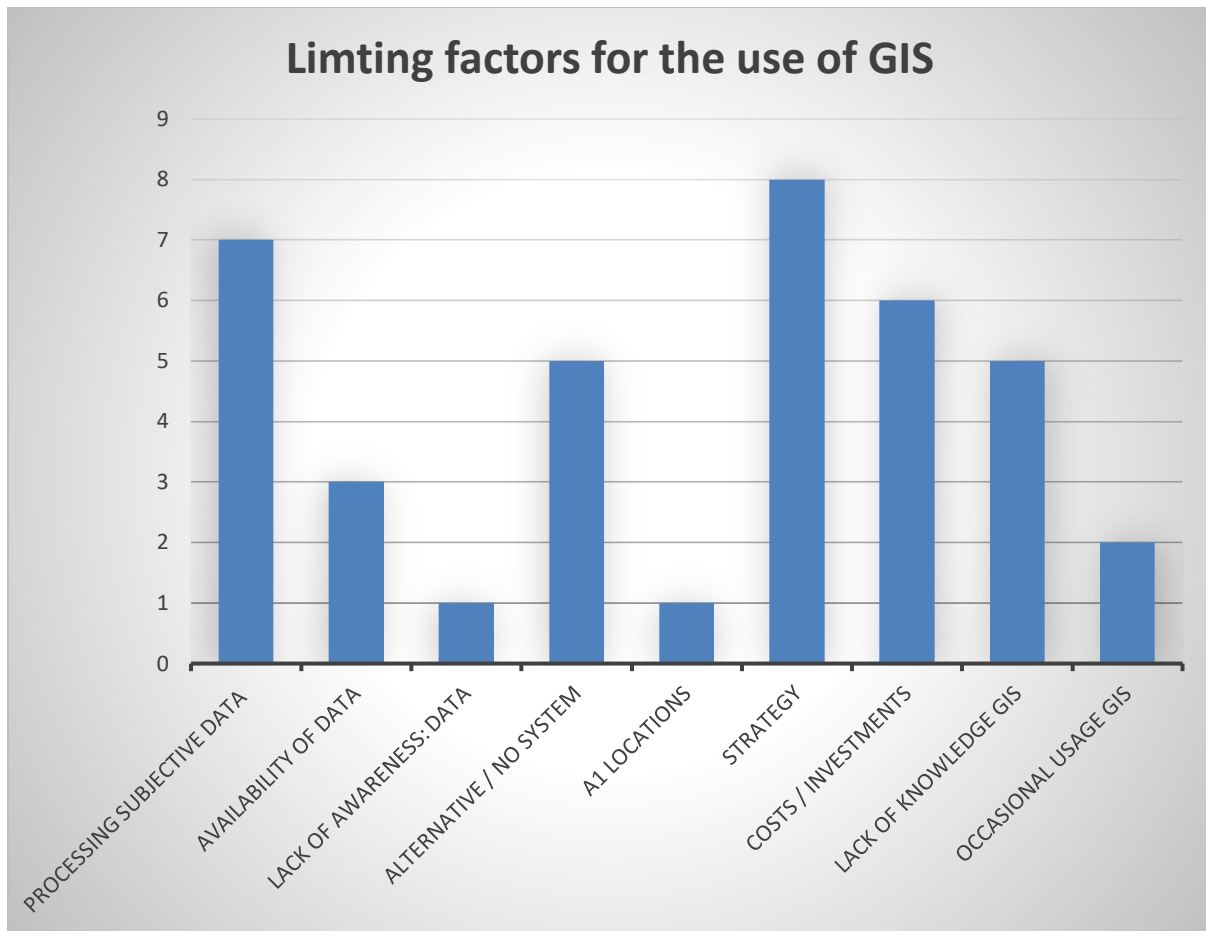


Figure 13. Mindmap: Insight into the possibilities of GIS and the relation with use and non-use factors of GIS.





**Figure 14. Mentioned limiting factors for the use of GIS.**

## 5.4 Increase usage of GIS

Insight into the possibilities of GIS is the key factor for many companies when it comes to the use or non-use of GIS. When companies do have an insight into what GIS could mean for them, actual use will increase and the location decision-making will be better underpinned by means of a GIS. Five of the ten interviewed companies stated that they did not make use of GIS for their site selection process. The reasons for not using GIS within those ten companies were diverse (see Figure 14).

To increase the actual use of GIS, the limiting factors for not using GIS should be removed, and emphasis should be placed on the encouraging factors. The most important encouraging factors can be derived from Figure 15 and can be linked to the limiting factors in order to increase the use of GIS and nullify the limiting factors (see Figure 16).

