Analyzing the Bicycle Parking Choice: An Investigation of Two Distinct Locations in Enschede, Netherlands
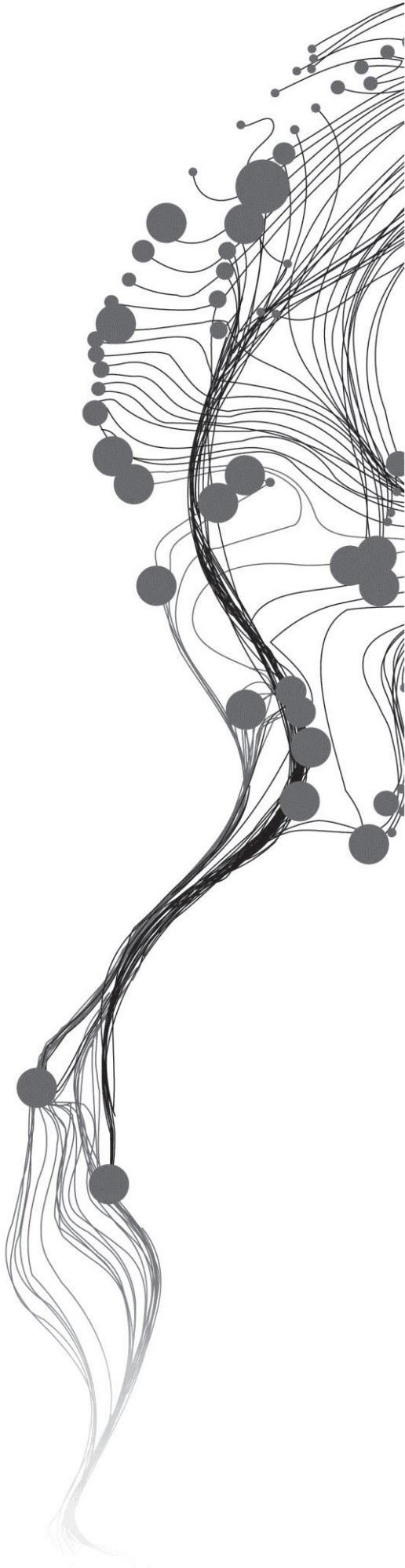
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ABSTRACT

Bicycle parking facilities are considered as an important element in encouraging bicycle usage in countries like Netherlands where 27% of all trips are made by bicycle. These facilities, on the other hand serve another function: as a regulator for organizing the chaotic bicycle parking situation particularly in vicinity of destinations like train station and city centre. With the high rate of bicycle usage, the problem of randomly parked bicycles has become a national concern in Netherlands. The problem of bicycle parking is mainly addressed by provision of more bicycle parking spaces, whereas the behaviour of bicyclists as the main users of parking facilities is underestimated.

This research with the main focus on the behaviour of bicyclists in choice of parking location, aims at providing detailed insight about the bicycle parking habits as well as presenting the bicyclists' perspectives about the future bicycle parking facilities.

The research first, identifies the problematic bicycle parking locations in Enschede city centre, by conducting several interviews with experts who directly or indirectly affect the decision making and planning procedure of bicycle parking facilities. In this study train station and the Van Heekplein are identified as the most problematic bicycle parking locations in Enschede, Netherlands.

Investigating the choice of bicycle parking in problematic locations is the most significant part of this study. The required data are collected through a survey which covers a broad array of relevant questions about the bicycle parking. The obtained data are statistically analysed to provide knowledge about the current bicycle parking situation. Individual characteristics of bicycle parking users (age, gender, and living neighbourhood) are extracted from collected data as well as the parking habits (parking frequency, parking duration, time of bicycle parking and pick up, and trip purpose). In addition, determinants of bicycle parking location choice (influential factors which determine the choice) are identified through running a statistical significance test. Bicycle parking choice factors and their relative importance in bicyclists' point of view also analysed and presented.

The results revealed that generally bicyclists would prefer to avoid the cost of bicycle parking and park their bikes as close as possible to the destination. Meanwhile, a distinct difference observed between the choice of bicycle parking in reality and what they generally bicyclists prefer. Besides, the supervised parking facility in train station is not utilized considerably because of the high parking cost and unsuitability of parking opening hours. Surprisingly, gender and parking frequency do not affect the choice of bicycle parking location. In addition, factors like not obstructing others in their movements, following other parked bicycles, and avoiding the bicycle mess are rated as 'not important' by bicyclists in choice of parking location. Comprehensive analysis of parking facilities users on the other hand indicates that there is a high demand for free, secure, and organized parking spaces in vicinity of current parking facilities.

The findings of the research could be utilized by local authorities for further developments or policy interventions in bicycle parking situation.

Keywords: Parking facilities, bicycle parking, parking choice, hotspots of bicycle parking, parking choice analysis, bicyclists

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1. RESEARCH PROPOSAL

1.1. Introduction

The bicycle is regarded as an environmentally friendly, cheap, space-efficient, and fast mode within the transportation system. Moreover, this mode has important advantages for society such as: improvement in public health and affordable infrastructure requirements (Heinen et al., 2009). Countries around the world developed a wide range of guidelines, programs, and policies like marketing campaigns, provision of infrastructure, awareness raising, and training for promoting cycling. For instance a recent research by Pucher et al. (2010) explored the role of bicycle infrastructure, bicycle parking facilities, integration of bicycle with public transport, and legal interventions in promoting bicycle usage in an international scope.

Netherlands is a country with a great reputation in cycling. The natural conditions of this country provide the opportunity for promoting cycling as one of the non-motorized transport modes. Regarding the fact that more than 27% of all trips in Netherlands are made by bicycle (Pucher and Dijkstra, 2000), this country has the highest rate of cycling between developed countries (Martens, 2007). Although cycling has become the most popular mode of transport in distances up to 7.5 km, there are barriers such as vandalism and fear of theft against bicycle usage (Ministerie van Verkeer en Waterstaat, 2007).

Provision of bicycle parking facilities for stimulating bicycle usage is of crucial specifically in cities with a high rate of bicycle usage for advocating parking policy. Besides, these facilities could encourage bicycle use (Moskovitz and Wheeler, 2011). On the other hand in Netherlands bike-and-ride could be promoted significantly through the provision of attractive and sufficient bicycle parking facilities according to Martens (2007). On the contrary inadequate bicycle parking facilities are regarded as a major constraint for bicycle use according to the stated preference surveys (Krizek, 2006). While these statements mainly justify the role of bicycle parking facilities as a stimulator for bicycle usage, these facilities also serve another function. According to Celis et al. (2008) *'bicycle parking could contribute positively to the aesthetics of townscape and urban environment'* . In this perspective bicycle parking facilities are regarded as a solution for managing the huge number of bikes which are parked inappropriately and regarded as a nuisance for pedestrians, other bicycles, and emergency services.

The proposed solutions for organizing the bicycle parking situation generally give more weight to provision of transport infrastructure. Although improving the infrastructure play an important role in providing sufficient and efficient bicycle parking spaces, cyclists continue to park their bicycles in locations other than allocated facilities. Creating more bicycle parking spaces without considering the demands and needs of cyclists will not address bicycle parking problems entirely.

1.2. Research Problem

With an increased rate of bicycle usage in Netherlands, provision of parking facilities is a crucial part of transport planning. In comparison with other modes of transportation, Netherlands has given a substantial role to the non-motorized modes (Rietveld and Daniel, 2004).

During the last decades a wide range of studies and surveys has been conducted such as: Fietsplan (Gemeente Tilburg, 2005), Meerjarenbeleidsplan Fiets (Gemeente Amsterdam, 2012), Fietsparkeren in Nederlandse gemeenten (Borgman, 2010), and evaluation of parking facilities in Eindhoven, Utrecht and Groningen to investigate the bicycle parking problems and shortcomings. Moreover, lots of projects like provision of guarded bicycle parking facility at secondary schools Den Haag (Voerknecht et al., 2009), and

Room for the bicycle (Fiets Beraad, 2003) have been implemented and evaluated in order to address bicycle parking demand.

One of the problematic aspects of bicycle parking issue is inappropriate bicycle parking. This refers to a general phenomenon in which cyclist park their bicycles neither at guarded parking facilities nor at bicycles stands, but in other places. According to Hossain et al. (2003) and Fujii (2005) several problems are engaged with inappropriate or informal bicycle parking that are categorized as follows:

- Aesthetic problems in different locations,
- Negative effect on perceived level of service (LOS) and safety by pedestrians and disabled people,
- Removal of inappropriately parked bicycles costs a huge amount of money for authorities,
- *'Preventing the smooth flow of pedestrian traffic', and*
- *'Preventing the flow of other bicycle traffic'.*

Furthermore, business owners face difficulties with a considerable number of bikes that are parked in front of their stores. These bicycles on the other hand would affect accessibility particularly for emergency services like police and ambulance. At weekends and during festivals when lots of people come to central part of the city for shopping or leisure activities, the problem of inappropriate bicycle parking becomes worse.

In Netherlands, inappropriate bicycle parking problem has been addressed mainly through policy interventions. These policies mainly include: provision of more bicycle parking spaces, orphan bicycles removal, and installing specific signs. Although these policies play an important role in addressing inappropriate bicycle parking problem, cyclists continue to park their bicycles in locations other than parking facilities. The fact that increasing the capacity will not address the bicycle parking problem entirely will draw attention to other aspects of the problem. While too much attention has been paid to supply side of bicycle parking (provision of bicycle parking facilities), demands and needs of bicyclists are overestimated. As a result, more careful and close attention is required in demand side of bicycle parking planning.

According to the aforementioned discussions and the lack of knowledge about the role of behaviour in bicycle parking facilities the main problem of this research is to incorporate bicycle parking choice behaviour in analysing the bicycle parking situation.

1.3.   Research Objectives

The main aim of this research is to analyse bicycle parking choice behaviour in order to provide a detailed overview about the current bicycle parking situation and propose possible interventions. Based on the key aim, three objectives are formulated. The first one aims at exploring the bicycle parking hotspots in Enschede city centre area, while the second objective focuses on investigating the bicycle parking choice behaviour in problematic locations. Finally, the third objective aims at providing alternative interventions based on the two other objectives.

Objectives:
1. To identify the problematic bicycle parking locations and their characteristics,
2. To explore bicycle parking choice behavior and the influential choice factors in problematic locations, and
3. To propose possible interventions based on the investigated bicycle parking choice behavior.

1.4. Research Questions

To identify problematic bicycle parking locations and their characteristics

- Where are the hotspots of bicycle parking in Enschede city center area?
- What are the characteristics of problematic locations?
- What kinds of problems these locations are confronting with?

To explore the bicycle parking choice behaviour and the influential choice factors in problematic locations

- Where do bicyclists park their bicycles?
- What are the individual characteristics of bicyclists?
- What are the trip purposes?
- How the choice of bicycle parking location varies based on the time of day and week?
- Is there a relationship between the choice of bicycle parking location and choice factors?

To propose possible interventions based on the investigated bicycle parking choice behaviour

- Where are the most potential locations for new parking facilities?
- What kinds of parking facilities are most favored?
- Which factors are perceived important by bicyclists in choice of bicycle parking location?
- How do bicyclists perceive the bicycle parking situation?

1.5. Conceptual Framework

Figure 1 presents the conceptual framework of this research. The main concepts and the relationship between them are studied during the research period. Bicycle parking choice behaviour as the main concept of this research is examined based on the individual characteristics of bicyclists and parking location features (location based variables). Studying these variables will give wider perspective about the current situation of bicycle parking in Enschede city centre area and provide details for future interventions.
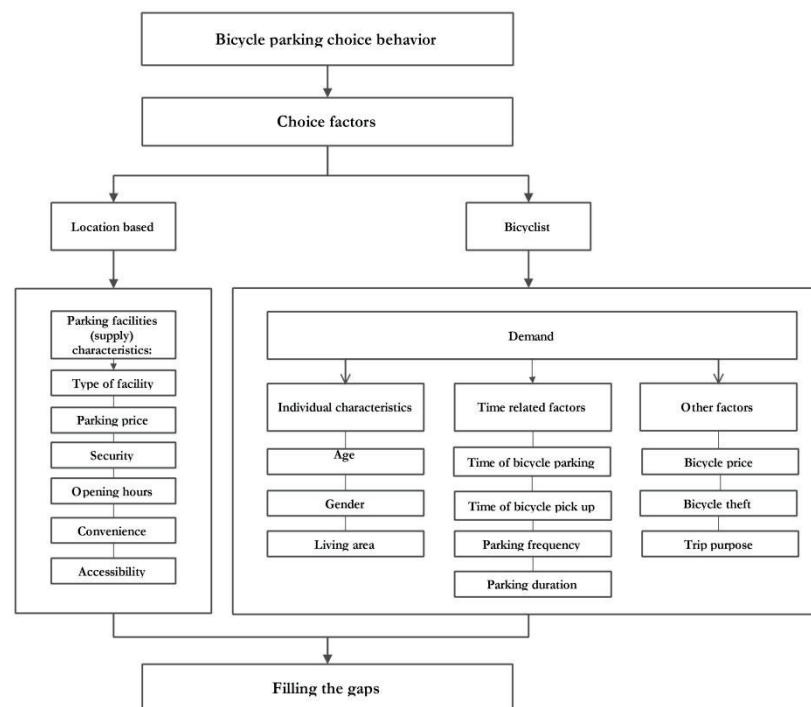
Figure 1: Conceptual framework

1.6.   Research Design

1.6.1.   Data Collection Methods and Approaches

Based on the purpose of the research, data collection methods vary. Data acquisition is required based on the research questions. In this research, data acquisition methods are classified as follows:

- Identification of bicycle parking hotspots: Several interviews are conducted with experts who play an important role in planning and decision making process of bicycle parking facilities.
- Investigating the bicycle parking choice behavior: a survey is designed and distributed in order to examine bicycle parking choice behavior.

1.6.2.   Research Methods

The data which are collected from parking choice behaviour survey are analysed in next step to describe bicycle parking choice behaviour. The captured data are utilized as an input for data processing phase. Statistical analysis is carried out on the collected data in order to address the research questions.

1.6.3.   Research Framework

The proposed procedure of research is illustrated by Figure 2.
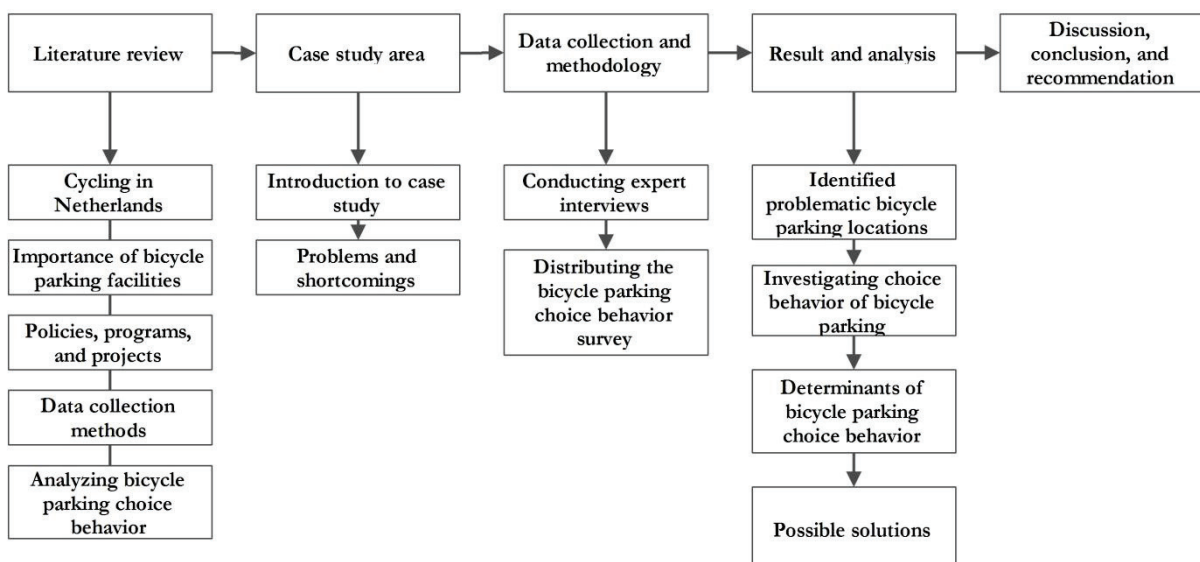
Figure 2: Research process

2. Literature REVIEW

This chapter explores the relevant and scientific knowledge on bicycle parking facilities. First a short background is provided about the cycling in Netherlands. Then bicycle parking facilities are discussed from several aspects. A number of researches with focus on the bicycle parking choice behaviour are presented following up by data collection methods for bicycle parking facilities. This chapter provides a theoretical background for addressing the research objectives, based on the previous works which are done in this subject.

2.1. Cycling in Netherlands

A detailed document published by Fietsberaad (Voerknecht et al., 2009) outlined different aspects of bicycle as a transport mode in the Netherlands where there are 16 million bicycles and more than 20% of all trips are made by bicycle. There are several influential factors which motivate the bicycle usage in this country. Morphological conditions facilitate the cycling and cultural background plays an important role in use of bicycle. In addition, short distances in compact Dutch cities could be covered by bicycle easily.

Bicycle usage is not limited to a certain age or social group, although high income groups are somehow less likely to ride a bike in comparison with lower income groups. The share of bicycle usage based on the various motives shows that, this mode of transport is highly utilized for educational scope. Moreover, the share of bicycle is considerable when the purpose of trip is shopping or socio cultural activities. The use of bicycle varies in different cities. For instance the use of bicycle in Zwolle and Groningen is considerably higher than cities like Rotterdam and Heerlen.

2.2. Bicycle Parking Policies in Netherlands

A set of guidelines and instructions provides planners and designers with useful information about the implementation, maintenance, and setting up good bicycle parking policies(Voerknecht et al., 2009). These kinds of instructions contain policy-oriented information, as well as practical information (costs, demand estimation, and technical aspects).

Generally, municipalities are responsible for managing and organizing the bicycle parking situation. A considerable number of municipalities provide guarded bicycle parking facilities at city centres in order to overcome the problem of inappropriately parked bicycles (Voerknecht et al., 2009).

In a study which was conducted by D. Ligtermoet (2009), ten cities with a relatively high rate of bicycle usage were studied. The problem of bicycle parking has been addressed through the following policies, programs and projects in different cities:

- Rolling Red carpets for preventing cyclists from parking in inappropriate locations (Groningen),
- Provision of free guarded parking facilities (Groningen, Zwolle, Munster, Veenendaal, Enschede, Amsterdam, Odense, Ghent),
- Increasing the capacity of current bicycle parking facilities (Groningen, Veenendaal, Freiburg),
- Making existing bicycle parking free of charge (Zwolle),
- Improving the quality of current bicycle parking facilities (Zwolle),
- Installing more bicycle stands (Groningen, Veenendaal, Amsterdam, Ghent),
- Introducing regulations on prohibition of parking and riding bicycles at certain locations like town centers and business districts (Veenendaal, Freiburg),
- Removal of abandoned bicycles (Copenhagen, Ghent),

- Provision of on-road bicycle parking spaces (Copenhagen),
- Converting car parking spaces to the bicycle parking facilities (Odense), and
- Use empty shops in the city center as temporal bicycle parking space (Breda).

2.3.   Role of Bicycle Parking in Bicycle Usage

In an international overview offered by Pucher et al. (2010) various interventions which affect the bicycle usage are discussed. Bicycle parking facilities as a part of cycling infrastructure are described and the role of these facilities in cycling level is reviewed. They conclude that according to the fact that studies related to the impact of parking facilities on bicycle usage are limited to a few cities it is difficult to generalize the results.

Wardman et al. (2007) on the other hand applied multivariate analysis to travel survey and concluded that bicycle parking facilities (outdoor, indoor, indoor with shower) do have a significant role in making a decision for cycling to work. In another study by Hunt and Abraham (2007) the significant impact of secure bicycle lockers in bicycle usage level at transport stations has been approved.

2.4.   Role of Bicycle Parking Facilities in Bike-and-Ride Trips

The bicycle usage in Netherlands was encouraged considerably by developing new bicycle paths in 1970s and 1980s (Martens, 2007), while the investment in the combined use of bicycle and public transport was limited in expansion of bicycle parking facilities in train stations (de la Bruhèze and Veraart, 1999). In 1990s when a barrage of criticism expressed against the Second Transport Structure Plan of the Ministry of Transport (Ministerie van Verkeer en Waterstaat, 1990), the Bicycle Master Plan (BMP) published in 1992 in order to formulate a broad bicycle policy (Martens, 2007). Table 1 shows the pilot projects that have been launched as a part of Bicycle Master Plan (BMP) for increasing the use of bike-and-ride in Netherlands. *'Bike –and-ride refers to the combined use of the bicycle and public transport for one trip'* (Martens, 2004). Besides, it is an alternative for replacing private car (Hine and Scott, 2000). The initial impetus behind the bike-and-ride comes from the idea of making transportation stops more accessible for trip makers (Martens, 2007).

It could be seen that provision of bicycle parking facilities both at train stations and bus stops could play a role in promoting bike-and-ride use. Out of 24 projects which aimed at increasing the combined use of bicycle and public transport, the main focus of 10 projects was on the bicycle parking facilities (The projects are shown in italics).

Type of project	Focus of project
Research projects	Potential of combined public transport and bicycle trips
	Comparison of travel times by car versus bike-and-ride
	Impacts of the introduction of student travel pass
	Compact automated bicycle parking at train stations
	Role of the bicycle for bus, tram and metro
	Criteria concerning the provision of bicycle parking at rural bus stops
	Feasibility of bicycle lease
	New concepts for rental bicycles at train stations
Pilot projects	Experiment travel chain train and bicycle
	Bicycle lockers for infrequent use at train stations
	Automatic entrance control for guarded bicycle parking facilities
	Unguarded bicycle parking facilities in Leiden

	Bike-and-bus on corridor Enschede-Oldenzaal
	Bicycle parking at bus stops in the province of Utrecht
	Bicycle parking at bus stops around the city of Leeuwarden
	Bicycle parking at bus stops in the province of Noord-Brabant
	Bicycle ferry Rhoon-Oud-Beijerland
	Public transport and bicycle lease in Rotterdam
	Express bus and bicycle lease in Friesland
	Interbike: express bus and bicycle lease
	Train and flexible bicycle rental along the River Maas
Development of instruments	*Bicycle parking policy for train stations*
	Bicycle parking at bus stations

Table 1: List of bike-and-ride projects carried out as part of the Bicycle Master Plan (BMP)
Source 1: Ministerie van Verkeer en Waterstaat (1997)

2.4.1. Promoting Bike-and-Ride in the Combined Use of Bicycle and Train

In 1992, when students introduced by a free public transport pass, bicycle parking facilities at train stations started to confronting quality, quantity, and accessibility problems (Naegele et al., 1992). In order to cope with these issues, the Dutch Railway company launched a program for increasing the number of bicycle parking spaces at train stations during 1993-1997 according to Martens (2007).

The aforementioned project provided 30000 bicycle parking spaces within two years (Ligtermoet and Welleman, 1997). Another program for promoting the bicycle parking facilities at 380 train stations in Netherlands was 'Room for the Bicycle' ('Ruimte voor de Fiets') (Martens, 2007). Dutch Organization for Public Transport Passengers and the Dutch Cyclist Association suggested set of guidelines about the quality and quantity of bicycle parking facilities, containing the following principles (Leeuw, 1998; Ministerie van Verkeer en Waterstaat, 1998):

- *'Bicycle parking places are available for regular and incidental train travelers;*
- *A mix of secure (guarded parking and bicycle lockers) and regular parking facilities is available at all*
- *stations;*
- *The maximum walking distance between secure parking facilities and the station entrance is 200 meter;*
- *Regular parking facilities should be visible from busy areas so as to reduce bicycle theft and vandalism'.*

After launching the program, the results of a survey at 5 train stations revealed that increasing the number of parking spaces, promoting the current bicycle parking facilities and walking paths toward platforms, increased the satisfaction of bike-and-ride users about bicycle parking facilities (Martens, 2007). They found out that, Improved bicycle parking facilities as a main impetus for using bicycle in access trips to train station and the increased number of bicycles parked at new bicycle parking facilities, are considered as two main indicators which showed the importance of upgraded bicycle parking facilities at train stations.

2.4.2. Promoting Bike-and-Ride in the Combined Use of Bicycle and Bus

According to Table 1, three pilot projects were launched for enhancing the combined use of bicycle and bus with the focus on improving bicycle parking facilities (Martens, 2007). The following will discuss the aforementioned projects:

1. Improving bicycle parking facilities at rural bus stops in the province of Brabant: Table 2 shows the results of promoting bicycle parking facilities in 7 bus stops in rural areas. According to the results, there has been an absolute growth in the number of bike-and-ride passengers at five bus stations.