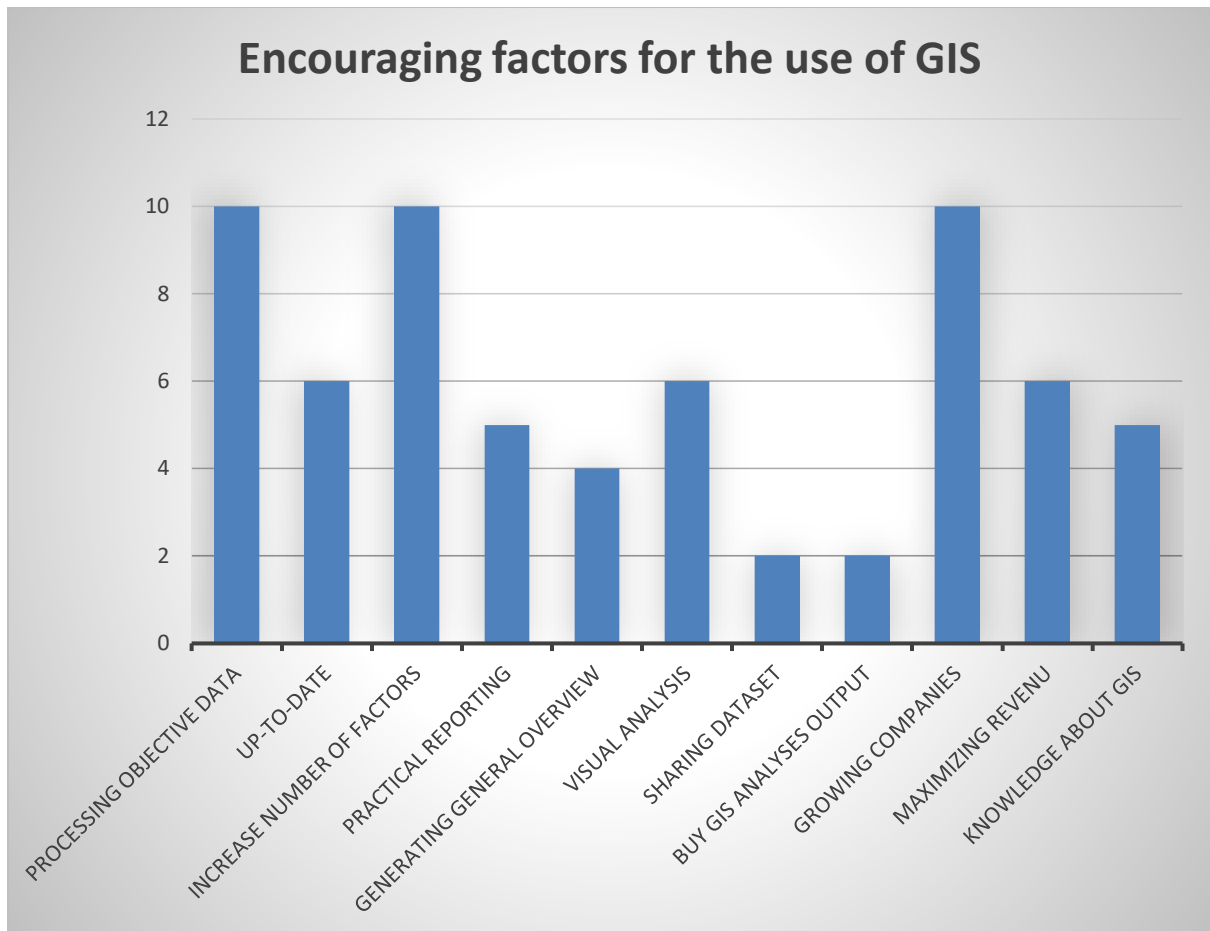


Figure 15. Mentioned encouraging factors for the use of GIS.