Name of bus stop	Number of passengers			Number of bike-and-ride users		Growth in Bike-and-ride users (%)	Share of bike-and-ride users	
	Before	After	Growth (%)	Before	After		Before (%)	After (%)
Zevenbergen-Drie Hoefijzers	28	28	0	23	18	-18	82	65
Oosterhout-Europaweg	32	47	47	4	14	250	13	30
Oosterhout-Napoleonlaan	195	211	8	10	17	90	5	8
Oosterhout-Elkhuizenlaan	127	123	-3	14	27	80	11	22
Oosterhout-Busstation	409	647	58	168	220	35	41	34
Werkendam-Sleewijk	129	184	43	92	127	32	71	69
Raamsdonkveer-Busstation	448	478	7	211	196	-6	47	41
Total	1368	1718	26	520	618	20	38	36

Table 2: The impact of improving bicycle parking facilities in the number of passengers and bike-and-ride users in 7 bus stops
Source 2: (Janse and Van Bremen, 1995)

2. Another pilot project whit focus on upgrading the bicycle parking facilities at 15 bust stops adjacent to small towns, provided 51 bicycle lockers, 256 bicycle parking spaces at covered facilities, and 75 open parking places for bicycles (Martens, 2007). According to Noord (1995), there was no big difference for bike-and-ride users between choosing covered or uncovered bicycle parking facilities and the occupancy rate of both facilities were about 50%. The results also revealed that bicycle lockers were utilized infrequently because of high rental price and the low risk of bicycle theft at bus stops.

3. The third pilot project was initiated in Utrecht, aiming at promoting bicycle parking facilities along secondary roads according to Martens (2007). The result of small survey indicated that: provision of bicycle parking facilities could improve the use of bike-and-ride instead of car, bicycle, or public transport; besides, some indicated that they prefer the equipped bus stops (AGV, 1994).

Another project focused on promoting bike-and-ride between cities of Enschede and Oldenzaal by providing new facilities such as bicycle parking spaces according to (Martens, 2007). Bus passengers and bike-and-ride users increased by 25% after upgrading the facilities (Haskoning, 1995).

Another research by Martens (2004), investigated the bike-and-ride experience in UK, Netherlands, and Germany. Table 3 shows the purpose of trips made by bike-and-ride users in these countries. Since the main users of bike-and-ride trips are commuters and students, it is of importance to provide secure and appropriate bicycle parking facilities in train stations, bus stops, and metros (D. Taylor and Mahmassani, 1996).

Travel motive	Train			Bus		Metro	
	NL	GE	UK	NL	UK	NL	GE
Work (%)	40	64	66	21	45	33	49
Education (%)	30	14	12	51	7	22	32
Shopping (%)	6	14	1	10	31	19	11
Business (%)	3	-	4	1	0	4	-
Other (%)	21	9	17	18	17	22	7

Table 3: Trip purpose of bike-and-ride users for Netherlands, Germany, and UK (access trips)
Source 3: Van Goeverden and Egeter (1993) for Netherlands; Bickelbacher (2001) for Germany; S. Taylor (1996) for the UK

2.5. Role of Bicycle Parking Facilities at Train Stations

A research conducted by Rietveld (2000) explored the role of bicycle in accessibility to train stations in Netherlands. They concluded that the low share of bicycle in access trips to train stations could be

explained by two main reasons: absence of bicycle at the activity-end trips and insufficient and inappropriate bicycle parking facilities. Secure and proper bicycle parking facilities should be provided by municipalities and railway organizations, and supply services should facilitate the activity-end trips which are made by bicycle, in order to address the above-mentioned problems (Rietveld, 2000).

Givoni andRietveld (2007) adopted Dutch Railways (NS) customer satisfaction survey for examining the 'capacity of car parks', 'quality of guarded and unguarded bicycle parking facilities', and 'quality of connections between the railway and public transport'. The results indicated that the quality of access infrastructure was perceived between sufficient and insufficient by customers. While the choice of traveling by train was influenced by price, perception of access mode and railway station environment. Access mode perception was the function of car parking availability, connection with public transport, and the quality of guarded and unguarded bicycle parking facilities (Givoni and Rietveld, 2007). Researchers estimated the impact of access/exit trip quality on the final customer satisfaction; Table 4 shows the regression model estimated for bicycle as an access mode to train stations.

They come up with the following result: when bicycle was the access mode to train stations, bicycle parking facilities were not perceived very important by bicyclists. It could be explained by the bicycle parking situation in the vicinity of train stations where there is a high demand for bicycle parking spaces and this demand usually accommodates by provision of remote bicycle parking facilities which are not attractive for bicycle parking users anymore (Givoni and Rietveld, 2007). They finally concluded that bicyclists who used proper bicycle parking facilities did not consider it in their final evaluation, as same as those who experienced low quality bicycle parking situations because of the aforementioned discussion.

	Coefficient	*t*	Sig.
Model: Bicycle as an access mode; facility: guarded and unguarded bicycle parking facilities			
Intercept	4.042	11.311	0.000
Price/quality	0.248	6.738	0.000
Station in general	0.188	3.660	0.000
Bicycle parking (guarded)	0.011	0.315	0.753
Bicycle parking (unguarded)	0.007	0.213	0.831
R^2: 0.240; *N*=226			

Table 4: Results of regression model for passengers' satisfaction
Source 4: (Givoni and Rietveld, 2007)

2.6.   Analysis of Bicycle Parking Choice

Very few studies are conducted, in order to investigate or analyse the bicycle parking choice behaviour. These researches are carried out in Dutch or Japanese context where the bicycle usage is high. The following provides an overview about these studies:

In a research conducted by Fietsberaad (2008) two main objectives were defined. The first one was to increase the capacity of unguarded bicycle parking facilities, while the second aim focused on reducing the nuisance of inappropriately parked bicycles. This research was conducted in train station area of four medium sized cities (Leiden, Eindhoven, Haarlem, and Nijmegen) in Netherlands. They applied counting and observation methods in order to address the research objectives and explore the behaviour of bicyclists in choice of parking location. They concluded that supervised parking fees should be decreased in order to increase the utilization rate of these facilities. Moreover, results revealed that orphan bicycles should be removed based on a short and regular basis; as a result, there will be more parking spaces available for bicyclists. Finally, they suggested that less well-located parking facilities should be promoted by modifying the parking behaviour. These modifications include: updating the bicyclists with information related to availability of parking space or removing orphan bicycles to less used parking facilities.

In another study which is carried out in Dutch context, Maat andLouw (2013) explored the bicycle parking choice behaviour in Delft train station area. They concluded that guarded bicycle sheds and high quality parking locations are mostly utilized by daily commuters, while students prefer to not pay for parking facilities. Besides, presence of guarded parking facility plays an important role in choice between central and peripheral stations.

In a recent research conducted by Fukuda andMorichi (2007) illegal bicycle parking behaviour at train station areas in Tokyo metropolitan was analysed. They integrated bicycle parking behaviour (in micro level) into discrete choice model. The data were collected in an individual level by sending a mail-back survey. The questionnaire was consisted of three parts. The first part asked about the household characterises. In the second part respondents were asked to answer questions about the trip intention, walking time to train station, time of departure from home, frequency and duration of bicycle parking, and choice of bicycle parking location. The third module of the survey investigated the impact of two latent factors (attitude toward risk and public morality) on illegal bicycle parking behaviour. Empirical analysis showed that regular commuters are more likely to park their bicycles off-street because they are aware of the bicycle removal risk. This applies to duration of parking also. Moreover, two aforementioned latent factors play a significant role in choice of bicycle parking location. Bicyclists with a high public morality preferred parking in allocated locations and avoided the risk of bicycle removal.

Addressing the illegal bicycle parking through persuasive communication is a main object of the research by Fujii (2005). Persuasive communication tries to reduce the inappropriately parked bicycles through increasing the awareness about the consequences of this behaviour. They concluded that moral obligation, behavioural intention, and awareness about consequences will reduce the illegal bicycle parking in long term.

2.7. Data Collection Methods for Bicycle Parking Facilities

Literature does not provide a lot about bicycle parking facilities data collection methods and approaches. The majority of these data gatherings focus on estimating utilization rate of bicycle parking lots in university campuses and transport hubs. The data collection methods and the purpose to do so have been discussed in different case studies in the following paragraphs.

In order to increase the capacity of over utilized bicycle parking facilities and installing new bicycle racks in the Colorado university campus at Boulder, Tracy Calvin et al. (2009) evaluated the current situation of these facilities. They assessed the capacity and efficiency of bicycle parking facilities at building entrances in university campus and data collection method was based on counting the number of parked bicycles at racks as same as counting those bicycles that considered as 'errata'. Errata bicycles referred to those bikes that were not parked in racks and were locked to urban furniture. They mentioned that errata bicycles considered important when more than one bicycle was parked at a specific location other than bicycle parking facilities, because bicyclists perceived the location as suitable for parking bicycle or the demand for bicycle parking space was higher than supply. They counted the number of parked bicycle at racks and errata bicycles within 50 and 200 feet of the building entrances, since the effective distance for locating a new bicycle parking lot should be within 50 feet from building entryway according to The Victoria Transport Policy Institute (2013) and DERO Bike Rack Company (2013). They observed that 1403 bicycle parking spaces were located beyond the 200 feet from building entrances.

The final analysis indicated that:
- The utilization rate of bicycle parking facilities within a distance of 50 feet was not necessarily higher than those facilities which were located within 200 feet,

- The number of errata bicycles decreased in some building entrances within 200 feet distance when no parking facility was provided in entrance, and
- Seven entrances had no utilization rate within 50 fee distance, whereas the number of unused parking facilities decreased within 200 feet radius.

Another survey which estimated the utilization rate of bicycle parking facilities is a report published by university of Washington transportation services (University of Washington, 2013). They collect bicycle parking data annually in university campus in order to identify locations with a high demand for parking space and also record any unattended changes. University of Washington (2013) collected the data based on counting method on Thursday, May 30th, between 11 AM and 2 PM. For each location they counted the number of parked bicycles at racks and bicycle rooms. Bicycles which were locked to railings, light poles, or locations other than allocated facilities also counted in this survey. University of Washington (2013) mentioned that because bicycles which parked in lockers, offices, or hallways had not been counted, they conducted an online survey to evaluate the occupancy rate of lockers. The final report provided the following conclusions:

- The utilization rate of sheltered racks were much higher than uncovered racks, and
- The overall utilization rate of bicycle parking facilities estimated 45.2 percent.

Besides, they applied a methodology for identifying locations with a high demand for parking spaces which consisted of three methods: evaluation of parking facilities with 80 percentage or higher utilization rates, evaluation of parking facilities with 5 percentage or lower utilization rate, and considering the coordinators and bicycle users comments and ideas.

Paez andBaetz (2010) in another study applied the following methodology for estimating the utilization rate of short term bicycle parking in the university campus:

- The study area was split in to small zones, and
- The zones were observed once a week in a period of five weeks; each bicycle rack was monitored twice on each weekday for capturing peak hours.

The collected data were utilized to generate a number of maps showing : 'The number of bicycle racks per zone', 'Type of parking facilities', 'Utilization rate of bicycle parking facilities during morning and afternoon', 'Bicycle rack utilization rate', and 'Proposed bicycle rack locations'.

It should mention that data collection method which applied in this study realized several limitations according to Paez andBaetz (2010): the data were collected by one individual, as a result the number of parked bicycles were recorded in a 'time window' rather than in an exact time; the data were captured during November, when the bicycle usage was not high; and it was difficult to understand the reason of underutilization, since it could be seen as a result of low demand or lack of parking spaces. The authors proposed that further studies in the university campus could investigate the influential factors which affect the choice of bicycle parking location.

In a recent survey which was conducted by Rebecca Lehman et al. (2009) set of data about both formal and informal bicycle parking situation were collected through observation and counting methods over the period of six days for assessing the bicycle parking facilities at public transport interchanges. The findings revealed that supply was not addressing the demand; many poor bicycle parking facilities were observed during the survey; and the number of informal bicycle parking areas was high at interchanges based on the observations.

While the aforementioned studies were based mainly on the counting and observation methodology, in order to address the shortcomings of research and data bicycle parking field Moskovitz andWheeler (2011), introduced a new methodology for estimating bicycle parking facilities utilization rate. The proposed methodology takes advantage of digital photography for capturing parking related data such as arrival and departure times, parking duration, and turnover rates over a period of time. The researchers did not count the bicycles which were parked in locations other than bicycle racks. For collecting the data in a more efficient way Moskovitz andWheeler (2011) selected those racks that were located close enough to each other.

While the time series photography was realized as a robust method which did not need special training and excludes the need for counting, several shortcomings were identified like: eliminating the number of informally parked bicycles in analysis (Moskovitz and Wheeler, 2011). They also mentioned that this methodology is not able to capture the data for events which are shorter than photo interval.

Data collection for bicycle parking facilities is not limited to university campuses. Besides, data collection occurs in locations other than university campuses. In a study conducted by Hossain et al. (2003), the acceptable distance in which bicyclists would walk to bicycle parking lots was estimated in vicinity of a train station in the Japanese city of Saga. They collected the data for the number of inappropriately parked bicycles, utilization rate of current bicycle parking facilities, and the satisfaction level of bicycle parking lots through the following methods:

- The number of inappropriately parked bicycles: the number of parked bicycles in prohibited zone was counted between 06:00-19:00. Besides, the age, gender, parking duration, and trip purpose were investigated,
- The utilization rate of bicycle parking facilities: in order to estimate the utilization rate of bicycle parking facilities in train station area, based on 5, 10, and 30 minute time intervals a field survey was conducted by counting the number of in-coming and out-going bicycles in different parking lots, and
- Satisfaction level: a questionnaire was distributed.

In an interesting research Portland Bureau of Transportation (Portland Bureau of Transportation, 2010) asked volunteers to count the number of bicycles parked in the corral and the number of bicycles and racks in a close approximation (50 feet) of the corral during a 6 months period, in order to estimate the utilization rate of these facilities and investigate the demand trend. Participants were asked to carry out the counting in a same day and time of the week during 6 months for the specific corral and take a clear photograph of it in the peak hours. They also were asked to illustrate a diagram showing the place of parked bicycles and rack in the vicinity of the corral.

In a more general content, city of New York conducted an online survey during a 6 months period in order to discover the cycling trends in this city (City of New York, 2006).

2.7.1.   An Overview on Data Collection Methods

In a comprehensive research conducted by U.S. Department of Transportation, a case study approach was selected in order to overview the data collection methods that had been carried out for pedestrian and bicycle parking facilities (Schneider et al., 2005). According to Table 5, data collection methods were categorized in 3 main classes. Key findings refer to the positive and negative aspects of each data collection method.

The method		Description	Key findings
Quantifying use	Manual counts	Counting carried out by data collectors	Cost efficient when integrates with motor vehicle counts
			Highly accurate field observations
			Labour-intensive
	Automated counts	A special equipment did the counting	Adjusting the device should be done with the highest accuracy
			These devices are not capable of observing behaviour
			Cost efficient
			Capable of working in inappropriate climate
			These devices are prone to vandalism
			The majority of these technologies do not count all types of non-motorized users
Surveying users	Targeting non-motorized users	Survey is distributed to people in the filed	Capturing detailed characteristics of non-motorized trip makers
			A clever design of survey is needed in order to encourage people to participate
			Provision of baseline and follow-up data about non-motorized trip makers
			High cost of labour
	Sampling a general population	A random sample of people is selected by making phone calls or mailing	Represents the entire community
			A clever design of survey is needed in order to encourage people to participate
			Provision of baseline and follow-up data for the whole community
			Analysis and collection of data is labour-intensive
Documenting facility extent	Inventories	The information is collect by remote sensing techniques or extracted from secondary sources. The obtained data generally will be stored in databases	Trained data collectors are needed
			Before data collection all needs should be predicted
			Checking data for several times specially when it were collected by different collectors
	Spatial analyses	Mapping the facilities through software like GIS and CAD	Generally is used at site scale
			Detailed features could be shown very well
			Trained operator software is needed
			Could be applied for ADA and streetscape inventories

Table 5: Overview of data collection methods for bicycle parking facilities

2.8.   Conclusion

This chapter described the role of bicycle parking facilities as an important element in transport supply. On the one hand, these facilities do play an important role in encouraging bicycle usage, and promoting bike-and-ride trips in multimodal journeys. The importance of bicycle parking facilities in train stations and bus stops also was discussed. These studies mainly consider bicycle parking facilities as a regulator for meeting the demand of bicyclist in different locations. A limited number of studies explored bicycle parking choice behaviour. These literatures mainly focused on the bicyclists as the main users of parking facilities and paid attention to bicyclists rather than parking facilities. Since the primary focus of this research is on the bicyclist behaviour, these researches will be utilized later in discussion and conclusion part. Moreover, data collection methods were discussed. These discussions lead to addressing the research

objectives. Based on the different behaviour analysis and data collection methods a research methodology is formulated for analysing the bicycle parking choice in the research case study area.

3. CASE STUDY AREA: ENSCHEDE

Enschede the largest city of Overijssel province lies in the eastern part of Netherlands (Figure 3). With a relatively high rate of bicycle usage (D. Ligtermoet, 2009), Enschede is competing for the 'Netherlands best bicycle city' title in 2014.

Figure 3: Location of Ensched in Netherlands
Source 5: (Statistics Netherlands, 2014)

Bicycle is the most popular mode of transport in Enschede for trips between 1-2 Km according to Kleizen et al. (2011). The main justifications for cycling are: 'it is easy to find a free of charge parking space', 'good for the environment', 'cheaper than bus/car', 'flexible mode', 'having no other means of transport', and 'competiveness in time'.

The bicycle vision (Kleizen et al., 2011) is developed in recent years for encouraging and increasing bicycle usage in Enschede. Improvement of main bicycle routes along the main roads and developing bicycle network routes through the neighbourhoods are two main focus points of the bicycle vision. Furthermore, other variables such as providing social security, provision of bicycle parking facilities, and establishing communication could exert a powerful effect on bicycle usage rate.

3.1.   Place of Bicycle Parking in Bicycle Vision

The role of bicycle parking and its place in bicycle vision could be outlined as follows (Kleizen et al., 2011):

- **Bicycle Parking Policy in Enschede**

The bicycle parking is an essential part of traffic and transport policy. The main aim of bicycle parking policies is increasing the bicycle usage. Lack of parking facilities should not discourage the bicycle use at all. The municipality of Enschede on the other hand wishes to overcome current bicycle parking bottlenecks such as orphan bicycles and inappropriately parked bicycles in short term.

- ### Importance of Bicycle Parking Facilities

Provision of bicycle parking facilities is of great importance for encouraging bicycle usage. For example particular attention has been paid to facilitation of cycling as part of mobility chain by provision of bicycle parking facilities at bus stops (Park-and-Ride). Besides, these facilities could reduce the nuisance of inappropriately parked bicycles. As a result, considerable attention should be devoted to current and future bicycle parking facilities.

- ### Orphan Bicycles

Although provision of parking facilities plays an important role in improving bicycle usage, these facilities need to be maintained and organized regularly. Removing the so called orphan bicycles could increase the parking capacity and reduce the bicycle theft, since it is easier for bicycle thieves to pick up a bike in an unorganized and messy situation. Orphan bicycles are those bicycles which are abandoned by the owners. A three year project has been implemented for organizing the abandoned bicycles situation in parking facilities at train station. The initial results are successful and promising.

- ### Bicycle Theft

Majority of bicycle thefts occur in central district of the city. Regarding the fact that bicyclists prefer to park their bikes in a safe environment, municipality of Enschede tries to prevent bicycle theft by providing guarded bicycle parking facilities. Moreover, neat and well organized parking spaces reduce the risk of theft.

- ### Quality of Bicycle Parking Facilities

The bicycle vision explains that bicycle racks in the train station (located in west and east of the station) together with racks in the Van Heekplein (located next to the bus stops) do not meet the quality requirements and will be replaced in a close future. It should be mention that the municipality follows the 'FietsParKeur' standards for bicycle parking facilities.

3.2.   Bicycle Parking Survey (2011)

In order to have an in-depth understanding about demand and supply, a bicycle parking survey was carried out in September 2011 in Enschede city centre during the busiest days of the week (Tuesday, Thursday, Friday, and Saturday) at different times of the day (Kleizen et al., 2011). This survey was conducted for unguarded bicycle parking facilities and the number of unattended bicycles (those were not parked in racks) also was counted. Figure 4 shows how the city centre was divided to different counting zones.
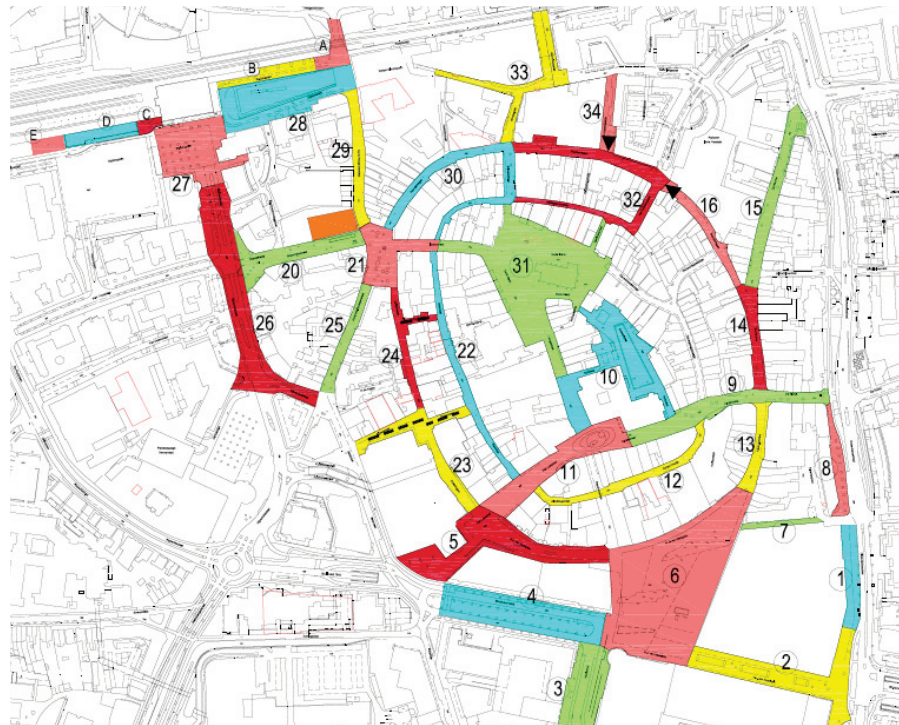
Figure 4: Counting zones
Source6: (Gemeente Enschede, 2011)

Figure 5, Figure 6, and Figure 7 show the number of parked bicycles on Friday afternoon and evening, and Saturday morning respectively. In green areas, there is a surplus of bicycle parking spaces. Yellow and orange areas show a deficit of less than 10 and 10-50 bicycle parking spaces respectively. The highest demand for parking space was observed in red areas (need for more than 50 bicycle parking spaces).
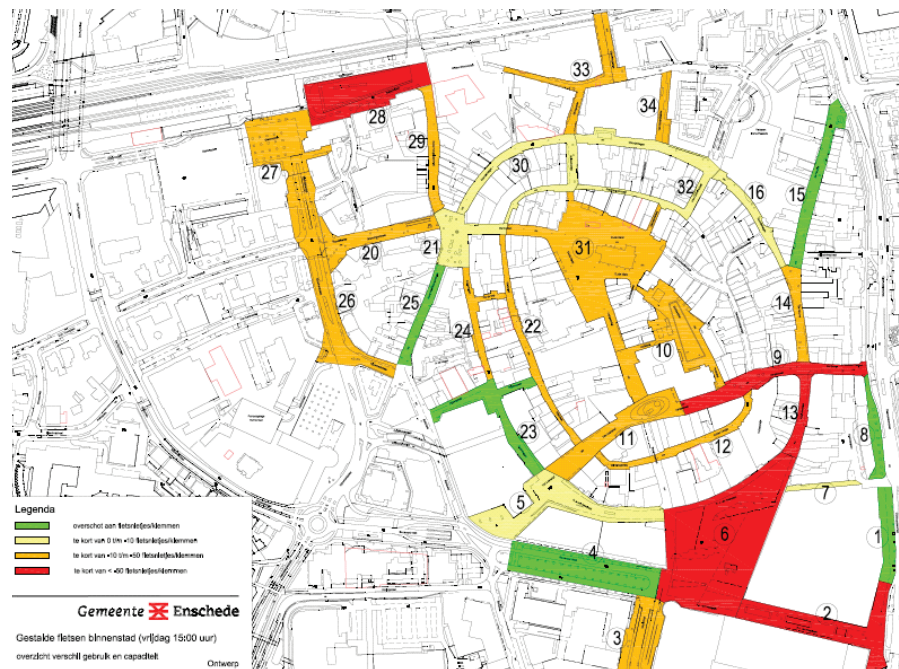
Figure 5: Parked bicycles on Friday at 15:00
Source7: (Gemeente Enschede, 2011)
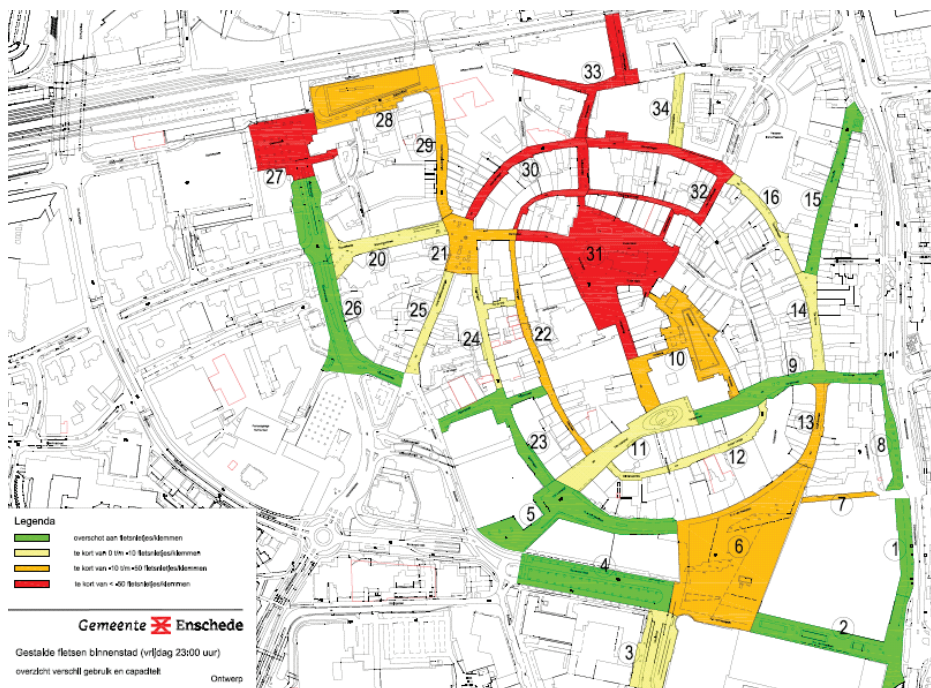
Figure 6: Parked bicycles on Friday at 23:00
Source 8: (Gemeente Enschede, 2011)
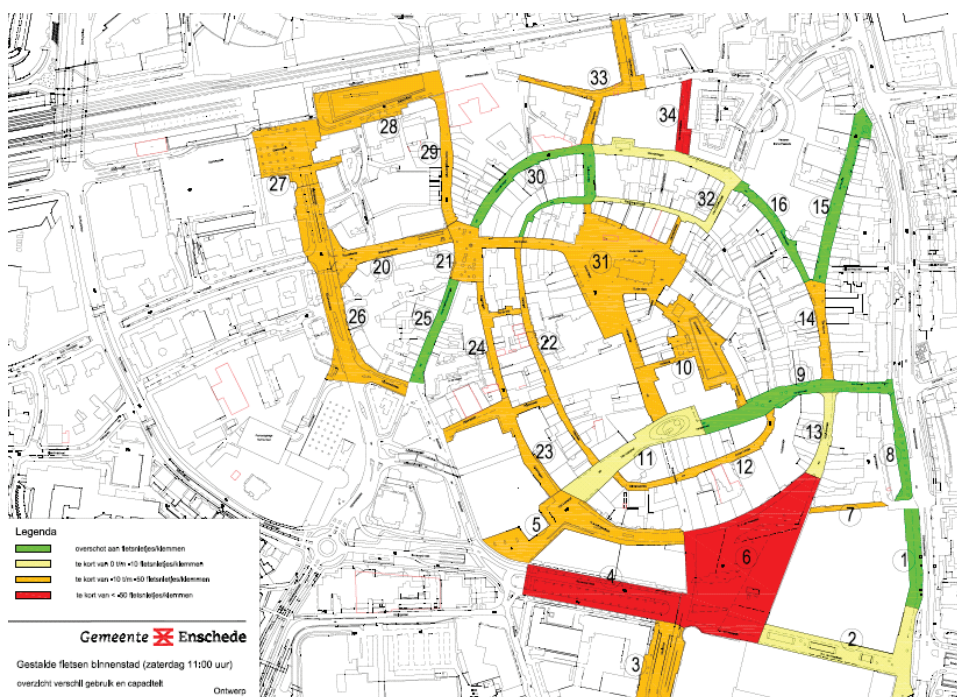
Figure 7: Parked bicycles on Saturday at 11:00
Source 9: (Gemeente Enschede, 2011)

During shopping hours, the greatest shortages were observed around the Van Heekplein (6) and Oude Markt (31). The Oldenzaalsestraat (1&8) and Heurne (15) do have a surplus of bicycle parking space in every time based on the Figures.

The result of the survey around the train station also revealed that all parking facilities were fully occupied during the survey period. Based on the counting, the deficit around the train station is about 1000 bicycle parking spaces. Table 6 presents the occupancy rate and capacity of parking facilities in train station area. The location of these facilities is illustrated in Figure 4.

Number	Location	Capacity	Average occupancy	Occupancy of the location	Total occupancy
28A	Train station east (1)	48	222	100%	463%
28B	Train station east (2)	180	348	100%	193%
28C	Train station west (1)	0	341	Not available	Not available
28D	Train station west (parking)	1000	1238	98%	124%
28E	Train station west (2)	190	163	84%	86%
	Total	**1418**	**2312**	**96%**	**163%**

Table 6: Occupancy rate of bicycle parking facilities at train station area
Source 10: (Gemeente Enschede, 2011)

3.3. Bicycle Parking Facilities in Enschede City Centre

Enscheda is equipped with two free guarded bicycle parking facilities at city centre area. At train station there is a paid guarded bicycle parking also. The following Table shows the bicycle parking facilities and their characteristics. The location of these facilities is presented in Figure 4.

Number	Name	Type	Parking price	Opening hours	Capacity	Picture
3	Van Heekplein	Supervised	No	08:00-19:00	1100	
21	De Graaff	Supervised	No	08:00-19:00	650	
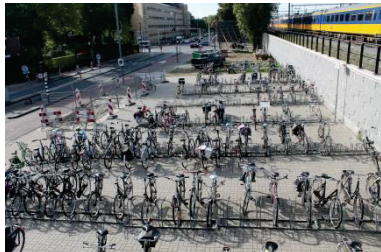
28	Supervise parking (train station)	Supervised	Yes	07:00-19:00	700	
28E	Bicycle racks (west)	Unguarded	No	All the times	Not available	
28(A-B)	Bicycle racks (east)	Unguarded	No	All the times	Not available	
28D	Bicycle shed (train station)	Sheltered	No	All the times	1000	

Table 7: Characteristics of bicycle parking facilities at Enschede city center area

3.4. The Future of Bicycle Parking Facilities in Enschede

Currently there are about 2100 parking spaces in train station area. In order to meet the demand there will be 1000 more spaces till 2020 according to Kleizen et al. (2011). Municipality of Enschede together with ProRail will implement this project. As a part of this plan new bicycle storage will be developed in northern part of train station. A total estimation of demand for new parking spaces is 4000 for 2030 vision. The guarded bicycle parking facilities in city centre are well utilized specifically on shopping days, although these facilities need to be promoted because 50% of bicyclists never used them. The increased use of these facilities in consequence could reduce the risk of theft.

4. METHODOLOGY AND DATA COLLECTION

This Chapter will discuss the applied methods for conducting this research. These methods are employed in order to address the research objectives. Figure 8 presents the taken steps for formulating research methodology. First data collection approaches are explained, and then applied data analysis is discussed.
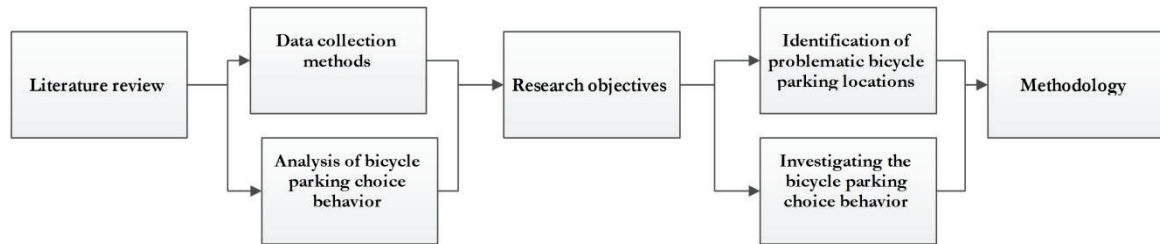
Figure 8: Taken steps for structuring research methodology

4.1. Data Collection

Field data collection is required for addressing the first and second objective of this research. In order to identify the hotspots of bicycle parking in Enschede city centre, several interviews with experts are conducted. On the other hand, for investigating bicycle parking choice behaviour in identified problematic locations, a survey is designed and distributed. Each step will be elaborated in the following sections. An overview about the utilized data sources in this research is summarized and presented in Table 8.

4.1.1. Data Sources

The primary source of data in this research is a dataset which is a result of bicycle parking choice behaviour survey. Expert interviews on the other hand are considered as a source for conducting the research. In order to report the current bicycle parking situation, secondary data sources are utilized. These data mostly provided by the municipality of Enschede and explain the on-going situation about bicycle parking facilities, the capacity, utilization rate, and other characteristics of these facilities in city centre area.

- **Primary and Secondary Data**

The following Table discusses the primary and secondary data sources which are used in this research. In addition, each dataset with its characteristics such as source and method of data acquisition are presented. Further discussion related to data will be explained in following sections in this chapter.

Data	Source	Year	Format	Collection Methods	Application
Primary data sources					
Problematic bicycle parking locations	Different stakeholders	2013	Map/Table	Interviews	Identification of problematic bicycle parking locations, their characteristics, and problems
Bicycle parking choice behaviour	Bicycle parking choice behaviour survey	2013-2014	SPSS	Survey	Investigating bicycle parking choice behaviour in details
Secondary data sources					
Hotspots of bicycle theft in Enschede city centre	Twente police	2012-2013	Table	Based on the bicycle theft reports	Case study description
	BPS/BVH	2007-2010			
Bicycle parking at city centre (Enschede)	Municipality of Enschede	2011	Table/map	Counting	Case study description
Bicycle vision (2012-2020)	Municipality of Enschede	2011	Document	Not applicable	Literature review, case study description

Table 8: Primary and secondary data sources

4.1.2. Identification of Problematic Bicycle Parking Locations

In order to collect the required data related to hotspots of bicycle parking in Enschede city centre, several experts are interviewed. Following steps are taken in order to collect the required data for identifying problematic bicycle parking locations.

- **Identifying Experts**

Based on the content of this research, the expert refers to organizations (in different scales: local, regional, and national), associations, groups, or individuals who directly or indirectly affect the decision making and planning process of bicycle parking facilities in Enschede. The following is a list of relevant experts for this research:

Municipality of Enschede: the municipality recently published a document under the title of 'Bicycle vision (2012-2020)' which covers a wide variety of topics about bicycle and cycling in Enschede including bicycle parking facilities (Kleizen et al., 2011).

Fietsersbond Enschede: Fietsersbond is the 'Dutch Cyclists' Union' with 150 local branches that accommodates cycling by providing high quality bicycle paths and parking facilities, decreasing bicycle theft, and creating more secure environment for bicyclists in traffic situations (Fietsersbond, 2013).

Keypoint consultancy: a consulting firm with central focus on following domains: public transport, parking, traffic infrastructure, Mobility Information Technology, and urban development and mobility policy (Keypoint Consultancy 2013).

Police department: the number of stolen bicycles and identifying locations with a high rate of bicycle theft also could provide useful insights for this research.

Bicycle parking facilities design group: a subdivision of 'Traffic and Transportation' department of municipality of Ensched.

ProRail: 'a government-owned company responsible for maintenance, operation, and expansion of the Dutch railway infrastructure' (Martens, 2007).

Federatie Centrum Ondernemers Enschede (FCE): private party who has interests in the city (VHSE, 2013).

VHSE (Vereniging Horeca Binnenstad Enschede): catering association which was founded in 1990 (VHSE, 2013).

Maintenance team of city center: the team of removing inappropriately parked bicycles from city centre according to G. Spaan (personal communication, September 10, 2013).

- **Arranging Expert Interviews**

Couple of interviews are carried out with a number of aforementioned experts who directly or indirectly are involved in design, management, maintenance, and planning of bicycle parking facilities (see chapter 5 for detailed explanation of interviewees). Their ideas and suggestions would give researcher an insight to the current situation of bicycle parking.

- **Structure of Interviews**

After identification of potential experts, interviews are conducted. Not all of the experts are interviewed in a same manner. While organizations like municipality of Enschede and Fietsersbond local branch in Enschede are directly and actively involved in bicycle related subjects like parking facilities, ProRail provides a general overview about bicycle parking facilities in all train stations in Netherlands.

For local organizations such as municipality of Enschede and Fietsersbond Enschede, the interview features in two parts. In the first part several questions related to the bicycle parking situation in Enschede are asked, while in the second section experts are given a map of Enschede city center and asked to indicate maximum 10 locations which are perceived as a place with bicycle parking difficulties. They are requested to indicate the problem for each specific location and suggest possible solutions for 3 locations which are perceived as the most problematic ones.

A discussion also is taken place between researcher and experts with general suggestions and ideas for bicycle parking facilities.

4.1.3. Investigating Bicycle Parking Choice Behaviour

In order to explore how bicyclists behave in choice of parking location a survey is designed. The survey is created in two languages (Dutch and English) in order to address the second objective of the research which is exploring bicycle parking choice behaviour and the influential factors which affect the choice in problematic locations. The survey examined the parking location choice behaviour in two different locations: Train station (as a transportation hub) and the Van Heekplein (city centre area).

- **Survey Locations**

Train station is mentioned by all stakeholders as a problematic location where rate of bicycle theft and demand for bicycle parking space are the highest. The Van Heekplein on the other hand is regarded as a shopping area with lots of shops. Furthermore, every Saturday and Tuesday the so-called 'open market' is held. Moreover, there is a free guarded bicycle parking facility in this location. The decision for choosing these two specific locations stems from results of expert interviews. Figure 9 shows the location of train station and the Van Heekplein in Enschede, Netherlands.
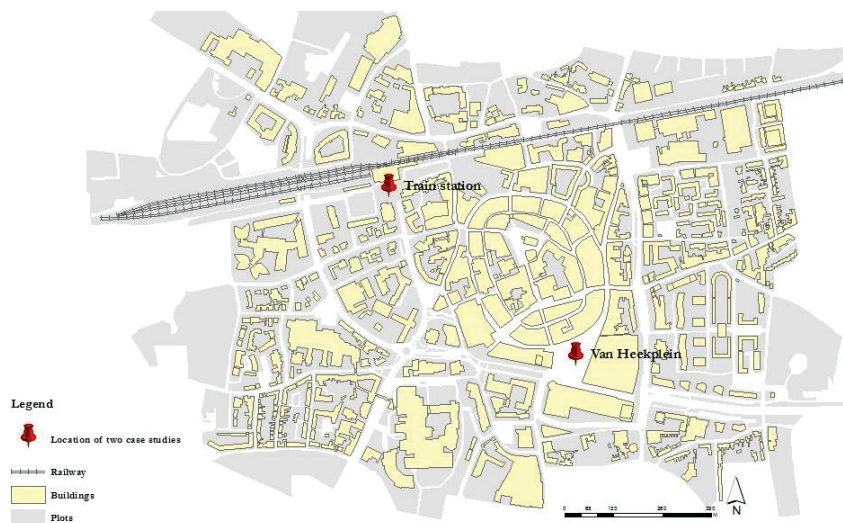
Figure 9: The location of two case studies

- **Framework of the Survey**

The survey is embedded in Survey Monkey website and designed to ask a broad array of questions. Furthermore, it consists of two parts. While the focus of part A is on examining the current situation regarding the choice of parking location, part B mostly investigates about the suggestions, recommendations, and ideas for future bicycle parking facilities.

The survey starts with a brief introduction about the research topic and then goes through the questions. Different question types are used in this survey like: multiple choice, rating scale, selection matrix, and open ended questions. Questions are arbitrary to answer and respondents are not forced to answer every single question.

At first, respondents respond to a question about the frequency of parking and their individual characteristics like age, gender, and living neighbourhood.

Questions related to experiencing bicycle theft and bicycle value are replied later, since these two factors could affect the choice of parking location. Then respondents are asked to answer questions related to the location for parking their bicycles and the reason behind it. Aerial photographs of both locations are uploaded showing the available bicycle parking options. In addition, a photograph of each parking location/facility is attached to each option in order to make the question clearer. The next questions in multiple choice format, examine the reasoning behind the choice of parking location. In addition, the respondents are asked about the time of arrival and departure in/from each location and parking duration. Purpose of the trip and relative importance of several proposed factors in choice of bicycle parking location are questioned also.

In part B, questions related to the bicyclists' preferences for new bicycle parking facilities and preferred type of parking facility (bicycle rack, supervised or sheltered facility, bicycle locker, and automated bicycle storage system) are brought up. For indicating the preferred locations for future bicycle parking facilities an aerial photograph for each location with grids is uploaded. Respondents are able to make more than one choice. Moreover, the reason for choosing a specific location is asked in order to provide the research with in-depth details. Finally, it comes to recommendations and suggestions. Besides, if an individual wishes to be informed about the result of the survey, he/she could fill out his/her Email address. Both surveys could be found in Appendix A and C.

- **Differences in Surveys**

The structure of both surveys is similar to each other, except for minor differences in several questions. For instance, parking duration in Van Heekplein is generally shorter than the parking period in train station area. As a result, answer options differ. These differences stem from the fact that each location has its own characteristics and features. It is important to mention that although the structure of the surveys for two locations is more or less the same; the expected outcomes are different.

- **Pre-distribution of Survey**

The survey is sent through Email to local experts, who are interviewed in the previous step. The comments are gathered and used for modifying the existing survey and make it easy to understand and answer for respondents.

- **Distributing the Survey**

Three methods are applied for distributing the bicycle parking choice behaviour survey. In the first approach the survey is shared in several Facebook pages and groups. These pages with a high rate of popularity in local scale (city of Enschede) are selected and a request was sent to the page's admin in order to receive their permission. These pages include educational institutions, entertainment activities, and administrative institutions like municipality. The surveys also are posted in several Facebook groups. These are dominantly open or closed groups with various themes and backgrounds such as: educational, commercial, entertainment, and sport.

One of the most important means for distributing the survey is University of Twente and ITC News channel. Publishing an article (ITC News, 2013; University of Twente, 2013) related to the research is considered as an effective way of obtaining data. Besides, the survey links are sent by Email to different members of faculty departments in order to collect more data.

In the second method a business card is designed presenting the internet address of the survey and contact details of researcher. This card is distributed among bicyclists at both locations at different times of the day/week. A sample of this card is presented in Figure 10.

Distribution of paper questioners in both locations is the third way of distributing survey. The questionnaires are distributed at entrance and exit areas of bicycle parking facilities, on train (for train station), in V&D entrance, in Albert Heijn entrance, and other potential locations. A brief description of the research is given to each respondent and if he/she wishes to participate, a paper questionnaire is given to him/her. If an individual refuses to fill out the survey, the second method will be utilized. It means that he/she will be given a business card and asked to answer the survey online.

Figure 10: Layout of the business card

4.2. Survey Results

The survey collector was open for 9 weeks (from 11 November till 13 January). During this period 164 and 89 responses were collected for train station and Van Heekplein surveys respectively. These figures include the paper questionnaires which are answered by respondent on train and other locations where field data collection took place. The progress of data collection is shown in Figure 11. These data are collected through the earlier discussed methods in. Both surveys received the most responses during the second and fourth week. It could be described by the fact that in the second week the survey link was shared in different Facebook pages and in the fourth week an article in University of Twente News about the research resulted in attracting more responses.
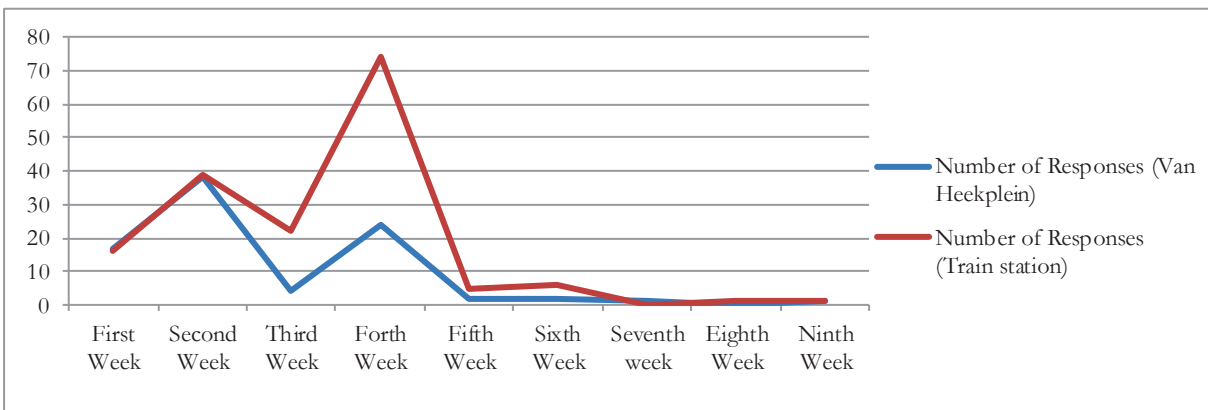
Figure 11: Data collection process

4.2.1. Text Analysis

Content analysis is considered as a systematic, replicable method for shortening text content into categorise based on coding rules (Berelson, 1952; Krippendorff, 2012; U.S Goverment Accountability Office, 1996; Weber, 1990). On the other hand, text analysis enables researcher to analyse through mass of data (U.S Goverment Accountability Office, 1996).

Text analysis is used to interpreting the open-ended questions in choice behaviour survey. The written comments for different questions are classified and coded in different categories. Interpreting the given answers and categorizing them in to different groups constitute a considerable part of text mining. A whole list of text analysis which is a result of interpretation and coding is presented in Appendix B and D. It should be mention that for Dutch survey, the indicated answers are translated in to English, and then analysed and coded. Extracting useful information from expert interviews also is done through text analysis.

4.2.2. Statistical Analysis

In order to analyse the obtained data from bicycle parking choice behaviour, statistical methods are applied. A small dataset for both surveys based on collected data is created in IBM SPSS environment and a number of categorical variables (variables that describe categories of entities and every case should fall into only one category (Field, 2009)) are defined.

5.   RESULTS AND DISCUSSIONS

The following chapter will discuss the results of expert interviews and bicycle parking choice behaviour survey, respectively. The outcome of expert interviews will be presented in form of report and a map showing the problematic bicycle parking locations in Enschede city centre area. The characteristics of these locations will be outlined as well. The next part is dedicated to the results of bicycle parking choice behaviour survey. This survey is designed for two locations (Train station and Van Heekplein) which are identified based on the expert interviews. The results of both surveys will be presented in this chapter as well as data analysis.

5.1.   Expert Interviews

The main purpose of conducting these interviews is to gathering useful information about the bicycle parking situation in Enschede city canter. The discussions with local experts focused on the hotspots of bicycle parking, confronted problems in these locations, and possible solutions for improving the current situation. Besides, an interview with ProRail representative is arranged for a detailed discussion about the bicycle parking facilities in train stations in Netherlands.

The first interviewee is Mr Gerran Spaan, an accessibility and mobility advisor working at municipality of Enschede. The discussion centres on bicycle parking problems in all over the city centre (particularly train station) and the current and future projects which are related to bicycle parking facilities. Mr Kees Lems who works as an urban planner in the municipality of Enschede also is interviewed. Bicycle parking problems and design of parking facilities are discussed mainly in this interview. The next interview is arranged with Mr Wim Koolhoven, who is the chairman of Fietsersbond in Ensched and works as information manager in University of Twente. The discussion focuses on the bicycle usage and bicycle parking situation in Enschede. Mr Leo de Jong and Mr Johan Beltman who are working in Keypoint consultancy as a director and transport consultant respectively, are interviewed in next step. The discussion focuses on the bicycle parking problems in Enschede. A short discussion is followed up by the role of bicycle parking facilities in park-and-ride. The next interview is arranged with Mr W.G.J. Nijhuis who is a police officer in Twente police. The main point of this discussion is about the bicycle theft in Twente region.