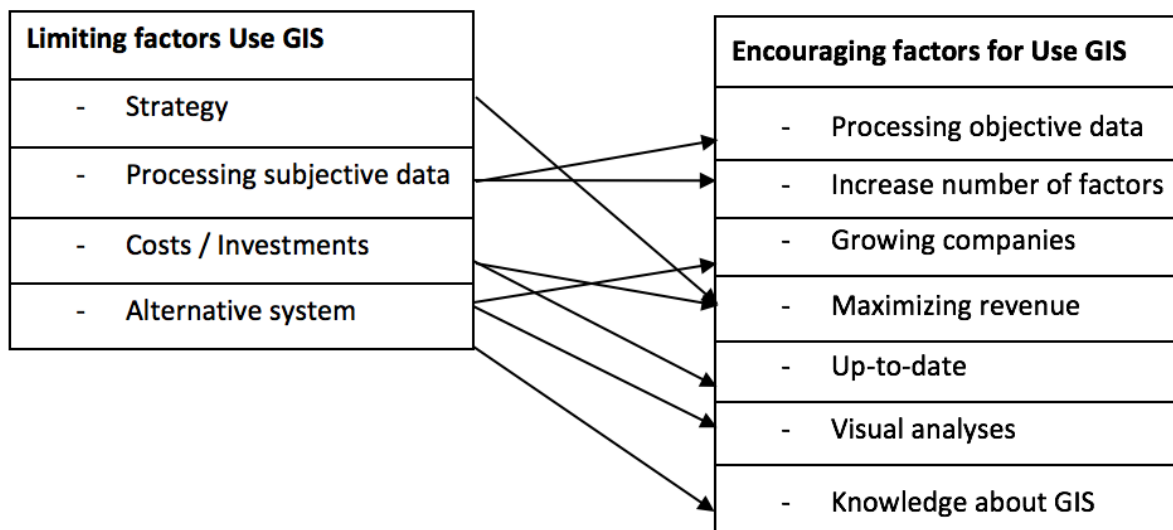


Figure 16. Encouraging factors for the use of GIS.

For every important limiting factor a linkage is made to an encouraging factor which cancel out the negative effect of the limiting factor. The *strategy* within a company is often determined by the management of the company. Management needs to be convinced of the added value of GIS for their company, as was underpinned by Company B. For example, this can be done by making a proof of concept, which indicates how the sales potential can be maximized on the basis of a simple network analysis. The *processing of subjective data* is a component in which a GIS is not very advanced. There is always an unquantifiable human component in the ultimate site selection, such as gut instinct. This is underpinned by Companies D., V., and M. However, GIS has many other components that prove its added value without using subjective data. For example, it can process a large number of quantifiable factors at the same time, and decide on what the most optimal location is. After the objective output of the GIS with regard to the most optimal location, the company can always decide that a location decision needs to be revised, based on the human component. Furthermore, depending on what kind of GIS analyses is done, the *costs/investments* or cost-benefit ratio can be relatively small. The costs depend, amongst other things, on the number of factors one takes into account. If the outcome of the analysis turns out to be valuable, and the sales potential can be maximized by choosing another, more suitable location, it is probably worth the investment (e.g. Companies B. & V.). In addition to identifying an optimal location, a GIS can also help determine future locations for establishment more quickly and effectively, as a result of the processing of up-to-date data. Finally, the presence of an *alternative system* (other than GIS). This is an important limiting factor for the use of GIS. However, according to Company B., GIS offers multiple possibilities which at least do the same analyses – but probably in a more efficient way – for multiple locations at the same time. For instance, this insight can be obtained by hiring an employee who possesses knowledge about GIS.

## **6. Discussion**

In this chapter this research is critically reflected. Therefore, this chapter is split into two parts. Paragraph 6.1 contains the internal discussion, about the execution of this research. Paragraph 6.2 contains the external discussion about the interpretation of the outcomes.

### **6.1 Internal discussion concerning the execution of this research**

When reflecting on this research some critical notes can be placed. The first important aspect concerns the saturation within the Grounded Theory. In the cyclic process of the analysis following the Grounded Theory it turned out that the number of new factors concerning the use or non-use of GIS strongly decreased after having done seven interviews. No new factors were discovered after the ninth interview and officially saturation was reached. Thereafter, a tenth interview was conducted and from this interview also no new concepts came forward. However, it could be possible that new factors would have occurred when interviewing the fifteenth or the twentieth company. Due to time constraints there was no time during this research for more interviews.

Secondly, the ten interviews were held in different branches within the retail sector, which gives a general insight into the usage of GIS. In a way, this is a strong point of this research, because a better overview for the retail sector is created and more factors for the use or non-use of GIS could be discovered. It could also be a weakness because the retail sector is a substantial sector with more than 110,000 companies spread over different branches, which provide both goods and services. Each branch could have their own reasons for the use or non-use of GIS, which obviously cannot be investigated in this research. Nevertheless, this research could be used as a starting point for further research within a specific branch, other sectors, or for comparison between different sectors or branches.

Thirdly, despite the effort to interview completely different companies within the retail sector, it is not certain that the way companies have been approached via LinkedIn and Geodan is not biased. It might be possible that companies that are active on LinkedIn already have more affinity with IT and because of that perhaps with GIS.

Lastly, this research was conducted in the Netherlands. It is possible that retail companies outside the Netherlands make better and more, or even worse and less use of GIS for determining the most optimal sites for their businesses. It would be interesting to investigate if companies outside of the Netherlands have a different attitude and behaviour towards the use of GIS for selecting the optimal site.

## **6.2 External discussion concerning interpretation analyses**

In this research is by means of semi-structured interviews determined which factors could play a role in the use or non-use of GIS for site selection. The largest retail companies that were interviewed are established worldwide, and therefore have more budget to spend on GIS. It is worthwhile for these companies to invest in proper GIS site selection analyses, because they are optimizing and expanding on a continuous basis. Smaller companies are often not expanding on a continuous base, and therefore such an investment might not be worthwhile. The focus for further research could therefore be on simple accessible analyses which are also suitable for smaller companies within the retail sector – especially those with a smaller budget.

Secondly, from the analyses of the semi-structured interviews it appeared that GIS is definitely not always used for site selection within the retail sector. However, the retail sector is a wide sector, so it could be possible that for some specific branches within the retail sector the usage of GIS is less difficult, or even more difficult. So, when this research is conducted within another branch, the output might differ from the output of this research. Therefore, this research can only point out a number of findings concerning the use of GIS in this sector.

Lastly, because of the explorative character of this research semi-structured interviews were held. A wide variety of answers was given, which resulted in a high number of different factors for the use- or non-use of GIS. Due to the differences concerning the origin of the interviewed companies, the importance of each factor was hard to determine. For further research, it would be interesting to research what the impact of each factor means. Therefore, a survey can give insight in the importance of the found limiting and encouraging factors.

## 7. Conclusion & Recommendations

In the literature it is presumed that there are numerous models that can be used to underpin location decision-making within the retail sector. This study has examined whether companies within the retail sector make use of GIS when they are searching for a new establishment, and what could possibly enhance its use. According to the theory, there are a number of sensitizing concepts that determine the use or non-use of GIS. This study has examined both the encouraging and limiting factors relating to the use of GIS. The results have revealed that not all interviewed companies in the retail sector make use of GIS when searching for a new establishment. There are a wide variety of reasons for the use or non-use of GIS, but the main factor is insight into the possibilities of GIS. Linked to this main factor, a number of encouraging and limiting factors for the use of GIS are determined. This research is one of the first attempts to investigate the actual use of GIS.

### 7.1 Sub-question 1: Work process

*What does the site selection process look like when companies are identifying a location for a new establishment?*

To answer this sub-question all ten retail companies were asked to describe the process of finding and opening a new establishment. The expectation was that retail companies in general often do not make use of GIS to underpin their location decision, but use simple GI such as demographics. This expectation appeared not entirely true. From the interviews it emerged that the work processes of the ten retail companies can be divided into three groups: Use GIS, Non-use GIS and External GIS. Not all three groups are using GIS, but two of them do. The *Use GIS*-group makes use of GIS themselves. They have a high level of awareness and knowledge concerning GIS, and have enough budget available for the investment in GIS. Also, the *External GIS*-group makes use of GIS, but this group is using a third party to do their analyses. Their awareness is also very high, but the knowledge is very low. Therefore, they make use of external companies to hire this knowledge. In contrast with this two groups, the *Non-use GIS*-group does not use GIS for their site selection. Their awareness and knowledge are low, as well as their budget. Lastly, the most important part of the work process for all three groups is their gut instinct. They think this subjective human part of their site selection is irreplaceable with any kind of analysis.

## 7.2 Sub-question 2: Factors use or non-use GIS

**Which factors determine whether a retail company uses GIS to analyse geographic information?**

This question is answered by doing both literary research and the analysis with the Grounded Theory. According to the theory, possible factors could be awareness, accessibility, accuracy and knowledge. In line with the expectation, these factors also emerged as important from the analysis of the interviews. Moreover, even more factors appeared to be of importance.

The factors in the theory corresponded with the findings from the interviews. The *awareness concerning GIS* corresponds with the factor *lack of knowledge of GIS*. Before GIS can be used, it is important to know that various kinds of GIS exists, and what their capabilities are. Therefore, in the theoretical framework it is called awareness and in this research it is called Lack of knowledge of GIS. *Accessibility of data* from the theoretical framework is similar to *availability of data* within the analysis of the interviews. Data was available, but not for the specific company that could have used it for an analysis. The *accuracy of the data* from the literature corresponds with the *processing subjective data* code in the interviews, and it is clear that within a GIS it is difficult to process subjective data that is not quantifiable. The *technological knowledge* of the theoretical framework corresponds with the *lack of knowledge of GIS* from the interviews. Especially the lack of knowledge and the processing of subjective data emerged as very important from the interviews as they were mentioned a lot, and companies highlighted them in the interviews.

Next to those two important factors from the analysis of the interviews, some others also seem to have an important role. The other most important factors are the *strategy of the company*, *a possible alternative method or system*, and *the costs/investment* (cost-benefit ratio). These, in total, five factors emerged from the analysis as most important.