In national scale, Mr Marco Hoogendijk is interviewed, who is working as a construction manager in ProRail. In contrast with aforementioned interviews, the main discussion of this interview is about the bicycle parking facilities in train stations in Netherlands.

5.1.1.   Outcome of Expert Interviews

The first interview with Mr Gerran Spaan took place in municipality of Enschede. In his point of view bicycle parking is a serious problem particularly in vicinity of train station, the Van Heekplein, and Oude Markt. He mentioned that increasing the capacity is one of the main solutions for improving the situation. Writing a ticket or prohibition of parking is not a proper solution for addressing inappropriate bicycle parking problem. Removal of so-called orphan bicycles on a monthly basis and provision of temporal and permanent parking facilities in potential places are among proposed suggestions from Gerran Spaan for improving the situation. He discussed that studying the behaviour of cyclists in the choice of parking space on the other hand could be considered as a useful tool for improving current situation and as an input for further developments for planning of new bicycle parking facilities. Moreover, studying the parking behaviour could evaluate the effects of policy interventions in bicycle parking field.

The next interview with Mr Kees Lems also held in municipality of Enschede. In his point of view although bicycle parking has become problematic in some locations, the situation is getting more organized by devoting more bicycle racks in locations with high demand. The problem becomes severe in train station, the Van Heekplein and De Klomp, where there is a considerable lack of parking space. He suggests that problem could be addressed by installing a 2 level parking in the east side of train station and making use of empty spaces between buildings in the Van Heekplein and De Klomp as a bicycle parking storage.

Mr Wim Koolhoen as the next interviewee also considers bicycle parking as a problem in some locations. He differentiates between informal and inappropriate bicycle parking. Inappropriate bicycle parking happens when bicycles are parked in a prohibited zone, whereas informal bicycle parking refers to a situation in which bicycles are not parked in an organized way. He mentions that distance plays an important role in choice of bicycle parking location. As a result, bicycle parking facilities should be located as close as possible to the destination. Provision of high quality bicycle racks and increasing the awareness would improve the existing bicycle parking situation. He identified train station, De Klomp, and the Van Heekplein as problematic bicycle parking locations. Provision of more parking spaces is suggested by Mr Wim Koolhoven as a solution for confronting with the problem.

Discussion about bicycle parking situation in Enschede city centre with Mr Leo de Jong and Mr Johan Beltman who do not consider a bicycle parking as a problem focuses on the following points:
- Nationaal muziekkwartier, train station, and the Van Heekplein are among the most problematic bicycle parking locations,
- More bicycle racks in these locations would help in organizing the chaotic mess of bicycles,
- The choice of bicycle parking location is dependent to the parking duration and the trip purpose, and
- For train station there is a need for more bicycle parking spaces and the first floor of bicycle shed could be connected to the platform.

Interview with Mr W.G.J. Nijhuis conducted in a police office in Hengelo and focused completely on bicycle theft issues. He provided a report about the rate of bicycle theft in Enschede city centre from 2007 to 2013.

The last interview is conducted with Mr Marco Hoogendijk in ProRail office in Utrecht. The following are the main aspects of the discussion:
- Lack of bicycle parking facilities has become a national problem,
- A combination of guarded and unguarded bicycle parking facility is provided nowadays in train stations. The share of supervised parking is 20% of parking spaces, whereas 80% of capacity is allocated to unguarded facilities,
- Design of the parking facilities could affect the decision for choosing a parking location, and
- Although the ProRail is responsible for provision, maintenance, and management of bicycle parking facilities at train stations, in some cases municipalities also are involved in decision making process because of the budget issues. Besides, the data related to population growth or demand trend in train stations are provided by local authorities for calculating the future demand.

5.1.2. Mapping the Problematic Bicycle Parking Locations

The results of the interviews are combined with obtained data from different sources (see data sources in Chapter 4: Methodology and data collection) in an attribute table in order to make a small database. Later, this database is utilized to map the current bicycle parking situation in Enschede city centre area (Figure 12). Table 9 presents the indicated problematic locations by interviewees and characteristics of each location. Each location is characterized by the activity, capacity of bicycle parking facilities, demand for bicycle parking space, number of stolen bicycles, the engaged problem, and proposed solutions for improving the situation.

Problematic bicycle parking locations

Current bicycle parking facilities

Frequency

Railway

Buildings

Plots

Train station

Muziekcentrum and Muziekkwartier

Oude markt

Van Heekplein

De Klomp
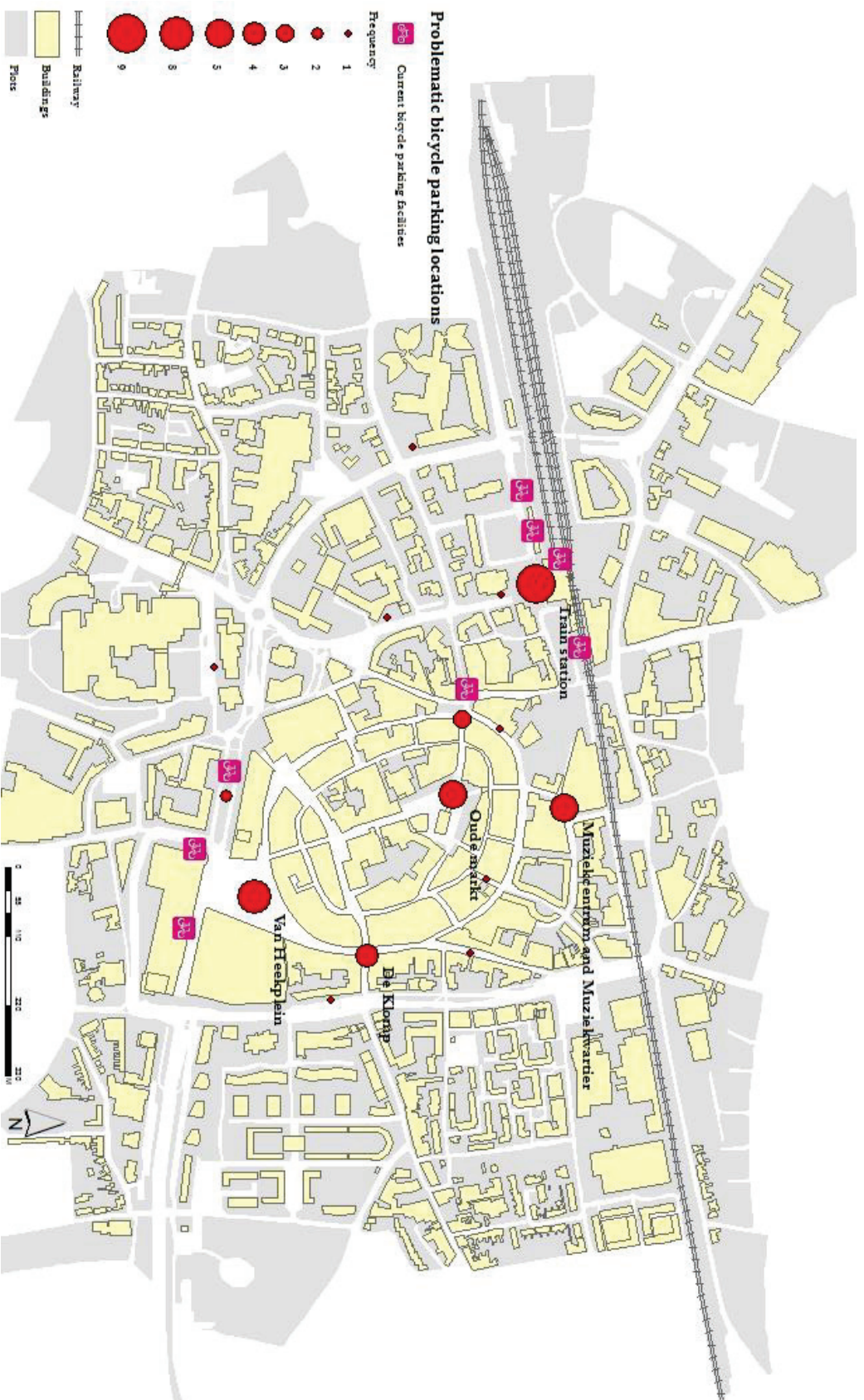
Figure 12: Hotspots of bicycle parking in Enschede city center
Source 11: (Expert interviews, 2013)

Location	Activity[1]	Capacity[2]	Fri 15:00	Fri 23:00	Sat 11:00[3]	Number of stolen bicycles[4]	Problem[5]	Solution[6]
Train station	Train station	1418	(red)	(red)	(red)	318	Lack of parking Space, Low Quality racks, Accessibility problems, Security problem, Mess of bicycles	Removing the orphan bicycles, Increasing the capacity, Construction of new bicycle parking
Muziekcentrum and Muziekkwartier	Movies, concerts, or entertainment shows	0	(orange)	(red)	(orange)	15	Lack of parking space, Security problem	Increasing the capacity, Offering incentive in order to encourage cyclists to park in right locations,
Oude Markt	Restaurant-type activity	39	(orange)	(red)	(red)	61	Aesthetic problems, Lack of parking space	Construction of new bicycle parking
Van Heekplein	Shopping	0	(red)	(orange)	(orange)	14	Mess of bicycles, Lack of parking space	Increasing the capacity, Improving the quality of bicycle racks
Boulevard 1945 (Albert Heijn)	Shopping	135	(red)	(green)	(yellow)	44	Mess of bicycles, Obstructing others in their movements	Provision of secure bicycle parking spaces, laying down a red carpet, Increasing the capacity
De Klomp	Shopping	32	(red)	(green)	(green)	14	Lack of parking space	Increasing the capacity

Demand for bicycle parking: >50 | 10-50 | 0-10 | Surplus

Table 9: characteristics of problematic bicycle parking locations in Enschede city center

[1] (Amercian Planning Association, 1994)
[2] (Gemeente Enschede, 2011)
[3] Demand for bicycle parking (Gemeente Enschede, 2011)
[4] (BPS/BVH, 2007-2010; Politie Twente, 2012-2013)
[5] (Expert interviews, 2013)
[6] (Expert interviews, 2013)

5.2. Bicycle Parking Choice Behaviour Survey

5.2.1. Sample Description

Both of datasets contain a lot of data related to bicycle parking choice behaviour. The characteristics of both datasets are presented in Table 10 and Table 11 which provides a general overview about the respondents' parking choice. The category with the highest frequency also is presented to explain the sample clearer. Both datasets are responded considerably by very young age groups who possess a bicycle with relatively average value. According to the survey, a considerable number of bicyclists park their bikes for 1-2 days in train station and take a train to go to home at evening. In the Van Heekplein sample, bicyclists mainly do the shopping in afternoon and park their bikes for 1-5 hours in city centre. The most preferred parking locations in train station and Van Heekplein are bicycle shed and supervised parking, respectively. It could be mention that both surveys are answered not only by residents of Enschede, but also some respondents from Hengelo filled out the survey.

Train station			
Variable	**Categories**	**Percentage**	**The category with highest frequency**
Age	>65	0.6	**15-24**
	45-54	3.1	
	55-65	3.1	
	35-44	4.3	
	25-34	29.6	
	15-24	59.3	
Gender	Male	55.6	**Male**
	Female	44.4	
Bicycle price (Euro)	400-600	4.6	**50-200**
	>600	7.6	
	<50	9.2	
	200-400	10.7	
	50-200	67.9	
Trip purpose	Sport	0.7	**Home**
	School and visiting family	1.4	
	School/university	2.9	
	Recreational activity and visiting family	2.9	
	Visiting family	4.3	
	Other	5.0	
	Shopping	5.8	
	Work	7.2	
	Work related location	10.1	
	Recreational/cultural activity	27.3	
	Home	32.4	
Parking duration	Other	2.1	**1-2 days**
	Less than one day and	2.9	

	1-2 days		
	More than 2 days	5.7	
	Less than one day	39.3	
	1-2 days	50.0	
Time of bicycle parking	00:00-06:00	0.7	**17:00-20:00**
	20:00-24:00	1.4	
	09:30-13:00	14.3	
	06:00-09:30	21.4	
	13:00-17:00	30.7	
	17:00-20:00	31.4	
Preferred parking location	Bicycle racks (west)	1.3	**Bicycle shed**
	Supervised parking	3.3	
	Other locations	4.6	
	Free standing area	10.5	
	Bicycle racks (east)	19.7	
	Bicycle shed (first floor)	28.9	
	Bicycle shed (ground floor)	31.6	

Table 10: Characteristics of train station sample

Van Heekplein

Variable	**Categories**	**Percentage**	**The category with highest frequency**
Age	35-44	6.7	**15-24**
	55-65	6.7	
	45-54	10.1	
	25-34	32.6	
	15-24	43.8	
Gender	Male	43.8	**Female**
	Female	56.2	
Bicycle price (Euro)	400-600	5.7	**50-200**
	200-400	10.3	
	>600	17.2	
	<50	20.7	
	50-200	46.0	
Trip purpose	Work	1.3	**Shopping**
	Recreational/cultural activity	1.3	
	Market	10.4	
	Home	36.4	
	Shopping	50.6	
Parking duration	One day	1.3	**1-5 hours**
	Less than one hour and 1-5 hours	3.8	
	Less than one hour	34.6	
	1-5 hours	60.3	

Time of bicycle parking	00:00-06:00	1.3	**13:00-17:00**
	20:00-24:00	2.6	
	17:00-20:00	5.2	
	09:30-13:00	27.3	
	13:00-17:00	63.6	
Preferred parking location	Other locations	4.9	**Supervised parking**
	Bicycle racks (west)	7.3	
	The public square	17.1	
	In front of Albert Heijn	18.3	
	In front of V&D	23.2	
	Supervised parking	29.3	

Table 11: Characteristics of Van Heekplein sample

5.3.   Reporting the Results

Since the bicycle parking location is one of the main elements of this research, it is of importance to examine in the first place where do bicyclists park their bicycles. The indicated reasons for choosing a specific parking location will be discussed as well as the reasons for not utilizing the supervised parking facility. Then the relative importance of bicycle parking choice factors (in general) will be compared to the actual (what is actually happens) preferences.

In the next step, the results will compare the preferred bicycle parking location as a dependent variable versus other independent variables. Independent variables are classified in 3 categories: individual characteristics of parking users, time related variables, and other variables. Based on the survey outline, age, gender, and living neighbourhood are categorized as individual characteristics. Time related variables are somehow related to the time and included: parking duration, time of bicycle parking, and parking frequency (how often an individual parks his/her bicycle at a specific location). Other variables include: bicycle price, bicycle theft, and trip purpose.

Determinants of bicycle parking choice will be identified through running the Fisher exact test is utilized when the dataset is unbalanced, contains many ties, sparse, not normally distributed, or poorly distributed (Mehta and Patel, 1989). In addition this method calculates the significance level for statistics which are available through crosstabs.

Finally, the favoured locations for new bicycle parking facilities, type of parking facility, and respondents' recommendations and suggestions will be presented and discussed.

The above mentioned steps will be taken for both locations separately.

5.3.1. Results of Train Station Survey

Figure 13 illustrates the choice of bicycle parking location in train station area. According to the figure, the most popular parking facility is bicycle shed, while bicycle racks in west side of the train station and supervised parking facility seem to be not popular parking preferences for cyclists.
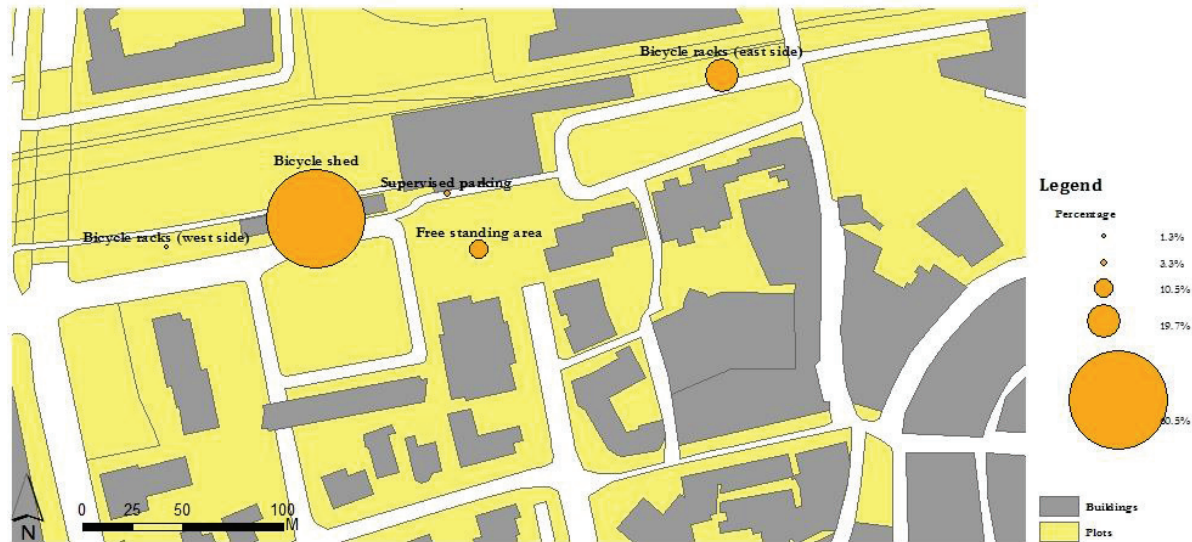
Figure 13: Choice of bicycle parking location (train station)

Protecting the bike against inclement weather, availability of free parking spaces, and public morality (not obstructing others in their movements) are the primary reasons for parking the bicycle in shed according to Table 12. Surprisingly, being close to destination is not a significant choice factor. It could be explained by the fact that in long parking period factors other than close distance to destination influence the choice.

Factor	Frequency
My bicycle is now protected against rain and snow	64
There are always lots of places free here	29
My bicycle is not obstructing anybody else in their movements	29
My bicycle is safe here	24
It is close enough to the destination	13
I just follow others	3
I do not know	3
The place is supervised	2

Table 12: Indicated reasons for choosing bicycle shed as a parking location (train station)

Contrary to bicycle shed, the supervised parking is not utilized very much. The resons for not making use of this facility are presented in Table 13. High cost of parking and unsuitability of parking opening hours are the major barriers against the use of this facility. The high frequency of unsuitable openning hours as a choice factor could be explained by the fact that early in the morning is the peak hour for parking the bike at train station and the parking facility opens from 07:00 am. As a result bicyclists have to choose another location over the supervised facility for parking the bicycle.

Factor	Frequency
It is too expensive	80
The opening hours do not suit my schedule	41
I have not thought about that	38
It is not easy to enter and exit the facility	27
The payment method is inconvenience	21
I do not know that there is a supervised bicycle parking in train station area	12
Being far from platforms	11
It is not easy to find a parking location over there	6

Table 13: Indicated reasons for not parking in supervised bicycle parking facility (train station)

Comparison of factors which are indicated as a justification for parking in a specific location (Table 14) with the general bicycle parking choice factors (Table 15) provides an overview about the actual parking behaviour and bicyclists' preferences. While in reality bicyclists dominantly park their bicycles in a sheltered location, their perspective toward a preferred parking location is different. They do prefer mostly the facilities which are located as close as possible to the destination and existence of a sheltered facility is not important very much. It could be described by the fact that in actual situation bicyclists have to make a choice between available parking facilities, whereas generally they would prefer closer parking facilities to train station. Although in reality bicyclists park their bikes in a specific location to avoid obstructing others, this factor generally is rated as a little bit important. Following other bicyclists in choice of parking location is not an influential factor nor in train station neither in the Van Heekplein. Avoiding the mess of bicycles is ranked as not important at all, which could explain the chaotic bicycle parking situation in train station area.

Factor	Frequency
My bicycle is now protected against rain and snow	67
There are always lots of places free here	50
My bicycle is not obstructing anybody else in their movements	35
My bicycle is safe here	33
It is close enough to the destination	26
The place is supervised	7
I do not know	5
I just follow others	5

Table 14: Indicated reasons for parking in a specific location (train station)

Factors	Relative importance
Being close to destination	Very important
Parking price	Very important
Minimizing the risk of theft	Important
Parking duration	Important
Availability of parking space	Important
Parking opening hours	Important
Not obstructing others	A little bit important
Existence of sheltered bicycle parking facility	A little bit important
Avoiding the mess of bicycles	Not important at all
Following other bicycles	Not important at all
Existence of supervised bicycle parking facility	Not important at all

Table 15: Relative importance of bicycle parking choice factors (train station)

Figure 14 shows how the choice of parking location varies between different age categories. Bicyclists in younger age groups do not park their bicycles in supervised parking, while elder cyclists do prefer supervised facility. While the ground floor of bicycle shed is chosen by bicyclists from all age groups, the first floor of shed entirely is a popular spot for 15-24 age range. The substantial difference could be justified by the fact that carrying the bicycle to the first floor requires extra effort and younger bicyclists would do that more easily.
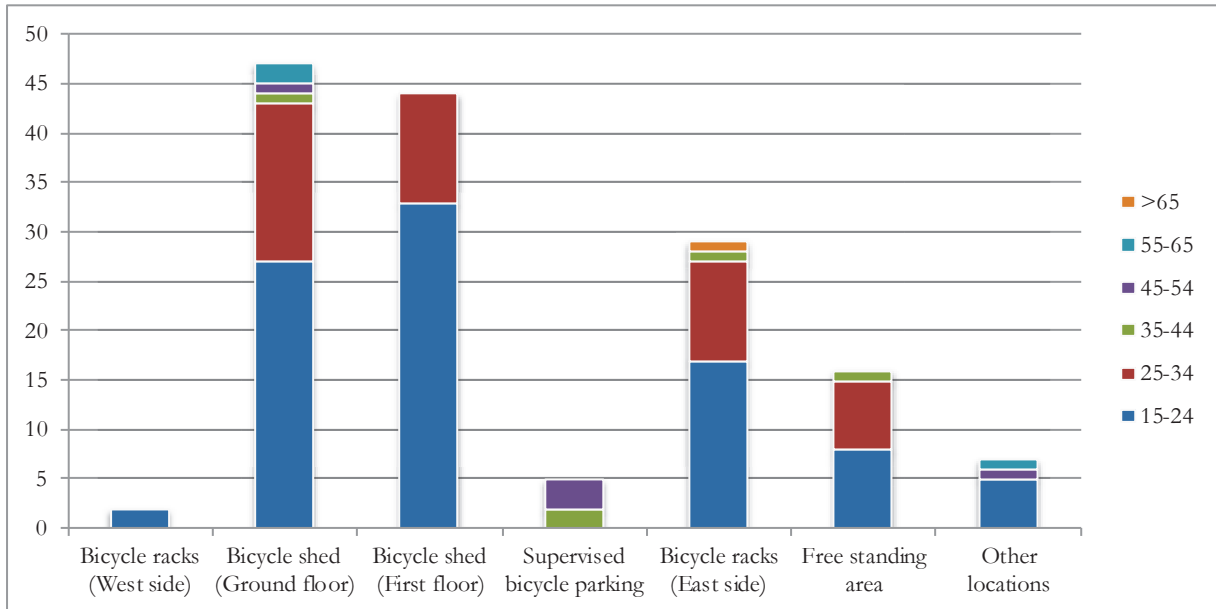
Figure 14: Frequency distribution of age groups between different parking locations (train station)