## 7.3 Sub-question 3: Possible gap

**What could explain the possible gap between what GI contributes to a company at present and the potential value of GIS for expanding companies?**

The outcomes of the interviews are used to answer this question. The expectation was that the gap is present and that one or more of the factors will have a significant influence on the non-use of GIS. At first there can be said that in line with the expectation, there is indeed a gap between the contribution of GI to a company at present and the potential value. The expected important factor was lack of awareness concerning the usefulness of GIS and the fact that it is easy to work with. Partly in line with this expectation, it emerged that *insights in the possibilities of GIS* is the main factor of all limiting and

encouraging factors. This is partly in line with the expectation, because the awareness is an important first step in this main factor. However, insight is a more encompassing term than just the awareness. Moreover, there is always a certain degree concerning the awareness of GIS. And this is also the case for insights into the possibilities of GIS. Especially the limiting factors linked to insights into the possibilities of GIS play an important role in explaining the gap. As mentioned earlier, the five most important factors are lack of knowledge, strategy of the company, cost-benefit ratio, alternative method, and subjective data.

Next to all these factors from the analysis of the interviews and the expectation from theory, another interesting angle is the comparison with the Dutch government. It appeared that the Dutch government had, or is having, the same circumstances as the retail sector. All their departments are very different from one another, just like all different kind of branches and companies in the retail sector. Nevertheless, it seems that they have a logical approach for using GIS to their questions relating to site selection. The reason could be that the Dutch government already had a shared opinion that GIS is of value for them. They probably have a high awareness about GIS and have great insights about all the possibilities of GIS. These insights are missing in the retail sector.

#### **7.4 Sub-question 4: Increased use of GIS**

##### **What possible solutions could lead to an increased use of GIS?**

This sub-question is answered as a summing up of all other research questions, and contains the most important practical recommendations of this research. It appeared that there is a gap between the actual use of GIS and the potential use of GIS, as is discussed in Paragraph 7.3. To increase the use of GIS, it is important to aim for a high level of insight into the possibilities of GIS. A lack of these insights is something that can be rectified by providing this knowledge and raising awareness of what GIS can achieve.

To decrease this gap and increase the usage of GIS the limiting factors for the use of GIS should be cancelled out by lying the emphasis on the encouraging factors for the use of GIS. By doing that, the insight into the possibilities of GIS is also enlarged. The following encouraging factors turned out to be the three most important for the potential use of GIS: *Process objective data*, *increase number of factors in GIS*, *growing companies* (company specific). Next to these three important factors, also *maximizing revenue*, *up-to-date data*, and *visual analysis* are mentioned encouraging factors. These factors together can all increase the insight into the possibilities of GIS. When these factors are promoted the usage of GIS will probably increase. Through promote the encouraging factors, it may be possible to nullify the limited factors.



This however is not possible for every factor, since one of the encouraging factors for example is the fact that a company itself is growing. Also, the absence of subjective data is a complicated factor to nullify. It is of great importance that a company knows that GIS can analyse all objective data, and that with the outcome of the analysis the companies can use their objective data to come to a conclusion about site selection. Moreover, it is still possible to use the information from driving around as a basis for their GIS analysis.

One of the most important limiting factors for using GIS is that a company does not have the right strategy to invest or want to use GIS. A way to nullify this is through the encouraging factors of the output category, such as sharing data and the practical reporting. When a company knows (has the insight) what the output of GIS is, and how they can use it, it is possible that they would change their strategy for it. Hopefully, if they know the value of GIS, their cost-benefit ratio will show them enough benefits. Again, the first aim is to create higher awareness.

To create more awareness and insights into GIS the recommendation is, in accordance with Jain (2008), 'GIS companies and academia should raise the awareness and further promote the possibilities of GIS within the retail sector.' When needed there could be further research into how this awareness and insights can be increased. This research should be done for specific companies or companies in the same branch. Because, as appeared from the comparison with the Dutch government, it is particularly important to take institutional and organizational aspects into account.

## **7.5 Main research question**

**To what extent are expanding companies in the retail sector using geographical information systems for their site selection and what could enhance its potential use?**

The analysis of the four sub-questions provided an answer the main research question. The answers to the sub-questions are partially in line with the expectations, but also new insight in the use or non-use of GIS have been revealed.

As expected, expanding companies in the retail sector are not using GIS in its full potential, or are not using it at all. The most important conclusion emerging from this research is that insights into the possibilities of GIS is the key for enhancing the potential use of GIS. In which a first part is always to raise awareness. Companies now will not buy GIS, because their cost-benefit ratio is very low. From the work processes it appeared that, when the awareness is high, the companies were using GIS already. A next possible step could be to give more insights and knowledge about GIS so every company can use its full potential. Furthermore, GIS is never decisive on its own and last but certainly not the least important conclusion: there is always a matter of subjective decision-making involved.

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## Appendices

### Appendix I: Overview of the interviews

Nr.	Company	Function Interviewee	Duration	Date of interview
1	J	CEO	21 minutes	7-12-2017
2	M	Expansion Manager	27 minutes	23-11-2017
3	V	CEO	45 minutes	16-01-2018
4	B	Business Analyst	34 minutes	17-11-2017
5	L	Manager	31 minutes	12-12-2017
6	E	Manager	26 minutes	28-11-2017
7	D	Expansion Manager	46 minutes	13-12-2017
8	S	Expansion Manager	20 minutes	24-11-2017
9	Automotive company	Expansion Manager	32 minutes*	6-12-2017
10	A	CEO	18 minutes	15-01-2018

**Table 8: Overview of the planned interviews and contacts for this research.**

\*The interview has not been recorded due to a technical problem. Based on extensive annotations a detailed report has been compiled. This report is used for the analysis of the interview, instead of the transcription.

## Appendix II: Interview guidance semi-structured interview

### INTERVIEW GUIDANCE semi-structured interview

- Is het toegestaan om dit interview op te nemen en te gebruiken voor mijn masterthesis?
- Voorstellen (wederzijds)
  - Naam
  - Uw functie binnen het bedrijf
  - leeftijd bedrijf
  - sector
- Aantal vestigingen
- **Hoe ziet het werkproces eruit van het openen van vestigingen, kunt u dit beschrijven van A-Z?**
  - Rol van geografische informatie?
    - Rol van demografische gegevens?
    - Rol van INWONERGEGEVENS:
    - Rol van HUISHOUDENS:
    - Rol van BEREIKBAARHEID?
    - Rol van GEBOUWEN in de buurt?
  - Weten jullie welke geografische informatie software / tool er is?
  - Rol van geografische informatie software?
    - analyses (software)
    - interpretatie (kaarten? analyses?)
    - conclusies?
  - Meerwaarde van het gebruik van geografische informatie software?
  - Voldoende kennis voor gewenste GIS resultaat?
- Hoe verantwoordt u uw vestigingsplaats keuzes aan uw leidinggevende?
  - rapporten,
  - (dynamische) kaarten,
  - modellen,
  - pdf / powerpoint(presentaties)

### **Tot slot:**

- Bedankt - eind februari kunt u uitkomsten van onderzoek op de mail verwachten.



## Appendix III: Information and participation master thesis

### LINKEDIN ALGEMEEN (om te delen)

Beste netwerk,

Momenteel ben ik bezig met mijn master Geographical Information Management and Applications (GIMA) aan de Universiteit Utrecht. Daarvoor ben ik binnen Geodan een interessant onderzoek aan het schrijven, waarvoor ik op zoek ben naar ondernemingen die naast hun bestaande (eerste) vestiging een nieuwe vestiging hebben geopend (of willen openen). Ik zou graag een interview van maximaal een half uur willen afnemen met het doel om te achterhalen of jullie bij deze vestigingsplaatskeuze geografische factoren hebben gebruikt of gaan gebruiken. Voor het interview is geen voorbereiding nodig. Hieronder een korte beschrijving van het onderzoek:

Bij de verantwoording van uw vestigingsplaatskeuze is de afstemming tussen strategie van uw bedrijf, geografische factoren en operationele processen belangrijk. Geografische factoren kunnen assisteren bij het maken van de juiste vestigingsplaatskeuze, om op deze manier een duidelijke en objectieve verantwoording te kunnen afleggen aan het management. Wanneer deze afstemming niet helder is kan dit leiden tot sub-optimale locatiekeuzes. Het doel van dit onderzoek is dan ook om duidelijkheid te krijgen in hoeverre geografische factoren een rol spelen bij het maken van uw keuzes rondom vestigingsbeleid.

De voorkeur is om de interviews af te nemen vanaf nu tot eind november. De resultaten worden uiteraard als eerste gedeeld met u als deelnemer.

Bent u de juiste persoon, of kent u iemand die mij zou kunnen helpen? Ik hoor het graag!

Met vriendelijke groet,  
Mark Bickel  
06-33810889

mark.bickel@geodan.nl

## Appendix IV: Code tree

Categories	Codes	Definitions	Examples (Quotations)
<b>Limiting factors for use of GIS: data</b>	Processing subjective data	The level to which GIS is able to process subjective data	<p>(D) We are also taking sentiment into account, based on that feeling we take decisions. Unfortunately, there is no formula to process sentiment, but luckily we are allowed to use or gut-feeling.</p> <p>(V) Purely objective data and hard figures are not sufficient. Based on that kind of information you can only justify the hard and technical side of a certain problem.</p>
	Availability of data	To what extent a company has access to the right data	<p>(D) We are also trying to gain insight in data of our competitors. We zoom out to a macro-level and try to determine what the best site selection location might be, with respect to our competitors.</p> <p>(an automotive company) The sales potential is estimated on the basis of national and regional customer data and sales figures. But, to really make a good overview of the sales potential we need local customer data and sales figures.</p> <p>(B) Yes, the data we have a kind of available. However, I am not sure about the file format and what kind of data is available.</p>
	Lack of Awareness: data	The awareness about data existence.	<p>(A) No, other factors concerning site selection did not play a role in our location decision. I did simply did not think about the density of airports in the neighbourhood. However, afterwards it is an important factor concerning accessibility.</p>
<b>Limiting factors for use of GIS: alternative method</b>	Alternative system / no system	Companies are using non-GI related systems	<p>(B) The tables with revenue are by far the most important factor and displaying is not important, that is just a matter of layout. We can</p>