Figure 15 shows how females and males behave in choice of bicycle parking location. Except for supervised bicycle parking and first floor of bicycle shed, other parking locations are more or less chosen equally by males and females. As discussed earlier parking the bicycle in first floor of bicycle shed takes more attempts. This could be considered as a reason for females to park over there less than males.
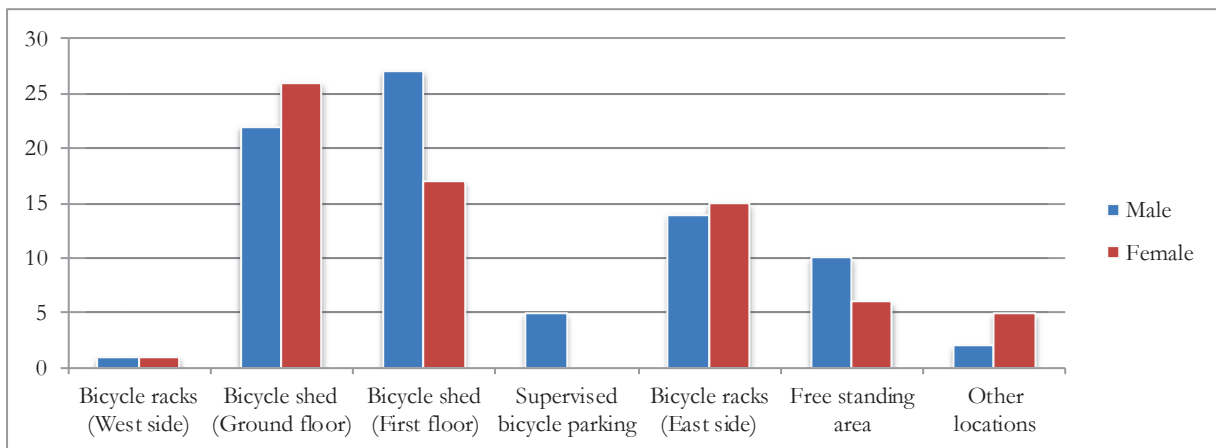
Figure 15: Gender and choice of bicycle parking location (train station)

Figure 16 shows how the choice of bicycle parking location based on the respondents' living neighbourhood. According to the map, bicycle shed (east side) is mostly taken up by bicyclists who come from eastern part of the city.
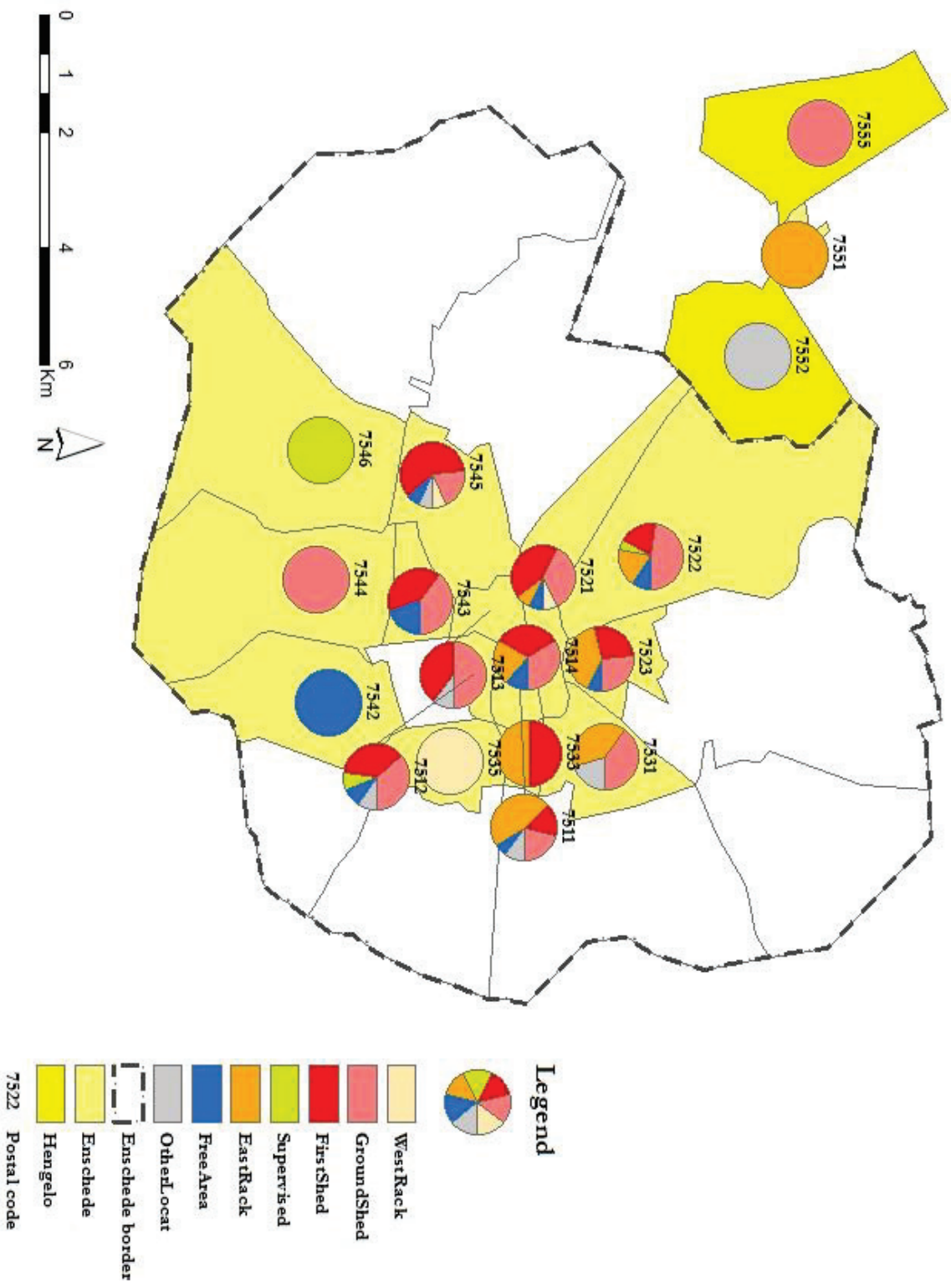
Figure 16: Choice of bicycle parking location based on the living neighborhood (train station)

Figure 17 shows the choice of bicycle parking location based on the parking duration. The majority of bicyclists park their bikes at train station area for 24-48 hours and they dominantly choose bicycle shed (first floor). The possible explanation is that the first floor is perceived safer and it is easier to find a parking location over there. The supervised parking facility is completely chosen for shorter parking period. It could be explained by the fact that the users of this facility are commuters who park their bicycles for a short period and collect the bike within 24 hours. Some respondents park their bikes in free standing area for 1-2 days, which is surprising.
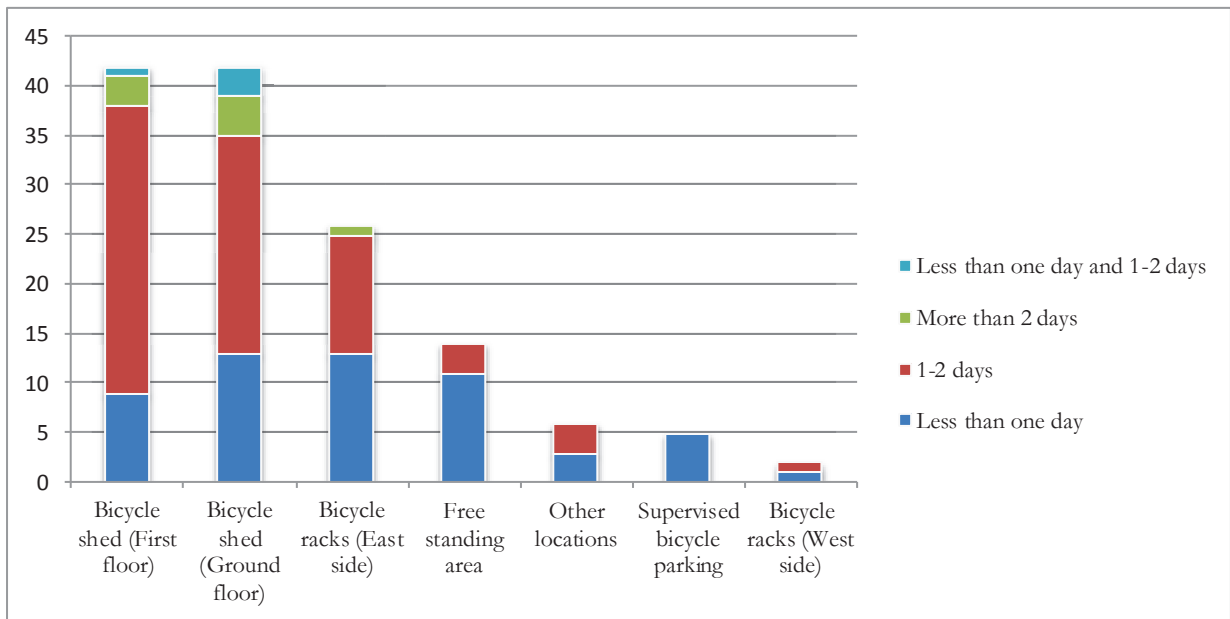
Figure 17: Choice of bicycle parking location in comparison with parking duration
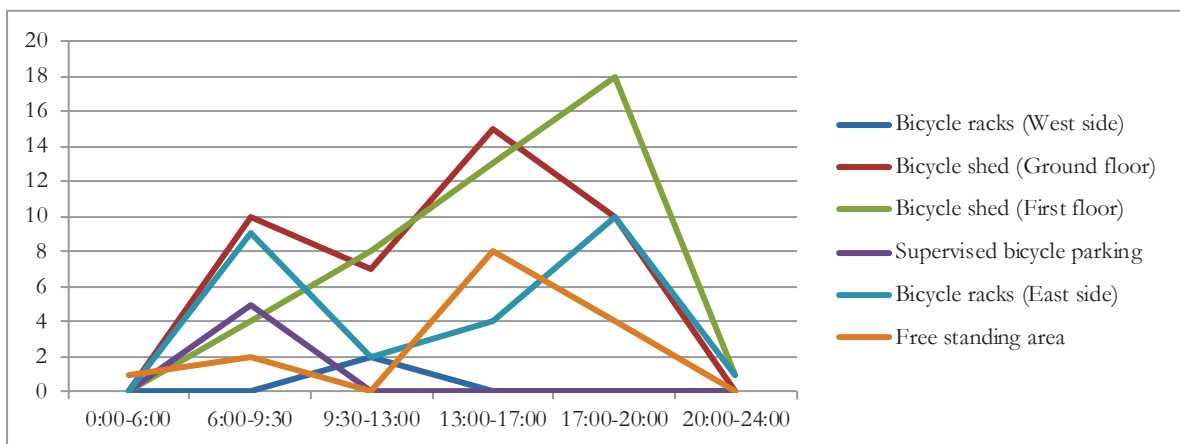
Figure 18: Choice of bicycle parking location based on the different times of a day

Figure 18 shows at what time of a day, which parking facility is preferred. The supervised facility is occupied mainly in the morning. The ground floor of bicycle shed is highly occupied during 13:00-17:00 hours, whereas the peak hours for parking in first floor are sometimes between 17:00-20:00. The difference is explained by the availability of more parking spaces in first floor during the evening. On the other hand, the parking locations are already taken up in the afternoon. As a result the choice f parking location shifts to the first floor.

Figure 19 shows how choice of bicycle parking location changes based on the parking frequency. Except for supervised parking and west side bicycle racks, there is not a considerable difference between regular and irregular bicycle parking users. The first floor of bicycle shed is occupied mostly by weekend commuters who park their bikes for a relatively long period (1-2 days).
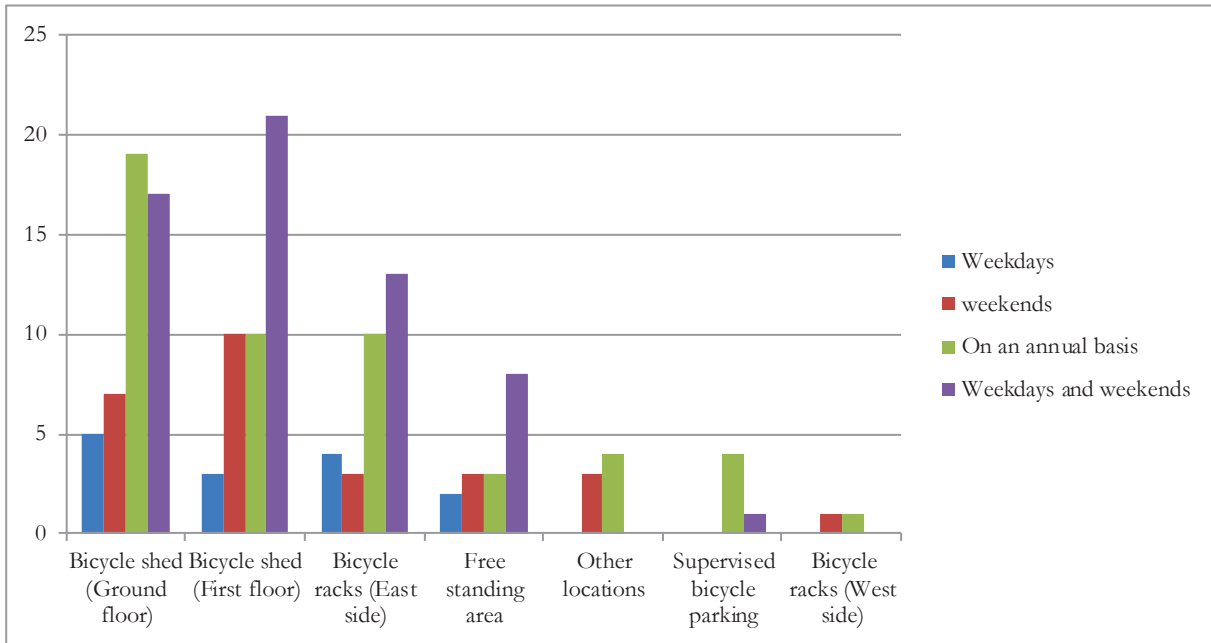
Figure 19: Parking frequency and choice of bicycle parking location (train station)

Another variable which affects the choice of bicycle parking location is the trip motivation. Figure 20 illustrates the relation between the parking choice and the intention for parking the bicycle. As the table presents, the bicycle shed is a popular parking location for all trip intentions. When bicyclists park their bikes for going to shopping, bicycle shed and free standing area are preferred. This is due to the close distance of these parking locations to city centre.
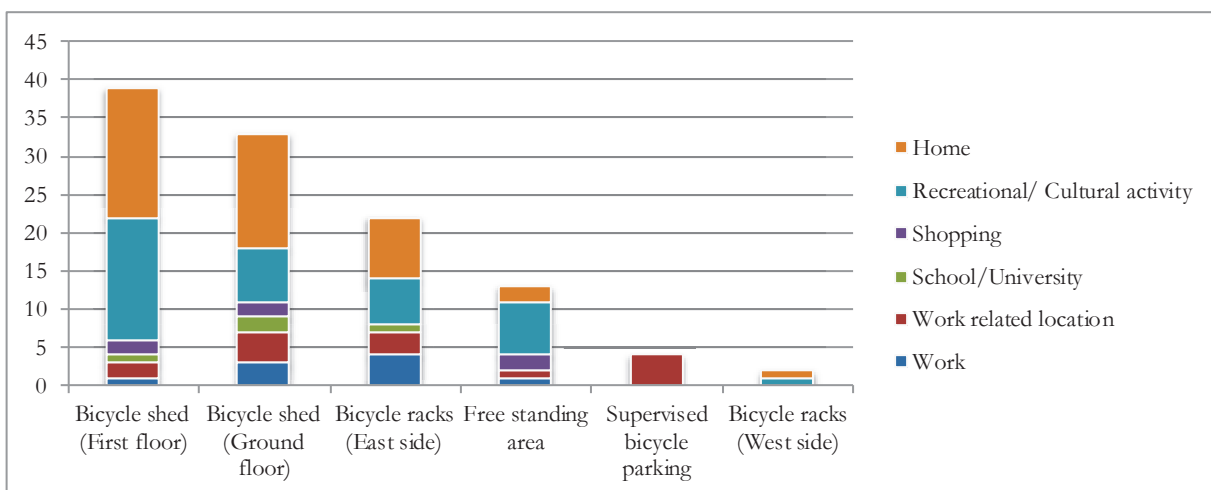
Figure 20: Choice of bicycle parking location based on the trip purpose (train station)

Figure 21 shows the choice of bicycle parking location compared to bicycle price. High value bikes are parked in both guarded and unguarded parking locations, whereas low price bicycles are parked in every parking facility except for supervised parking.
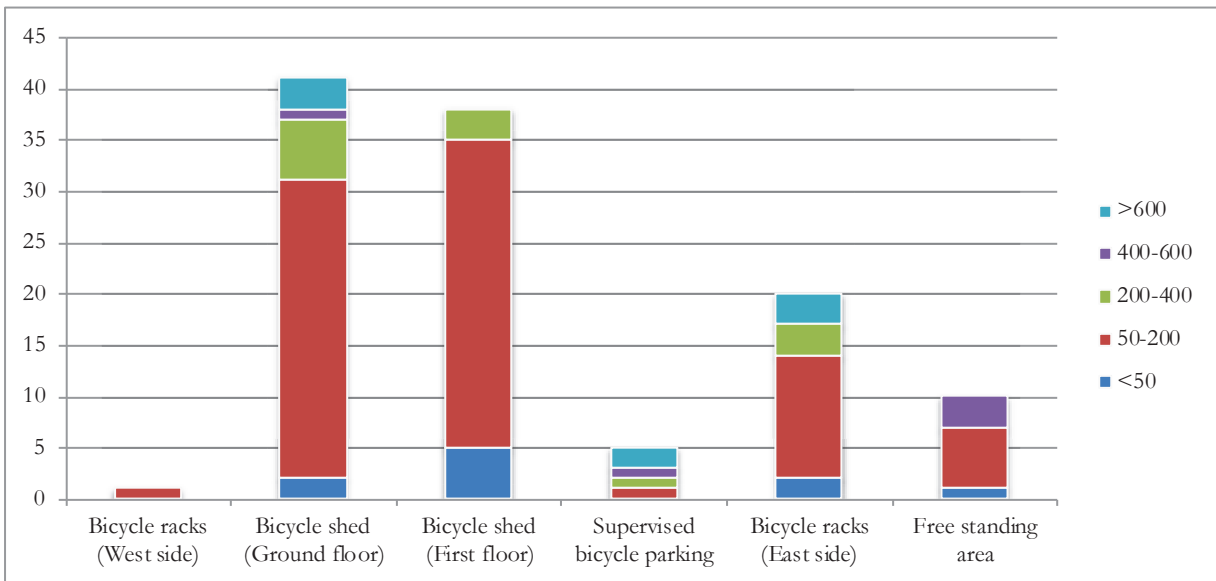
Figure 21: Choice of bicycle parking location based on the bicycle price (train station)

Finally, the results revealed that less than 60% of respondents did not experience bicycle theft during last five years (Table 16). It could be mention that the table itself does not reveal any specific pattern regarding the choice of bicycle parking location when an individual experienced bicycle theft or did not.

The preferred parking location	Bicycle theft	
	No	Yes
Bicycle shed (Ground floor)	18.2%	13.5%
Bicycle shed (First floor)	16.9%	11.5%
Bicycle racks (East side)	11.5%	8.8%
Free standing area	6.8%	4.1%
Other locations	2.0%	2.0%
Supervised bicycle parking	2.7%	0.7%
Bicycle racks (West side)	1.4%	0.0%
Total	59.5%	40.5%

Table 16: Choice of bicycle parking location and bicycle theft (train station)

- **Determinants of Bicycle Parking Choice Behaviour**

Table 17 presents the P-value which is calculated in order to examine the association between the preferred bicycle parking location and independent variables. The P-value which is a result of running Fisher exact test indicates the level of significance. A very small value of P shows a high association between two variables (Mehta and Patel, 1989). Among individual characteristics of bicyclists, age and living area are associated highly with choice of the parking location. It means that bicyclists in different age groups who come from various neighbourhoods park in different locations. Moreover, duration and time of bicycle parking are influential factors in choice of bicycle parking location. When the parking period is short, bicyclists would park in the first available location, whereas in longer durations they would park the bike in more secure locations and consider other factors like risk of theft. Trip purpose and bicycle value also are correlated with choice of bicycle parking. Parking frequency and gender surprisingly do not influence the choice of parking location. Being regular or irregular user of parking facilities does not affect the choice of parking location significantly.

Variable	P-value
Age	0.000
Time of bicycle parking	0.003
Bicycle price	0.005
Living area postal code	0.013
Parking duration	0.015
Trip purpose	0.027
Time of bicycle pick up	0.104
Gender	0.140
Parking frequency	0.178
Bicycle theft	0.931

Table 17: Determinants of bicycle parking choice (train station)

- **Preferred Locations for New Bicycle Parking Facilities**

Figure 22 shows the potential locations for new bicycle parking facilities from respondents' point of view in train station area. The relative locations of current bicycle parking facilities are also illustrated in order to compare the available facilities with preferred ones. Each location is presented based on its frequency (how many times the location is indicated by respondents). While the map shows the favored locations for new parking facilities, the reasoning behind selection of these locations are extracted based on the given answers. The whole list of interpretations could be found in Appendix ().

As the map illustrates, 3 locations are chosen dominantly. These locations are: E5, C5, and G3. The most indicated reasons for choosing these spots are: being close to train station, perceived as a potential location, and based on the bicyclists' personal preferences. Potential locations are those which are empty at the moment and are suitable for new parking facilities. The high share of personal preferences in choice of new parking locations shows that each individual tries to make an optimum choice based on his/her situation. This somehow confirms the obtained results from bicycle parking choice behavior determinants that: there is a high correlation between the age, and living neighborhood and choice of bicycle parking location. It means that coming from a specific direction determines the choice of bicycle parking location considerably. Besides, aforementioned locations are located in a close distance from current parking facilities. Although the supervised parking facility is not utilized by the respondents of this survey, there is a high demand for new parking spaces just in front of this facility. This is the case also for bicycle racks in east side of the train station. Generally, the demand for bicycle parking is concentrated on close distance to current bicycle parking facilities.