			reproduce it in Google Maps for instance.
	A1 locations	Just using an existing static map	(M) If I am being honest, in our company, we are acting pretty elementary with concern to the location decision making process. There are companies, who are doing a thorough study on site selection. However, we are just focussing at the all-ready determined A1 locations (as we call it). These locations have the highest footfall and that is the place to be for us. In general, we do not deviate from that, even when another place is cheaper. Eventually we are probably regretting the cheaper location. We need to locate our stores at the very best location.
<b>Limiting factors for use of GIS: company</b>	Strategy	Companies choose locations based on other strategies	<p>(E) We did not use GI, but we went to our human connections to help us search for the best location.</p> <p>(J) We are simply looking to capital cities throughout the Netherlands and when a nice building crosses my path, it will be deliberated with the board and then we will decide. It is all about human connections, that is how I found our latest establishment.</p> <p>(M) I know about the GIS knowledge you can buy or hire. However, I did not really investigate that opportunities, because it became clear that it was not wat my company wanted.</p> <p>(L) When expanding to a new establishment, a whole facility department is going to interfere. Off course we have our specific method</p>

			for calculating how many square meter we want versus the costs per square meter.
	Costs/invest-ments	Implementing a GIS is seen as an expensive method	<p>(B) The financial aspect of using GIS is really important. Last year a GIS consultancy company advised us on maximizing our revenue, by means of using a GIS application. However, the application was expensive and there were no clear prognoses about maximizing the revenue versus the costs we needed to pay.</p> <p>(J) I think GIS can play an important role in selecting the most suitable site, and in some way it is also important for us. Nevertheless, it is not worth the financial and time investment of our company. The way we are selecting our new location at the moment is really effective as it turns out.</p>
	Lack of knowledge: GIS	Before using GIS, it is important to know that multiple GIS exists and what their capabilities are.	<p>(B) We actually do not really know how to use GIS and what kind of GIS analyses are available. That is why we need help for, but unfortunately we did not find suitable help. I do not have the right knowledge, and honestly, I am wondering if it is possible that we can extend our model, with competitor analysis and so on. We really would like to keep our basic model and make it more flexible by adding factors if that is possible.</p> <p>(B) I do not have the knowledge, but I know GIS exists. However, I am wondering if it is possible to implement all factors in to a GIS.</p>
	Occasional usage of GIS	How often makes a company really makes use of GIS.	(L): travelling time from our potential new establishment to the railway station, the amount of parking spots in the area is all important information, when we buy a property. That are all things we want to know, and we could do it

			<p>ourselves. However, partially we do not have the GIS knowledge about how to analyse all features.</p> <p>Moreover, it is incidental work, so we do not think it is worthwhile investing in GIS.</p>
<b>Encouraging factors for use of GIS: data</b>	Processing objective data	GIS is able to process different types of objective data	<p>(D) We are searching for locations where our potential customers are habitat. That is a specific target audience and therefore, we need to focus on the top-20 biggest cities within the Netherlands. We are establishing on sites which are positioned as close as possible to our potential customers.</p>
	Up-to-date	To respond quickly to market developments, you need accurate and up-to-date data.	<p>(L) Because we are offering a product with an extremely variable demand, we need up-to-date information on the demand. We are not location bound with our teachers, so we are able to divert our courses to locations where were not active yet.</p> <p>(D) More important is that we can help our customers and the users of our products at any place and any moment in time. Therefore, we must be able to provide our customers with up-to-date information about our nearest establishment which has a new product in stock, if necessary.</p> <p>(an automotive company) The boundaries of the target area are changing several times in each quarter. It would be nice to visualize, change and update these borders on an interactive map.</p>
	Increase number of factors	Add new factors to their current analyses	<p>(B) We preferably have a list with options we can check. Then I would like to see the ideal location with maximal revenue potential, with the checked boxes (different factors) in mind. However, at the moment, I am</p>

			<p>only able to check one postal code at the time and the only response I get is, the estimated amount of revenue at one certain location. I am not able to compare multiple locations or regions and I also cannot add different factors. For example, it does not become clear how location A potentially affects the revenue of location B, because customers who originally were going to location A. However, if the revenue of an additional establishment is still positive, it might be worth opening a new establishment.</p>
<p><b>Encouraging factors for use of GIS: output</b></p>	<p><b>Practical reporting</b></p>	<p>Figures and facts which support a written report.</p>	<p>(M) Every Monday I have a meeting with the president of our company. He is the one making the calls and I need to convince him in a one to one conversation. I do not need to get up and give a top of the line presentation. However, I need to convince him of my story. Therefore, I am presenting just simple facts and figures, which I am supporting with tables, maps and the sentiment I am having on that specific location</p> <p>(an automotive company) To enrich the mailings to our customers with location information about the nearest dealer or service point. This would especially be of great added value when a recall of a certain car type occurs.</p>