In addition, more than 50% of respondents prefer bicycle racks as a new parking facility. Bicycle shed is in the second place with less than 30% of responses.
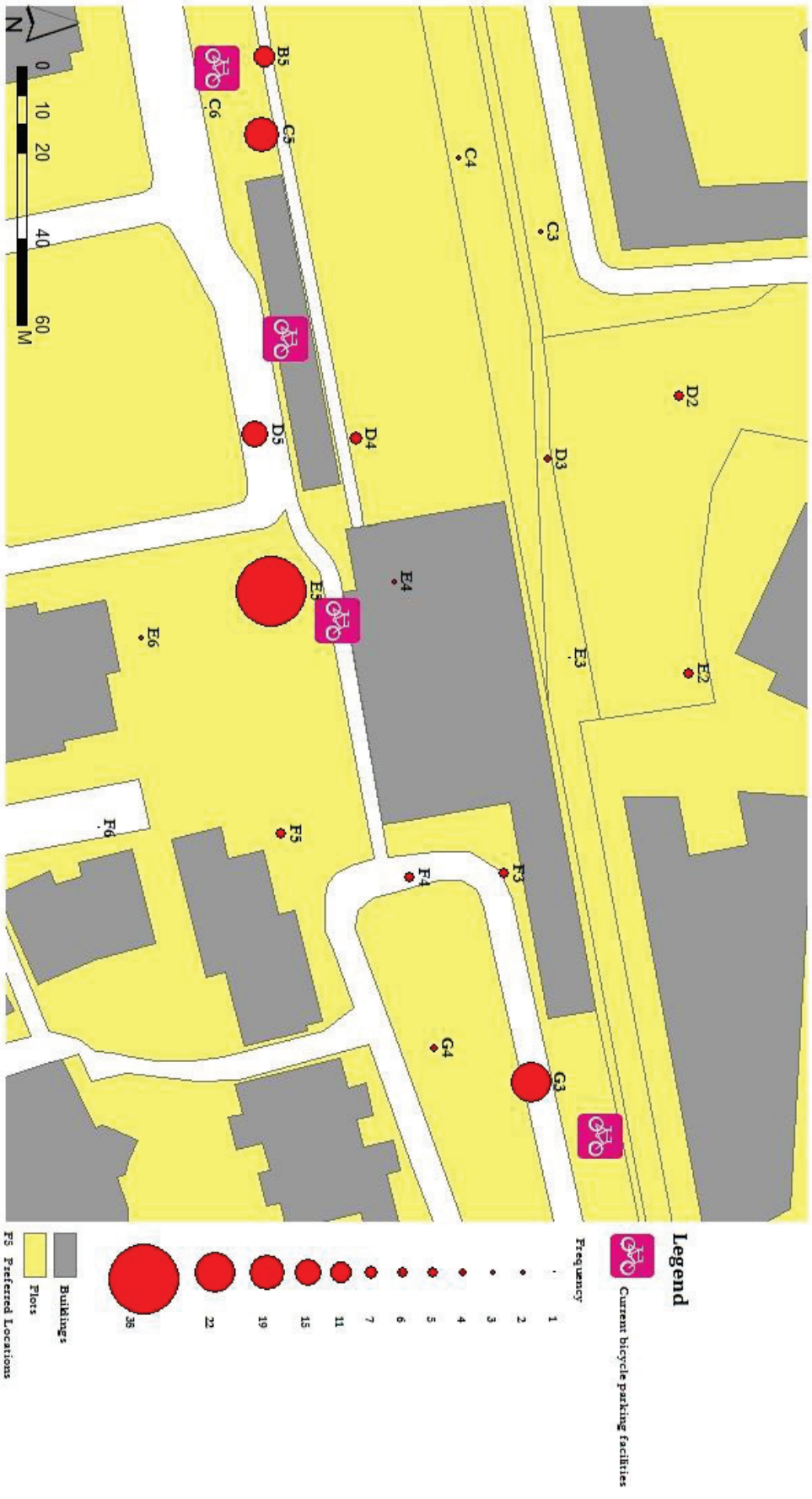
Figure 22: Spatial distribution of preferred locations for new bicycle parking facilities (train station)

5.3.2. Results of Van Heekplein Survey

Choice of bicycle parking location in Van Heekplein is illustrated in Figure 23. According to the map, supervised parking facility is the most preferred parking location in this area. Bicycle racks are not utilized extensively, although they are located in a close distance from supervised parking. Although there is not any bicycle parking facility in Public Square or in front of V&D (department store), these locations seem to be potential parking spaces.
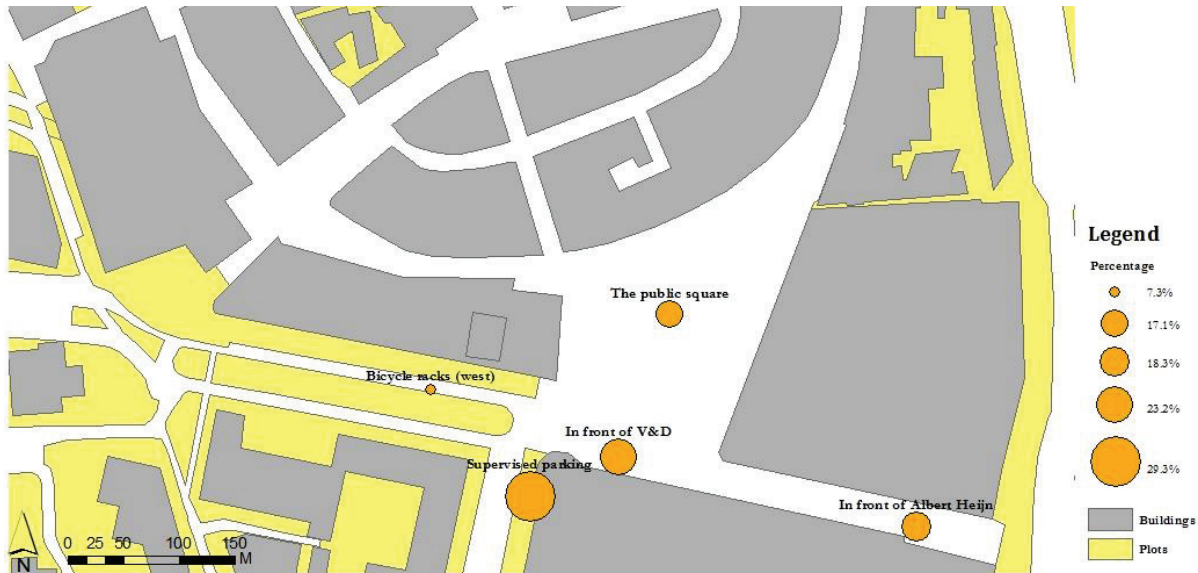
Figure 23: Choice of bicycle parking location (Van Heekplein)

Although supervised parking is the most utilized facility in Van Heekplein based on the results, some respondents avoid parking their bikes in this facility. According to Table 18, the most indicated reason for not making use of this facility is that it is located far from the desired destinations. Since the majority of bicyclists come to Van Heekplein for shopping and they spend a short time over there, they would prefer to park their bikes as close as possible to the shopping area.

Factor	Frequency
It is far from my usual destination	29
I have not thought about that	14
I do not know that there is a supervised bicyde parking over there	11
It is not easy to enter and exit the facility	9
The opening hours do not suit my schedule	5
It is not easy to find a parking location over there	2

Table 18: Indicated reasons for not parking in supervised bicycle parking facility (Van Heekplein)

Brief overview of factors which determine the choice of bicycle parking location in Van Heekplein (Table 19) shows that bicyclists first and foremost, park their bikes as close as possible to the destination. Availability of free, secure and supervised parking facility also affects the choice of parking location.

Factor	Frequency
It is close enough to the destination	56
There are always lots of places free here	21
My bicycle is safe here	21
The place is supervised and free of charge	21
My bicycle is now protected against rain and snow	13
It is convenient to park my bicycle here	13
I do not want to make any inconvenience for others	10
I just follow others	5
I do not know	1

Table 19: Indicated reasons for choosing a parking location (Van Heekplein)

Analyzing the general bicycle parking choice factors (presented in Table 20) is in line with the findings of Table 19. Being close to the destination is the most important factor for choosing a parking location. Availability of free and secure parking spaces is rated as important just as Table 20. Again, similar to Table 20, bicyclists do not normally follow other parked bikes in choice of parking location. Not obstructing others is ranked as a little bit important, which is in agreement with what happens in real situation (a small number of respondents consider this factor in choice of bicycle parking location).

Factors	Relative importance
Being close to destination	Very important
Parking price	Very important
Minimizing the risk of theft	Important
Parking opening hours	Important
Parking duration	Important
Availability of parking space	Important
Following other bicycles	A little bit important
Not obstructing others	A little bit important
Existence of supervised bicycle parking facility	A little bit important
Existence of sheltered bicycle parking facility	A little bit important
Avoiding the mess of bicycles	A little bit important

Table 20: Relative importance of bicycle parking choice factors (Van Heekplein)
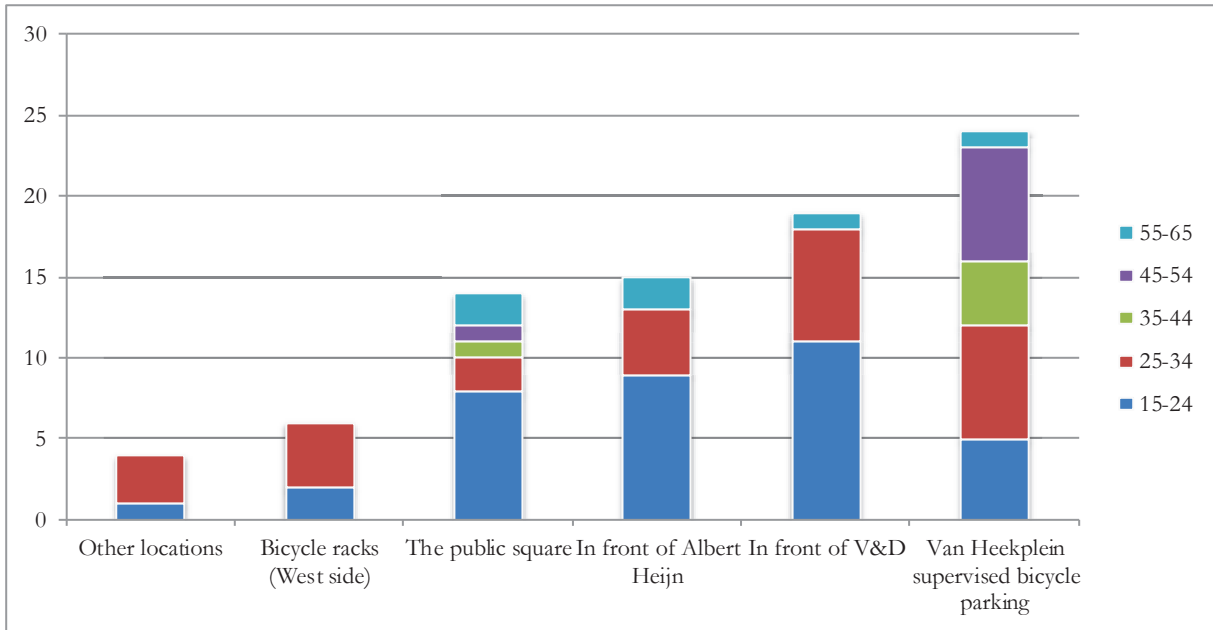
Figure 24: Frequency distribution of age groups between different parking locations (Van Heekplein)

Age as an individual characteristic of a bicyclist could affect the choice of parking location. Figure 24 shows the choice of bicycle parking location based on different age categories. It does not seem that a specific age group preferred a certain parking location. Meanwhile, Supervised parking facility is chosen by all age categories. This is due to the perceived security of this facility which minimizes the risk of theft.
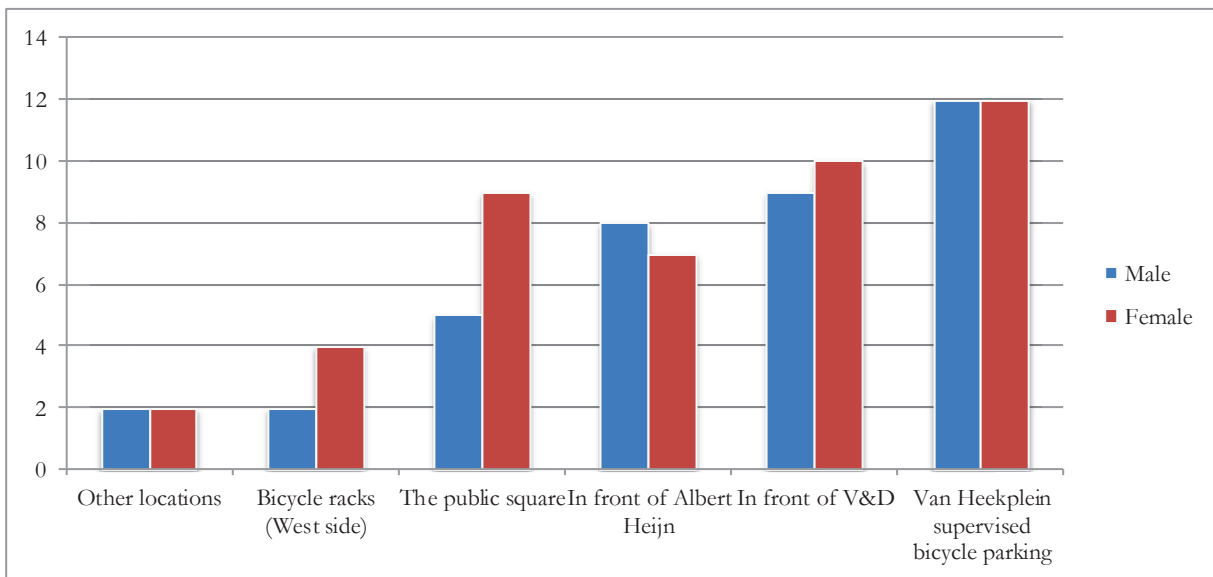
Figure 25: Gender and choice of bicycle parking location (Van Heekplein)

Males and females display changing attitudes toward choice of bicycle parking location. Choice of parking location based on gender is shown in Figure 25. While the supervise parking facility is preferred equally by both genders, more women are likely to park in public square and in front of department store. Analyzing the results shows that females do park in these two locations because it is close to their destination. According to the fact that lots of shopping areas are located in these two locations, women would prefer to park as close as possible to shopping areas and go for shopping.

Share of different living areas in choice of bicycle parking location is shown in in Figure 26.
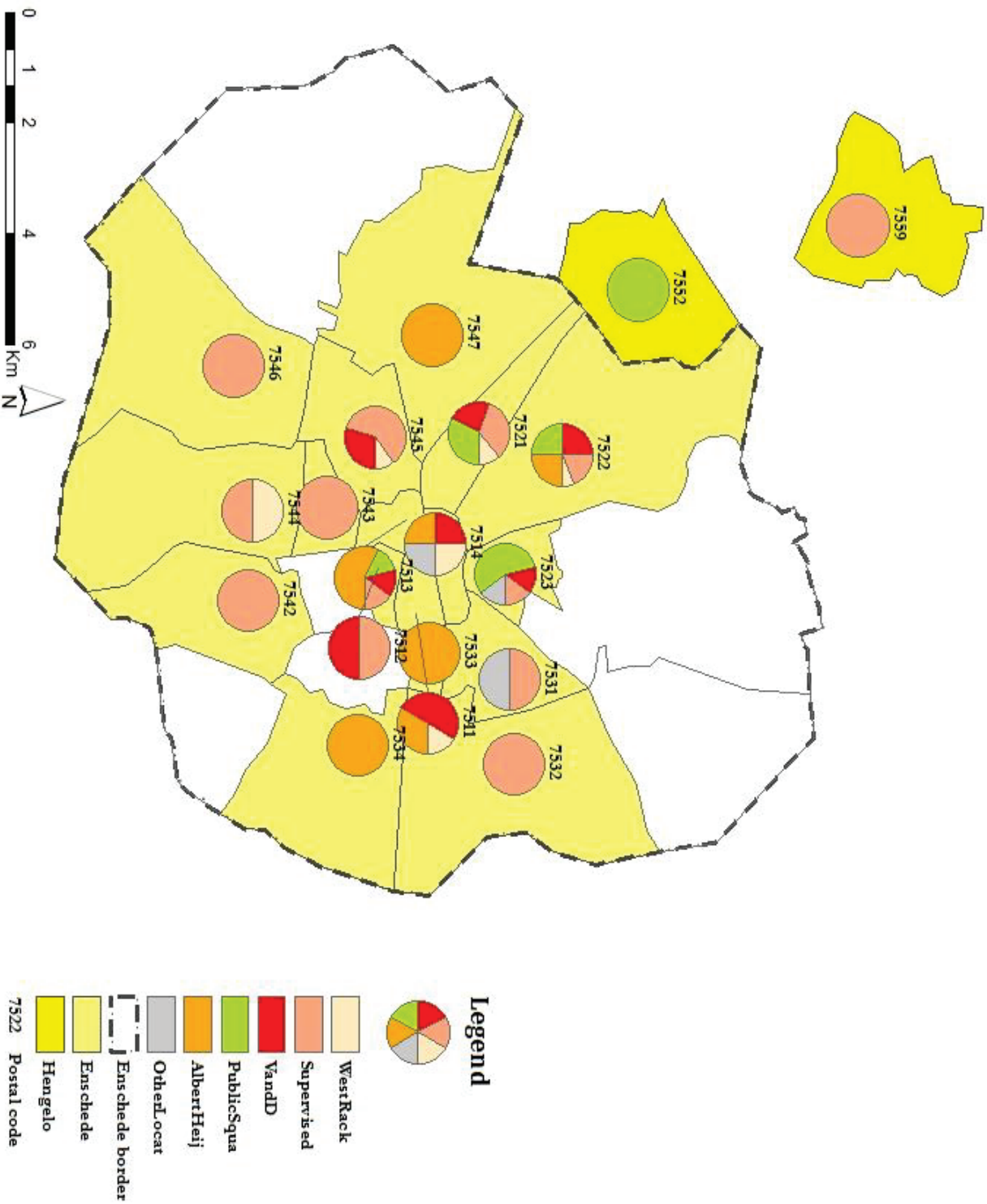
Figure 26: Choice of bicycle parking location based on the living neighborhood (Van Heekplein)

Legend

	WestRack
	Supervised
	VandD
	PublicSqua
	AlbertHeij
	OtherLocat
	Enschede border
	Enschede
	Hengelo
7522	Postal code

Figure 27 shows how choice of parking location varies based on the parking duration. While unguarded parking locations are chosen for short parking duration, the supervised parking facility is preferred considerably for longer periods. In short parking duration, proximity to destination and availability of parking spaces are influential factors, whereas secure and supervised location is chosen for longer parking intervals.
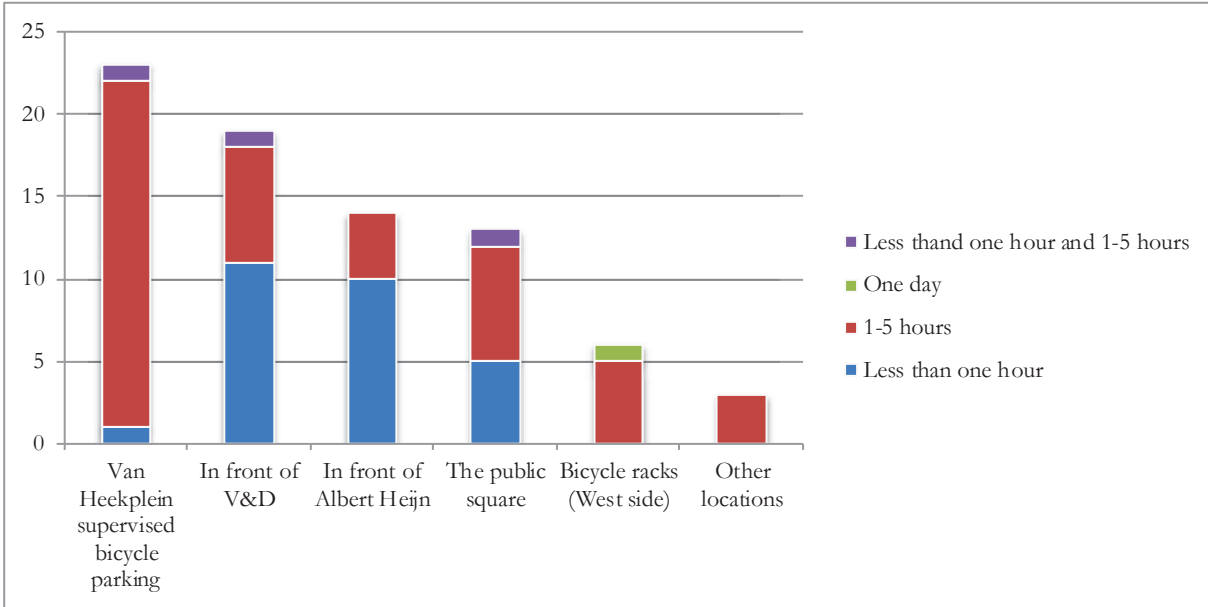
Figure 27: Choice of bicycle parking location in comparison with parking duration (Van Heekplein)

Figure 28 shows how parking locations are occupied during a day. Except for west side bicycle racks, the peak hour for parking a bicycle is between 13:00 till 17:00. When the shops close in the evening, the occupancy decreases considerably. Early in the morning and late at nights, parking facilities in Van Heekplein are not utilized at all. This is due to the type activity (shopping area) that happens in this location.
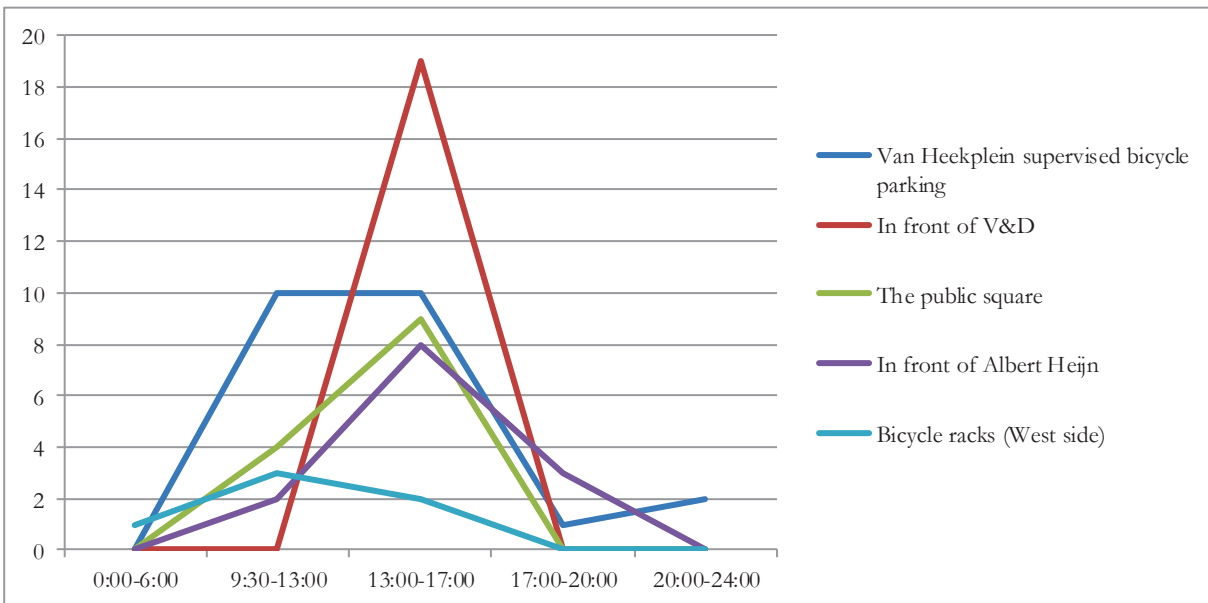
Figure 28: Choice of bicycle parking location based on the different times of a day (Van Heekplein)

The relation between parking frequency and choice of bicycle parking location is presented in Figure 29. As the figure illustrates, the choice of parking location does not vary between regular and irregular bicyclists. Both groups park their bikes in all available parking locations. Importance of other factors like parking duration and trip purpose could be the reason for this behavior.
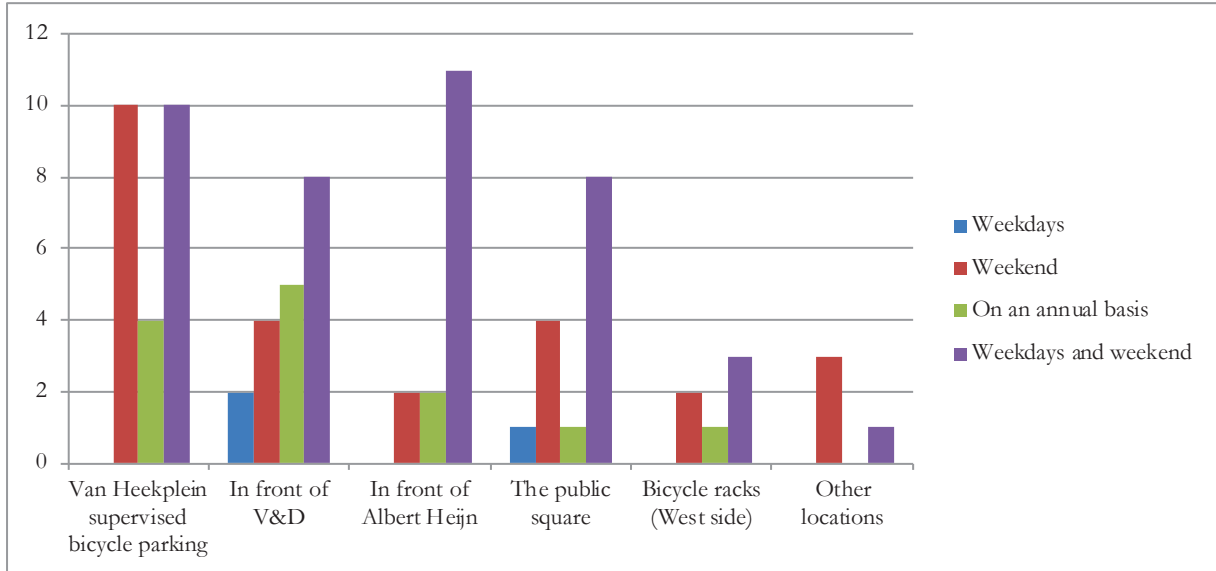
Figure 29: Parking frequency and choice of bicycle parking location (Van Heekplein)

The choice of bicycle parking location based on the trip purpose is shown in Figure 30. Shopping is the main intention for parking a bicycle in Van Heekplein. All locations are used as a parking space for doing the shopping. Those who park their bikes in Van Heekplein in order to go to home, dominantly choose the supervised parking.
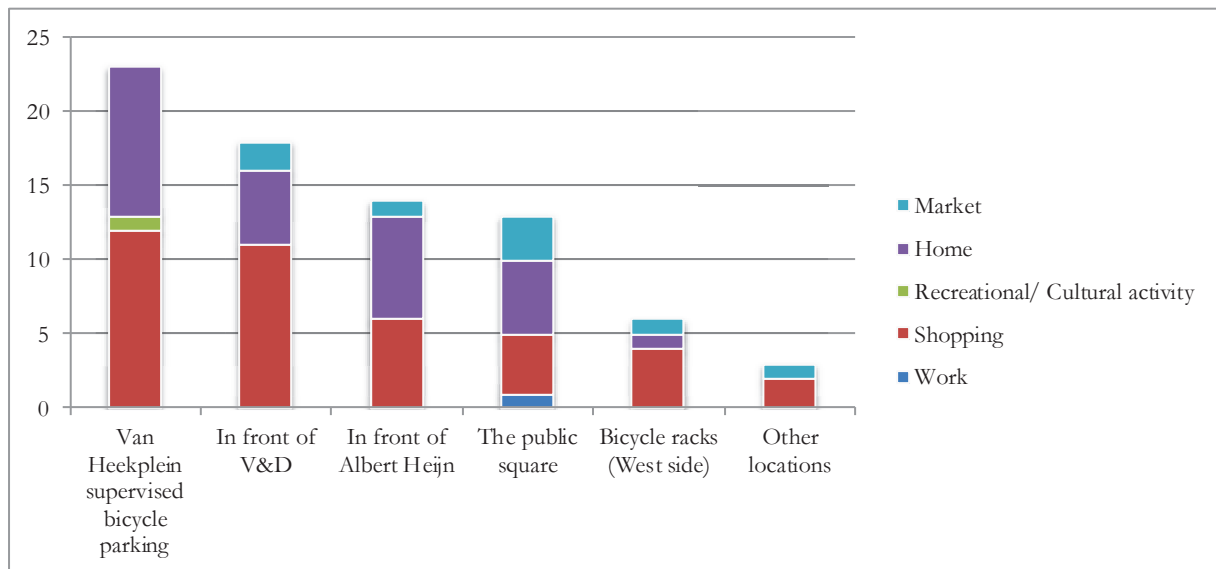
Figure 30: Choice of bicycle parking location based on the trip purpose (Van Heekplein)

Choice of bicycle parking location compared to bicycle value is illustrated in Figure 31. Bicycles with a high value are mostly parked in supervised parking. Unguarded parking locations are dominantly occupied by inexpensive bicycles. Bicycles in all price range are parked in the supervised facility. Free and secure parking spaces motivate bicyclists to park over there.
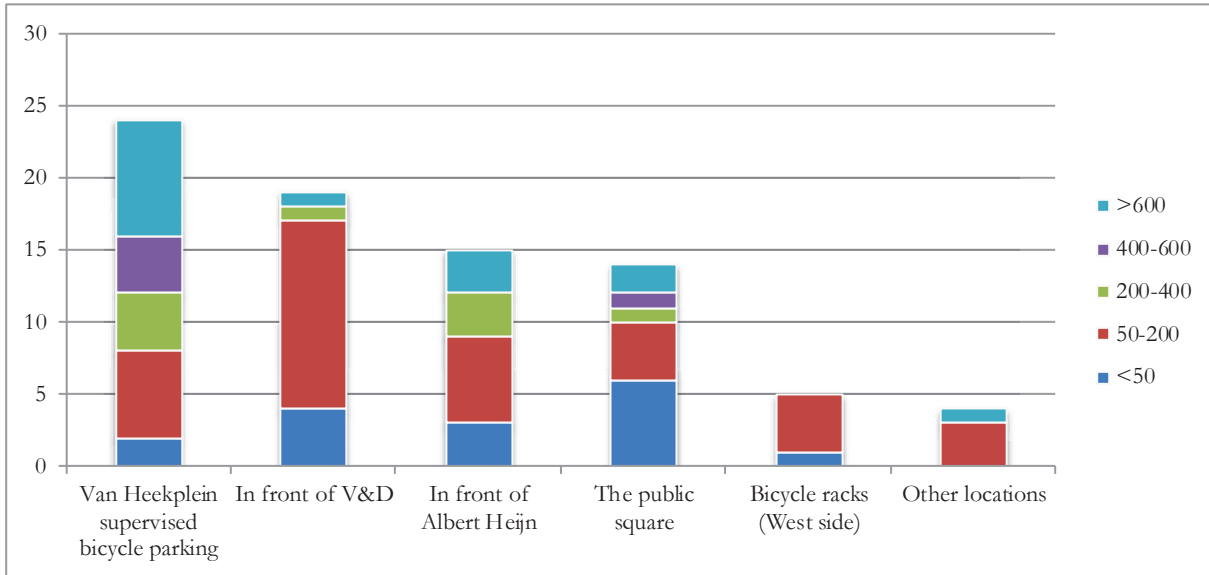
Figure 31: Choice of bicycle parking location based on the bicycle price (Van Heekplein)

More than 60% of respondents did not experience bicycle theft according to Table 21. It seems that bicycle theft decreases by parking in supervised parking location, while a considerable proportion of bicyclists who park their bikes in unguarded locations have experienced bicycle theft.

The preferred parking location	Bicycle theft	
	No	Yes
Van Heekplein supervised bicycle parking	50.5%	9%
In front of V&D	10.3%	10.3%
In front of Albert Heijn	12.8%	6.4%
The public square	11.5%	6.4%
Bicycle racks (West side)	6.4%	1.3%
Other locations	1.3%	3.8%
Total	62.8%	37.2%

Table 21: Choice of bicycle parking location and bicycle theft (Van Heekplein)

- **Determinants of Bicycle Parking Choice Behaviour**

Individual characteristics of bicyclists like age and living neighbourhood do play an important role in choice of bicycle parking location in Van Heekplein, while gender does not affect the choice considerably (Table 22). It means that coming from a certain direction determines the choice of bicycle parking location. At the same time, the choice of parking location varies across the age groups.

Among time related variables, time of parking and pick up, and parking period influence the choice of parking location. The shorter the parking period, the higher the chance a bicycle is parked in an unguarded location. Surprisingly, bicycle price and trip intention do not play an influential role in choice of bicycle parking location in the Van Heekplein.

Variable	P-value
Time of bicycle parking	0.000
Parking duration	0.000
Time of bicycle pick up	0.002
Age	0.009
Living area postal code	0.027
Bicycle price	0.074
Trip purpose	0.259
Bicycle theft	0.422
Parking frequency	0.424
Gender	0.922

Table 22: Determinants of bicycle parking choice (Van Heekplein)

- **Preferred Locations for New Bicycle Parking Facilities**

Similar to train station area preferred locations for future parking facilities are shown in Figure 32. Based on the indicated answers, justifications for choosing a specific location are classified in several groups which could be found in Appendix. The main indicated reasons are: being close to shops, potential location, and personal preferences. As the map shows, G4, D6, and F5 are the most indicated locations for new parking facilities. Although there are a considerable number of bicycle racks in D6, bicyclists demand for new parking facilities in this location. Low quality of racks could explain this issue. On the other hand, G4 as one of the potential locations is considered as an entrance point to the Van Heekplein. In addition, this is a very popular destination for bicyclists. Although a majority of respondents prefer new bicycle parking facilities in the public square, it is not allowed to install bicycle parking racks over there. The most favored parking facility in Van Heekplein is bicycle racks same as train station.
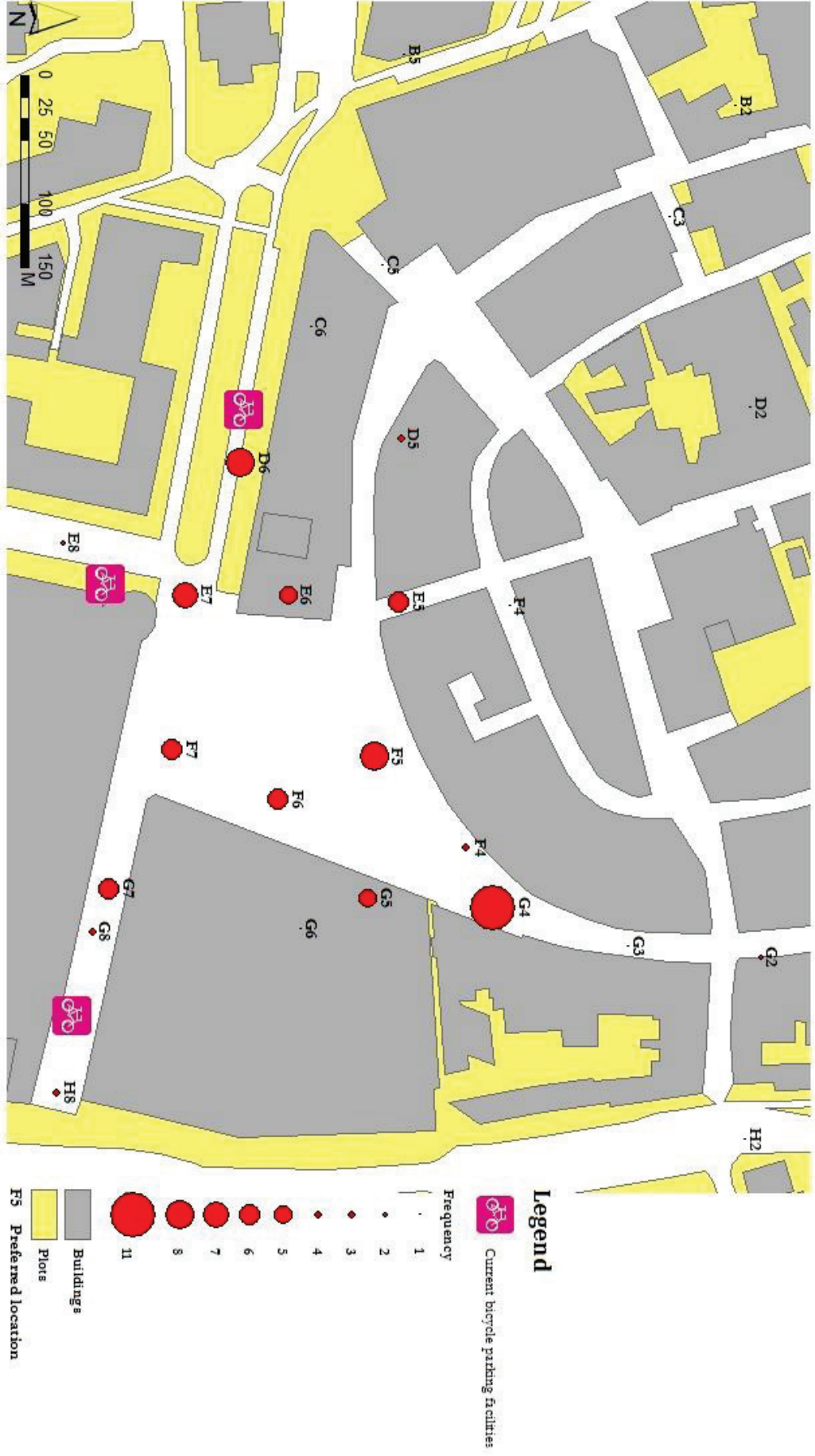
Figure 32: Spatial distribution of preferred locations for future bicycle parking facilities (Van Heekplein)

5.4. Disscusion of Results

Bicycle parking choice behavior is explored in few studies. A research by Maat and Louw (2013) concluded that students would like to avoid the extra cost of bicycle parking, while daily commuters make use of proper and good quality guarded parking facilities in train station. This is in line with the findings of this study where majority of respondents are in the 15-24 age range and have a bicycle with relatively low value. As a result they would prefer to park in a free parking facility.

Investigating the bicycle parking choice in four train stations (Leiden, Haarlem, Eindhoven and Nijmegen) (Fietsberaad, 2008) revealed that bicyclists avoid parking their bicycles in supervised parking facility because they found it time-consuming and expensive. In Enschede, on the other hand supervised parking facility is underutilized because of the high price and unsuitability of opening hours.

Analyzing the bicycle parking choice factors in both locations shows that, generally parking price and close distance to the destination are perceived as very important by bicyclists. The results of train station survey revealed that bicycle shed is chosen by most of the respondents as a parking location because it protects the bike against the inclement weather. For Van Heekplein, the determining factor for choice of bicycle parking location is a close distance to the destination. The minor importance of factors like avoiding the mess of bicycles and not obstructing others could justify the chaotic bicycle mess especially in train station area.

Following other parked bicycles as a bicycle parking choice factor is investigated by Fukuda and Morichi (2007) and Fujii (2005). They believe that the choice of bicycle parking for each individual strongly depends on the decisions made by other bicyclists. On the contrary, the results of the current research revealed that following other bicyclists in choice of parking location is not a significant factor in comparison with other choice factors. The possible explanation could be the cultural differences. While the aforementioned studies are conducted in Japanese environment, the current research reflects the Dutch bicycle parking behaviour.

Determinants of bicycle parking choice behavior in train station are: age, living neighborhood, bicycle value, time and duration of parking, and trip purpose. In Van Heekplein these factors are limited to age, living area, time of bicycle parking and pick up, and parking duration. In contrast to train station, bicycle price and intention of trip do not influence the parking choice. It could be explained by the fact that bicyclists park their bikes in train station for longer periods; as a result bicycles with a high value would be parked in a more secure location. Surprisingly, for both locations gender and experiencing the bicycle theft are not considered as important choice factors.

Analyzing the bicycle parking choice for estimating the acceptable distance for new parking facilities in a Japanese train station by Hossain et al. (2003) shows that bicyclists prefer locations which are as close as possible to the destination particularly in short parking durations. This is in line with the findings of current research in Enschede, Netherlands. Overviewing the indicated reasons for choosing a spot for future bicycle parking locations in train station and Van Heekplein shows that, personal preferences, close distance to destination, and perceiving the spot as a potential location are the main factors for making new demands. Respondents of both surveys prefer bicycle racks as a new parking facility.

The result of the survey conducted by Fietsberaad (2008) showed that bicyclists suffer from huge lack of bicycle racks. They also concluded that choice of parking location is a matter of habit which could be modified by relocating bicycle parking facilities to bicyclists' preferred locations or construction of new entrances to platforms. Besides, removing the illegally parked bicycles and creating more parking facilities could affect the parking choice.

Overviewing the recommendations of the current study in Enschede is in line with findings of the aforementioned survey. Here a distinction should be made between supply oriented (provision of parking

facilities) and demand oriented (actual needs and wishes of bicyclists) measures. While supply oriented measures are limited to the provision of secure and free of charge bicycle parking spaces, bicyclists request for extending the opening hours of parking facilities, organizing the mess of bicycles, improvement in accessibility between parking locations and destination, and removing the orphan bicycles more regularly. This could help considerably in increasing the capacity of bicycle parking facilities and make them well-utilized.

6.   CONCLUSIONS AND RECOMMENDATIONS

This chapter aims at concluding the research and propose recommendations for future improvements. Important observations from the study first will be presented as research achievements, following up by a discussion about the research limitations. Recommendations will be provided and some ideas for further research.

6.1.   Research Achievments

This study used two case study areas to analyse the bicycle parking choice in the train station area and the Van Heekplein in Enschede, Netherlands. Realized research objectives and specific research questions were answered as follows.

6.1.1.   Addressing the Research Objectives

The first research objective of the research was to identify the problematic bicycle parking locations and their characteristics. A number of interviews with experts were conducted in order to recognize problematic bicycle parking locations and the engaged problems. Deficiency of parking spaces, security concerns, accessibility problems, chaotic mess of bicycles, and poor quality of bicycle racks are among the main problems in these locations. Characteristics of these locations on the other hand were extracted from secondary data sources.

The second research objective was to explore bicycle parking choice behaviour and the influential choice factors in problematic locations. A survey was designed in order to examine the parking choice in two locations. Both surveys were answered dominantly by youth who possess an average price bicycle. Most of the bicyclists came from north-west of Enschede. Bicycle shed and supervised parking facility were identified as the most popular parking destinations. Bicyclists park their bikes generally in parking facilities for going to home and shopping. The choice of bicycle parking location shifted from the ground floor of bicycle shed during the morning and afternoon to the first floor of shed in the evening. The first floor of bicycle shed facility was chosen mostly by weekend commuters. For Van Heekplein all facilities were occupied dominantly in the shopping hours (13:00 pm-17:00pm). Statistical analysis revealed that choice of parking location in train station is highly correlated with bicycle value, living neighbourhood, age of the bicyclist, duration and time of bicycle parking, and purpose of the trip. Although influential choice factors were limited to age, living area, time of bicycle parking and pick up, and parking period in Van Heekplein.

The third objective of the research was to propose possible interventions based on the investigated bicycle parking choice behaviour and addressed similar to the second objective through the bicycle parking choice behaviour survey. Bicycle racks were ranked as the most popular type of parking facility in both case studies. Generally, bicycle price and close distance to destination were ranked as very important in choice of bicycle parking location. Besides, the preferred spots for new parking facilities were identified and illustrated in a map. Finally, Recommendations and suggestions are proposed by respondents and provide a better insight in to the demands and needs of bicycle parking users.

6.2.   Limitations

One of the main restrictions of this research was the lack of relevant literature about the choice of bicycle parking location. Although bicycle parking facilities as a supplement to cycling infrastructure, an important

element in increasing the bicycle usage, and a feedering mode in multimodal journeys are examined in a number of studies (AGV, 1994; Bickelbacher, 2001; Bördlein, 2000; Borgman, 2010; Buehler, 2012; Heinen et al., 2009; Hunt and Abraham, 2007; Martens, 2004, 2007; Moskovitz and Wheeler, 2011; Paez and Baetz, 2010; Portland Bureau of Transportation, 2010; Pucher et al., 2010; Rebecca Lehman et al., 2009; Rietveld, 2000; Rietveld and Daniel, 2004; Tracy Calvin et al., 2009), investigating the bicycle parking choice in particular has received scant attention (Fietsberaad, 2008; Fujii, 2005; Fukuda and Morichi, 2007; Hossain et al., 2003; Maat and Louw, 2013).

Moreover, not all of the experts were interviewed in order to identify problematic bicycle parking locations. Due to time limitation and receiving no response from stakeholders just a limited and available number of experts were interviewed. Those who were interviewed are considered as the most influential ones in planning and decision making process of bicycle parking facilities in Enschede. All interviews were conducted in English, although in few cases language barriers caused complications in interview process.

The interface for the online survey had some limitations and shortcomings (it is not possible to combine a picture with text in a same question); which in a more professional oriented research could be overcome.

This survey is distributed in form of paper questionnaire in entrance areas of parking facilities (both locations), on train (in train station), and in different shops in Van Heekplein. Normally bicyclists were not likely to answer a list of questions when they were exiting or entering the facility. Besides, distributing the questionnaire among people on shops also did not attract many respondents. On the contrary, going on a train and distributing the questionnaire between passengers was a more effective method for collecting the data. People had more time and were not busy with something else. In addition, they were not in a hurry for catching the train or parking their bicycles. Furthermore, language was a very major obstacle in communication with people. Especially with elderly bicyclists it was not very easy to approach and ask them for filling out the questionnaire. Being alone in collecting the data on the other hand was a very time-consuming process.

The online survey on the other hand was distributed by Internet dominantly in Facebook pages which are popular by young people rather than elderly age groups. Besides, sharing the survey in ITC and University of Twente news attracted mostly university students in young ages. It resulted in a sample with a relative high number of younger respondents.

6.3.   Recommaendations and Future Work

Interviewing more experts who provide in-depth and detailed overview about bicycle parking situation should be considered in future works. For future improvements it is advised to collect the data in groups (not individually) and try to convince bicyclist to cooperate. This could be done by offering incentives. Since a considerable number of respondents are in young age groups, In order to improve this obstacle data collection should be organized in a way which all age groups with different interests and demands will be able to answer the survey. Collecting more data from all age groups could provide better context for analysing the bicycle parking situation.

The structure of online survey did not reveal from where respondents informed about this survey. It would be a good idea to know which source of data collection attracted more respondents. As a result for future research those pages, groups, or websites could facilitate the data collection.

The findings could be utilized for organizing the current bicycle parking problems in two locations (train station and Van Heekplein). Determinants of bicycle parking choice behaviour on the other hand could be considered in planning the future bicycle parking facilities or policy interventions. For instance, since the living area and choice of parking location are highly associated to each other, it is of importance to provide bicycle parking facilities in entrance points to train station and Van Heekplein from different directions.

The locations which are identified as potential for new parking facilities could be used in future development. Recommendation and suggestions on the other hand could be a useful source for local authorities which provide an insight in to the bicycle parking situation in two hotspots of bicycle parking. The future work could focus on how to implement these recommendations through innovative approaches.

LIST OF REFERENCES

AGV. (1994). Onderzoek fietsvoorzieningen bij openbaar vervoerhaltes.

Amercian Planning Association. (1994). Retrieved 01.11.2013, 2013, from http://www.planning.org/lbcs/standards/activity.htm

Berelson, B. (1952). *Content analysis in communication research*. New York, NY, US: Free Press.

Bickelbacher, P. (2001). Bericht zur Vorheruntersuchung im MOBINET Arbeitspaket A4 Bike+ Ride. *SRL/SSP Consult, München*.

Bördlein, E. (2000). *The Munich bicycle development concept*. Paper presented at the Paper for the Velomondial 2000 Conference, Amsterdam.

Borgman, F. (2010). Fietsparkeren in Nederlandse gemeenten, de stand van zaken

BPS/BVH. (2007-2010). Fietsdiefstallen in Enschede.

Buehler, R. (2012). Determinants of bicycle commuting in the Washington, DC region: The role of bicycle parking, cyclist showers, and free car parking at work. *Transportation Research Part D-Transport and Environment, 17*(7), 525-531. doi: 10.1016/j.trd.2012.06.003

Celis, P., Bølling-Ladegård, E., Forbund, D. C. (2008). *Bicycle parking manual*: Danish Cyclists Federation.

City of New York, D. o. C. P. (2006). The New York City Bicycle Survey.

de la Bruhèze, A. A., Veraart, F. (1999). Fietsverkeer in praktijk en beleid in de twintigste eeuw. *Ministerie van Verkeer & Waterstaat, Den Haag*.

DERO Bike Rack Company. (2013). Retrieved 06.11.2013, 2013, from http://www.dero.com/

Field, A. (2009). *Discovering statistics using SPSS*: Sage publications.

Fiets Beraad. (2003). Ruimte voor de fiets: een problematisch succes. *Fietsverkeer*.

Fietsberaad. (2008). Fietsparkeerproblemen onder het vergrootglas.

Fietsersbond. (2013). Retrieved 06.11.2013, 2013, from http://www.fietsersbond.nl/english-info

Fujii, S. (2005). Reducing inappropriate bicycle parking through persuasive communication. *Journal of Applied Social Psychology, 35*(6), 1171-1196. doi: 10.1111/j.1559-1816.2005.tb02165.x

Fukuda, D., Morichi, S. (2007). Incorporating aggregate behavior in an individual's discrete choice: An application to analyzing illegal bicycle parking behavior. *Transportation Research Part a-Policy and Practice, 41*(4), 313-325. doi: 10.1016/j.tra.2006.09.001

Gemeente Amsterdam. (2012). Meerjarenplan Fiets.

Gemeente Enschede. (2011). Fietsparkeren binnenstad Enschede.

Gemeente Tilburg. (2005). Tilburg Fietst. *Fietsplan Tilburg, 2015*.

Givoni, M., Rietveld, P. (2007). The access journey to the railway station and its role in passengers' satisfaction with rail travel. *Transport Policy, 14*(5), 357-365. doi: http://dx.doi.org/10.1016/j.tranpol.2007.04.004

Haskoning. (1995). Evaluatie effecten COREO-project: Corridorstudie Enschede-Oldenzaal.

Heinen, E., van Wee, B., Maat, K. (2009). Commuting by Bicycle: An Overview of the Literature. *Transport Reviews, 30*(1), 59-96. doi: 10.1080/01441640903187001

Hine, J., Scott, J. (2000). Seamless, accessible travel: users' views of the public transport journey and interchange. *Transport Policy, 7*(3), 217-226.

Hossain, Q. S., Botma, H., Vandebona, U., Kiyota, M. (2003). *Acceptable Access Distance to Bicycle Parking Facilities*. Paper presented at the Transportation Research Board 2003 Annual Meeting CD-ROM.

Hunt, J. D., Abraham, J. E. (2007). Influences on bicycle use. *Transportation, 34*(4), 453-470. doi: 10.1007/s11116-006-9109-1

ITC News. (2013). Iranian student examines bicycle parking behaviour in Enschede Retrieved 23.01.2014

Janse, J., Van Bremen, J. (1995). Effectmeting fietsinfrastructuur bij zeven streekvervoerhalten: eindrapport. *DTV Consultants, Breda*.

Keypoint Consultancy (2013). Retrieved 06.11.2013, 2013, from http://www.keypointconsultancy.nl/index.asp?Taal2=EN

Kleizen, W., Klok, E., Lems, K., Spaan, G., Salomons, W., Rouwette, E. (2011). Fietsvisie 2010-2020.

Krippendorff, K. (2012). *Content analysis: An introduction to its methodology*: Sage.