	Generating general <b>overview</b>	A simple map with one attribute to create a clear overview of the situation, for instance a heat-map.	<p>(E) It appeared that the prices were much higher, when the buildings were situated closer to the city centre of Amsterdam.</p> <p>(L) We are making a heat-map of our students through time. Every year we are simply point out where our students come from and when we manually overlay these layers, we see the hotspots of our students through the years.</p> <p>(an automotive company) At the end of every year a discussion about the predicted objectives takes place between al dealers. Geographical insight in the composition of the dealers in each area could certainly enhance the discussion.</p> <p>(A) Yes, we mapped all customers, and 80 percent was within a range of 75-80 kilometres around Zell am See Kaprun. That was a nice underpinning of my feeling. Now, I am able to drive to all customers within 2,5 hours.</p>
	Visual <b>analysis</b>	Analysis done with a map as result, for instance an isochrone map	<p>(D) We have decided that we want to establish in a certain city Therefore, we want a range which is as wide as possible for 10, 20 and 30 minutes of travelling. Therefore, we make a isochrone map, in which we incorporate rush-hour, the costs of the buildings, natural barriers, and locations no one wants to come, according to our own sources. Our own sources are our employees who live throughout the Netherlands and can give us information about certain parts of cities and municipalities, which we then further investigate.</p> <p>(an automotive company) By making use of an isochrone map the</p>

			potential service area of the company becomes much more clear. It could give a clear overview of the potential needs concerning establishments.
	Sharing dataset	Geodatabases easily can be exchanged between companies	(B) At the moment, the sharing of the findings of a dataset is simply over by mail. However, when a final decision has been made, the management, the franchiser and I come together and discuss the particular outcome. Afterwards, the outcome is shared again by mail...
	Buy GIS analyses output	When a company buys external GIS output or knowledge	(S) I am really curious if companies within the retail sector themselves are doing GIS analyses. Many real estate agents are using Locatus. Locatus and the real estate agents are giving the data to their customers (retail companies). We do not need the system of Locatus, we are sophisticated. Certainly, when I look around, all international, but also national retailers who I speak a lot. They are all way less sophisticated with GIS. They are only looking at: What is the big city, and they are not into analysing the geographical information, such as we do. They only look: What are the main shopping streets... That is where we need to establish.
<b>Encouraging factors for use of GIS: company</b>	Growing companies	Growing companies are more likely to invest in GIS	<p>(L) This year we have 14 establishments. Next year it is the ambition to be situated in 20 establishments.</p> <p>(B) Yes, together with the entire market we are growing rapidly</p> <p>(M) Yes, in three countries we have over 200 establishments. The goal for the coming years is to add 60 to 70 establishments to our real estate portfolio in the Netherlands,</p>



			Germany and Austria. Particularly in Germany
	Maximizing revenue	GIS can determine which place has the highest turnover	<p>(E) with our new services we are questioning ourselves if it is necessary to open a new establishment in Rotterdam. Or, maybe we can expand our services to Rotterdam from our location in Utrecht....</p> <p>(L) Are we located at the best possible locations? How long are people prepared to travel for our courses? Maybe we should raise our prices and establish ourselves on more locations? Maybe we should lower our prices, and let people travel longer for a course? Where is the breakeven point? It pointed out, that people in Zwolle are prepared to travel at least 30 to 60 minutes. That knowledge has strengthened our proposition concerning the offering of every single course at every single location.</p>
	Knowledge about GIS	If you know about the existence and capabilities of GIS, you can buy a GIS or hire a GIS company	<p>(S): We have around 150 IT people within our company. They are making applications, websites, maps, etcetera. They are also making the heatmaps with a programm called tableau reader. Those ITers are putting everything in queries, a kind of database, which I can download on my device and display with a sort of Google Maps. In that specific application with the right layers, I have a clear overview of all our competitors.</p> <p>(M) I know about the GIS knowledge you can buy or hire. However, I did not really investigate that opportunities, because it became clear that it was not wat mu company wanted.</p> <p>(J) I know a lot of companies who deliver some kind of GIS service.</p>

			<p>However, I do not think this is really interesting for every company. Some companies simply do not use it. At least, I know we do not.</p> <p>(B) I do not have the knowledge, but I know GIS exists. However, I am wondering if it is possible to implement all factors in to a GIS.</p>
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## **Appendix V: Transcriptions interviews**

The interview transcriptions contain 75 pages of text. This does not mean it is not important for this thesis research. Therefore, an USB flash drive is attached containing a Word file and a PDF version of the transcriptions of the interviews.