Krizek, K. J. (2006). Two Approaches to Valuing Some of Bicycle Facilities' Presumed Benefits: Propose a session for the 2007 National Planning Conference in the City of Brotherly Love. *Journal of the American Planning Association, 72*(3), 309-320. doi: 10.1080/01944360608976753

Leeuw, P. d. (1998). Met de fiets naar de trein. Den Haag.

Ligtermoet, Welleman. (1997). De keten ov+fiets (Vol. 5, pp. 30-34).

Ligtermoet, D. (2009). Bicycle policies of the European principals:continuous and integral (pp. 120).

Maat, K., Louw, E. (2013). *Bicycle Parking Behaviour*. Paper presented at the Transportation Research Board 92nd Annual Meeting.

Martens, K. (2004). The bicycle as a feedering mode: experiences from three European countries. *Transportation Research Part D: Transport and Environment, 9*(4), 281-294. doi: http://dx.doi.org/10.1016/j.trd.2004.02.005

Martens, K. (2007). Promoting bike-and-ride: The Dutch experience. *Transportation Research Part A: Policy and Practice, 41*(4), 326-338.

Mehta, C. R., Patel, N. R. (1989). IBM SPSS Exact Tests: Camebridge Massachusetts.

Ministerie van Verkeer en Waterstaat. (1990). Tweede Structuurschema Verkeer en Vervoer (Second Transport Structure Plan). *Deel d: regeringsbeslissing. SDU, The Hague, the Netherlands.*

Ministerie van Verkeer en Waterstaat. (1997). Evaluatierapport Masterplan Fiets.

Ministerie van Verkeer en Waterstaat. (1998). Met de fiets naar de trein: voorwaarden die de rijksoverheid stelt aan fietsenstallingen bij spoorwegstations.

Ministerie van Verkeer en Waterstaat. (2007). Cycling in the Netherlands. *PWaWM (Ministry of Transport, Directorate-General for Passenger Transport).*

Moskovitz, D. A., Wheeler, N. (2011). Bicycle Parking Analysis with Time Series Photography. *Transportation Research Record*(2247), 64-71. doi: 10.3141/2247-08

Naegele, R. C., Wilbers, P. T., al., e. (1992). Integratie fiets-Openbaar Vervoer. Veenendaal.

Noord, G. (1995). Evaluatie-onderzoek keten fiets-openbaar vervoer Stadsgewest Leeuwarden.

Paez, A., Baetz, B. (2010). Short Term Bicycle Parking Utilization Study.

Politie Twente. (2012-2013). Diefstal van fiets gevolgd door geweld.

Portland Bureau of Transportation. (2010). Summer Bicycle Parking Corral Counts Retrieved 08.11.2013, 2013, from http://www.portlandoregon.gov/transportation/article/299925

Pucher, J., Dijkstra, L. (2000). Making walking and cycling safer: lessons from Europe. *Transportation Quarterly, 54*(3), 25-50.

Pucher, J., Dill, J., Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: an international review. *Preventive Medicine, 50*, S106-S125.

Rebecca Lehman, Jessica Zhong, Cheng, C. (2009). The provision and use of bicycle parking at Sydney region public transport interchanges.

Rietveld, P. (2000). The accessibility of railway stations: the role of the bicycle in The Netherlands. *Transportation Research Part D: Transport and Environment, 5*(1), 71-75. doi: http://dx.doi.org/10.1016/S1361-9209(99)00019-X

Rietveld, P., Daniel, V. (2004). Determinants of bicycle use: do municipal policies matter? *Transportation Research Part A: Policy and Practice, 38*(7), 531-550. doi: http://dx.doi.org/10.1016/j.tra.2004.05.003

Schneider, R., Patton, R., Toole, J., Raborn, C. (2005). Pedestrian and Bicycle Data Collection in United States Communities: Quantifying Use, Surveying Users, and Documenting Facility Extent.

Statistics Netherlands. (2014). Retrieved 15.02.2014, from WWW.CBS.nl

Taylor, D., Mahmassani, H. (1996). Analysis of stated preferences for intermodal bicycle-transit interfaces. *Transportation Research Record: Journal of the Transportation Research Board, 1556*(1), 86-95.

Taylor, S. (1996). Bike and ride: its value and potential. *TRL REPORT 189*.

The Victoria Transport Policy Institute. (2013). Retrieved 06.11.2013, 2013, from http://www.vtpi.org/

Tracy Calvin, and, D. C., Roper, P. (2009). Bicycle Parking Assessment:University of Colorado at Boulder University of Colorado at Boulder.

U.S Goverment Accountability Office. (1996). General Accounting Office," Content Analysis: A Methodology for Structuring and Analyzing Written Material: GAO/PEMD-10.3.1. Washington, DC.

University of Twente. (2013). Iraanse onderzoekt Enschedees fietsparkeergedrag Retrieved 23.01.2014

University of Washington. (2013). BICYCLE PARKING INVENTORY &UTILIZATION SURVEY REPORT.

Van Goeverden, C., Egeter, B. (1993). *Gecombineerd gebruik van fiets en openbaar vervoer: verwachte effecten op de vervoerwijzekeuze van optimale fietsbeschikbaarheid in voor-en natransport*: Technische Universiteit Delft, Faculteit der Civiele Techniek, Vakgroep Verkeer.

VHSE. (2013). Retrieved 09.11.2013, 2013, from http://www.vhse.nl/

Voerknecht, H., Fruianu, M., Munck, G. d. (2009). Cycling in the Netherlands.

Wardman, M., Tight, M., Page, M. (2007). Factors influencing the propensity to cycle to work. *Transportation Research Part A: Policy and Practice, 41*(4), 339-350.

Weber, R. P. (1990). *Basic content analysis*: Sage.

APPENDIX A: BICYCLE PARKING CHOICE BEHAVIOR SURVEY (TRAIN STATION)

<b> **Bicycle parking location choice behaviour (Train station)**

Part A

Dear respondent,

I am an M.Sc student at the ITC faculty of the university of Twente. My thesis topic is about bicycle parking location choice behavior. Understanding the behavior could help considerably in planning the future bicycle parking facilities and organizing the current situation. As a part of my research I have made the following set of questions for investigating how bicyclists behave when park their bicycles at train station area. The collected data will only be used as an input for my research and treated strictly confidential.

The questionnaire consists of two parts and containing open, multiple choices, rating scale, and ranking questions.

I kindly would like to ask you to give me just 10 minutes of your precious time and fill out the following survey.

＊2. Do you normally park your bicycle at train station area?

◯ Yes   ◯ No

3. How often do you park your bicycle usually at train station area during working days?

	0	1	2	3	4	5
Working days per week	◯	◯	◯	◯	◯	◯

4. How often do you park your bicycle at train station area usually during weekends (times per month)?

	0	1	2	3	4
Saturday	◯	◯	◯	◯	◯
Sunday	◯	◯	◯	◯	◯

5. If you have answered questions 2 AND 3 with 0, please indicate how many times you parked your bicycle at train station area during the past year?

[   ]

6. What is your age category?

◯ 15 - 24   ◯ 25 - 34   ◯ 35 - 44   ◯ 45 - 54   ◯ 55 - 65   ◯ > 65

7. Gender:

◯ Female   ◯ Male

8. Please indicate the postal code of your residential area:

ZIP/Postal Code: [   ]

<b> Bicycle parking location choice behaviour (Train station)

9. What is the value of your currently used bicycle?

○ <50 Euro   ○ 50-200 Euro   ○ 200-400 Euro   ○ 400-600 Euro   ○ >600 Euro

10. Have you experienced bicycle theft in last five years?

○ Yes   ○ No

11. How many times have you experienced bicycle theft in last five years?

12.

Where do you park your bicycle normally at train station area?

○   ○
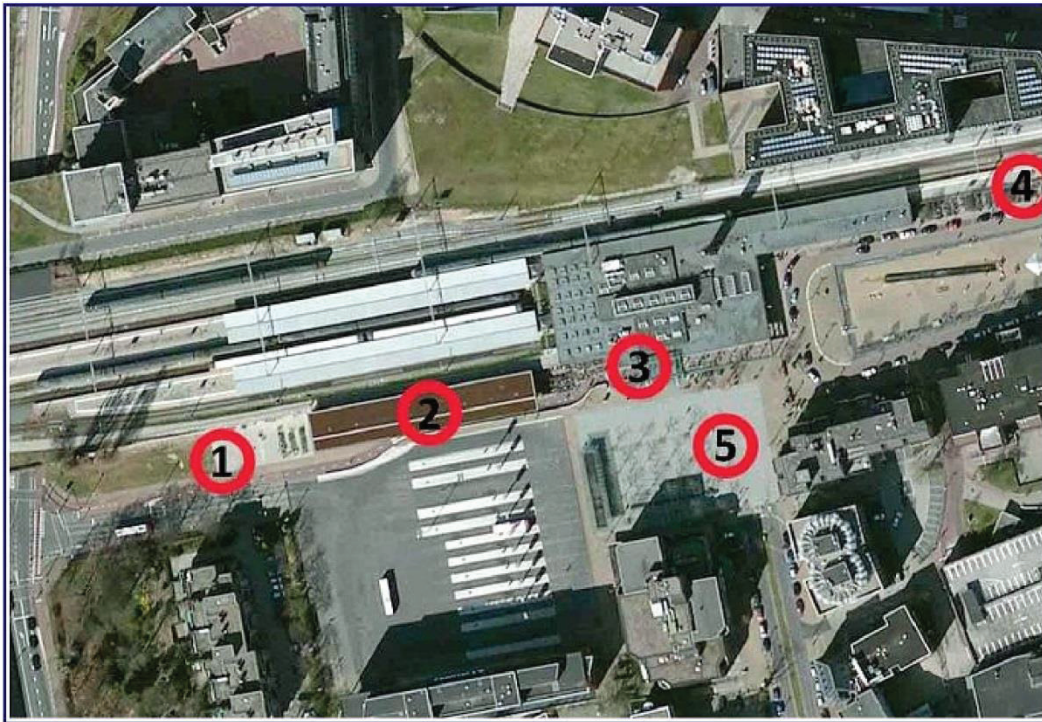
1. Bicycle racks (West side)   **4. Bicycle parking (East side)**

○   ○

\<b\> Bicycle parking location choice behaviour (Train station)

2.1. Bicycle shed (Ground floor)

○

5. Free standing area

○

2.2. Bicycle shed (First floor)

○

Other locations

3. Supervised bicycle parking

\<b\> Bicycle parking location choice behaviour (Train station)

13. Which of the following options best indicates your reason for Not parking your bicycle at the supervised bicycle parking facility? (More than one answer is possible)

☐ It is too expensive

☐ The payment method is inconvenient (Chipknip,subscription)

☐ The opening hours do not suit my schedule

☐ It is far from the platforms

☐ It is not easy to find a parking location over there

☐ It is NOT easy to enter and exit the facility

☐ I don not know that there is a supervised bicycle parking in train station area

☐ I have not thought about that

Other (please specify)

[   ]

14. Why do you park your bicycle in your preferred location? (More than one answer is possible).

☐ It is close enough to the (initial) destination

☐ There are always lots of places free here

☐ I just follow others

☐ My bicycle is safe here

☐ The place is supervised

☐ My bicycle is now protected against rain and snow

☐ My bicycle is not obstructing anybody else in their movements

☐ I don't know

Other (please specify)

[   ]

15. For how long do you usually park your bicycle at train station area?

☐ Less than one day

☐ 1-2 days

☐ More than 2 days

Other (please specify)

[   ]

<b> Bicycle parking location choice behaviour (Train station)

16. What is the usual time of bicycle parking at train station area?

○ 0:00-6:00

○ 6:00-9:30

○ 9:30-13:00

○ 13:00-17:00

○ 17:00-20:00

○ 20:00-24:00

17. What is the usual pick up time of your bicycle from train station area?

○ 0:00-6:00

○ 6:00-9:30

○ 9:30-13:00

○ 13:00-17:00

○ 17:00-20:00

○ 20:00-24:00

18. After parking your bicycle you would usually:

○ Take a bus

○ Take a train

○ Visit the city centre

Other (please specify)

[   ]

19. What is usually your purpose for taking a train/bus/visiting the centre? To go to:

○ your work

○ another location because of my work

○ school / university

○ shop(s)

○ recreational / cultural activities

○ your home

or another place (please specify)

[   ]

<b> Bicycle parking location choice behaviour (Train station)

20. How important are the following factors for you in choice of a bicycle parking location? Please indicate on a scale of 1 (Not important at all) to 4 (Very important)

	Not important at all	A little bit important	Important	Very important
As close as possible to the destination	○	○	○	○
Minimize risk of theft	○	○	○	○
Parking price	○	○	○	○
Parking duration	○	○	○	○
Availability of proper parking space	○	○	○	○
Avoiding the mess of bicycles	○	○	○	○
Bicycle parking opening hours	○	○	○	○
Supervised bicycle parking	○	○	○	○
Sheltered bicycle parking	○	○	○	○
Not obstructing anybody else in her/his movement	○	○	○	○
Following other parked bicycles	○	○	○	○

<b> Bicycle parking location choice behaviour (Train station)

Part B

21.

At what location(s) would you like to see new/more bicycle parking facilities? You can indicate more than one location;for example: A1, B2, C3 etc.
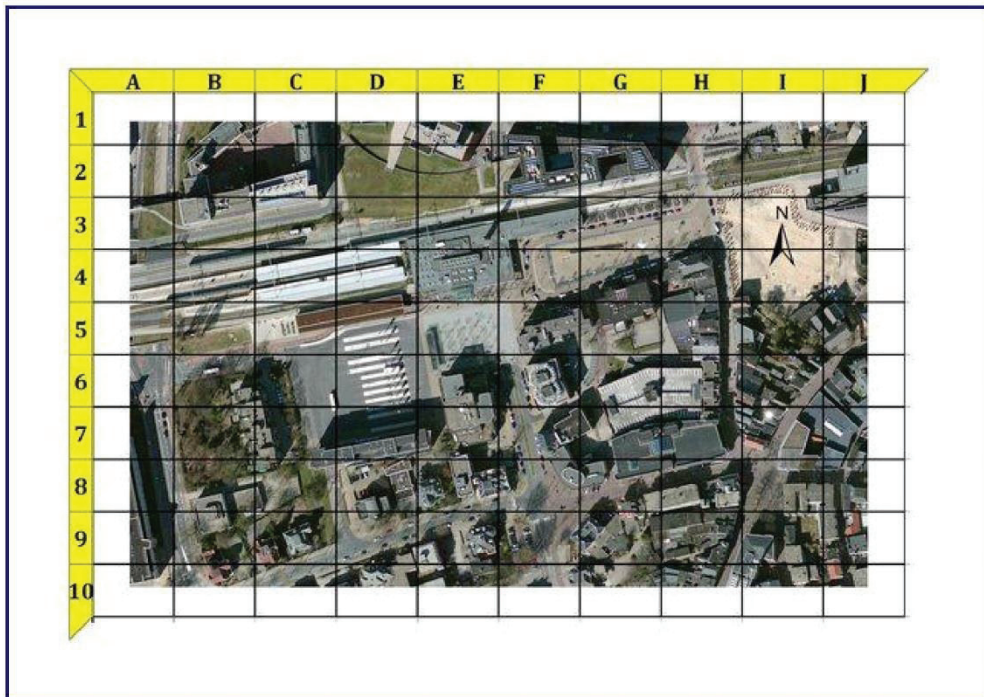
22. Why did you choose that specific location?

<b> Bicycle parking location choice behaviour (Train station)

23. What kinds of facilities would you prefer generally in the indicated locations? Please rank the following in order of importance to you.

☐	Bicycle parking rack	☐ Do not care
☐	Supervised bicycle parking	☐ Do not care
☐	Sheltered bicycle parking	☐ Do not care
☐	Bicycle locker	☐ Do not care
☐	Automated bicycle storage system	☐ Do not care

24. If you have any further suggestion or recommendation for improving bicycle parking around the train station, please comment here.

25. If you would like to receive the feedback of this survey please in the fields below indicate your name and Email address.
I would like to take this opportunity to thank you for taking the time to complete the survey.

Name:

Email Address:

＊26. This is the end of survey please select the Finish option in order to end it.

◯ Finish

APPENDIX B: OPEN-ENDED QUESTIONS (TRAIN STATION)

Indicated reasons for Not parking in supervised bicycle parking facility

Given Answer	Interpretation	Code
Why should you pay for something that is free? If you walk a little bit further you will have a free one where you don't have to pay for	Not willing to pay for bicycle parking	6
My house is close by the train station. As a result there is no reason to pay for that	Not willing to pay for bicycle parking	6
Takes too much time	It is time consuming	5
I'm not going to pay to park my bike!	Not willing to pay for bicycle parking	6
Unsafe feeling, you would like in the evening only going fast through the tunnel. Moreover, the ordinary bicycle storage I've clicked on in the evening, is also not safe, many dealers so you need to think where you put your bike and how quickly you again (or together with others) leave the bike shed	Lack of security	7
Don't find it necessary if my bike stays only for a short period on the railway station	Not being mandatory to park in supervised bicycle parking	2
Non-guarded bike parking works fine/too much hassle	It is inconvenient to park there	4
Costs time	It is time consuming	5
Costs extra time	It is time consuming	5
Also takes just too long if you want to get the train. This is already a problem in the covered shelter, but guarded is more time-consuming than other options	It is time consuming	5
Not really necessary for sporadically for short time (max 14 hours) bike parking. I did it in the past for daily parking	Short parking period	3

Indicated reason for parking in the preferred parking location

Given Answer	Interpretation	Code
My bicycle has less chance to get stolen on the ground floor than the first floor. The thief has more time to steal a bike on the first floor.	Secure location	1
My bicycle is safe at home and at the bicycle shed at ITC	Secure location	1
There are also better and free of charge bicycle parking places in the bicycle parking garage called 'stalling De Graaf close to the station	Personal preference	6
Because is safer than in the street alternatives and cheaper (no cost) than the supervised option	Secure location	1
It is also close to the route to home	Being close to bicycle paths	2
Don't want to risk losing my bike when the municipality takes my bike in a clean-up.	Minimizing the risk of bicycle removal	3
Easy, no intermediary to park your bike.	It is inconvenient to	4

		park there	
In the direction of my house. It feels like a detour to park in the indoor garage.		Personal preference	6
Time		It is time-saving to park there	5

Reasons for choosing the specific location for future bicycle parking facilities

Indicated Location	Given Answer	Interpretation	Code
F8	Close to the shops	Being close to shops	2
E5, F4, G4	A lot of space which is now not used	Potential location	3
E5, D5, G3	Close to platform	Being close to train station	14
E5	Enough space	Potential location	3
-	No need for a new location	No need for more bicycle parking spaces	8
G3	Replaced messy situation with small covered shed; near route from home and next to the platform	Being close to bicycle paths, Being close to train station	1 14
D2, D3, E2, E3	Plenty of space and possibility to enter station from the other side	Connecting point between platforms and bicycle parking, Potential location	10 3
H2	H2 used to be a good storage place for me coming from 7522 BJ	Personal preference	6
C5	Close to existing covered bicycle shed	Being close to existing parking facilities	11
G3 H3	I park my bike there always, that whole square is unused. The covered bicycle parking is always much too full and a large mess, so I almost never come there	Personal preference	6
D4, G3	Close to the station	Being close to train station	14
D5, C5, G3, H3	I think the existing bicycle parking to the left of the track can be higher. To make a transit in the future from the first floor directly to the platform, there are probably more people using this possibility and won't park their bicycle not outside the parking storage. After all, this is the shortest route to the platform	Connecting point between platforms and bicycle parking	10
E5	Nonsensical space, could be much more done with it; as some time back temporarily was possible	Potential location	3
	With the proposed crossing ability over the railway track the station is close by, and it saves time (one traffic light) and distance coming from the Hengelosestraat	Connecting point between platforms and bicycle parking	10

D3			
G3	Easily accessible from the East	Accessible location	12
C5	I like the covered bicycle shed, but in the weekend too full. The shed should be expanded to C5	Personal preference	6
E5	This is a convenient place if you want pick up someone from the bus or train	Being close to train and bus station	15
E5	Very close to the train station, with hurry you don't want to have to walk far	Being close to train station	14
E5, E6, F5, F6	I don't need to cross over the station square to reach the bike shed	Personal preference	6
D1, D2, E1, E2	Closer to home	Personal preference	6
E5, D5	Close to the station and in the direction of my work	Being close to train station	14
C5, D5	The place over there is fine, only the parking shed is not well accessible, partly because there is too little space available for bicycles	Potential location	3
C6	Bicycle thieves feel here being watched more than for example, at location B5. C6 is also quite close to the railway station.	Secure location	13
G3	It is always extremely full on this side	Potential location	3
F1, G1, G4, F4	The location is on my route	Being close to bicycle paths	1
E5	This is the closest to the station	Being close to train station	14
C4	Close to the station	Being close to train station	14
E5, B5, C5	Close to station	Being close to train station	14
E5	Close by	Being close to train station	14
F3	Near the entrance and space left. On the side of my living location	Being close to train station, Personal preference	14 6
C5, D4, E5, H2	Close to the station	Being close to train station	14
D5	Often full	Potential location	3
E5	Right in front of the entrance of Central station	Being close to train station	14
E5	Close to entrance of the train station and bus stop	Being close to train station	14
F3, G3, H3	Close to the station and I come from that side	Being close to train	14

		station,	6
		Personal preference	
H2	Close to my house, location is convenient	Personal preference,	6
		Convenient location	16
D4, D5, E4, E5	Because there now often already a lot of bicycles, but unordered. This prevents people who park their bicycle neatly, to pass along. Furthermore it is close to the station	Being close to train station, Potential location	14 3
F4, G3, G4	Near entrance station and in the direction of my house + Centre	Being close to train station, Personal preference	14 6
E5	Close by	Being close to train station	14
E5, F5	Close by	Being close to train station	14
C5, D5	Relatively close to station and there are relatively few people	Being close to train station	14
C5	Often not enough place	Need for more parking spaces	17
A5, B5, C5	From that side I arrive by bicycle	Personal preference	6
E5	Current storage facilities little focused on bus	Being close to bus stop	18
I1	I parked there in the past when there was still a bike shelter	Personal preference	6
C3	Possible	Potential location	3
D5	Convenient place	Convenient location	16
E5, C5	Close by and enough space	Being close to train station	14
B5, C5	That's fairly close	Being close to train station	14
B5, C5, G3	All are close to the station. According to me there is still plenty of room at B5/C5 and I think the parking spaces at G3 can be better and more efficient	Being close to train station	14
F3, G3, H3	That location is the closest to my destination and there is never enough place to put my bike in the shelters	Personal preference	6
D5, C5, G3	Increase the capacity	Need for more parking spaces	17
G3	Location where I always park, but always quickly fully occupied	Personal preference	6
D5	That location is already good, but it is often such an	Convenient location	16

	incredible mess of bicycles. The entrance at the front of the bicycle storage is often blocked to pass through in a normal manner		
C5, D5, E5	Existing shed I find fine but it has often too little space. A little more expansion would be nice	Need for more parking spaces	17
-	There are enough parking places	No need for more parking spaces	8
F4, F5, E5	Directly on the station and the location where I drop my bike now	Personal preference	6
B5, C5	Close to the station and the other shed	Being close to train station, Being close to other parking facilities	14 18
F8, G8	Slightly quieter because it is just outside the station and in the evening there are many people making the risk of theft less	Secure location	13
G1	Distance	Being close to train station, Being close to other parking facilities	14 18
E5	Easy to reach and easy to walk to station	Accessible location	19
C3	Empty lot	Potential location	3
E4	Most convenient	Convenient location	16
B2	Not standing in other ones way	Not obstructing others	20
D7	Convenient for me	Convenient location	16
F3	I park it always there and its really close to it	Being close to train station	14
B5	It is close by the train station and there is open space for constructing new parking facilities	Being close to train station Potential location	14 3
G3	Near the railway station. Located in the direction from where I cycle to the station	Being close to train station	14
E5	Seems like a good place	Potential location	3
F5	It is close and convenient	Being close to train station Convenient location	14 13
E6, F7, H8, I8	Close to city	Being close to city	21
B5	It is close	Being close to train station	14
E7	Proximity with road lanes - Surrounding of building facilities - Perceived safety	Being close to bicycle paths, Secure location	1 13
D4, E5, G3	A connection between the bike stalling and the station	Connecting point	10

	platform would be great. Also G3 is always too crowded	between platforms and bicycle parking, Organizing the mess of bicycles	22
E5	Nearer to the bus station	Being close to bus station	14
C5, D5, E5, E4	Close to station, convenient	Being close to train station, Convenient location	14 / 16
D2, E2	There's no use of that space at the moment	Potential location	3
E5, B5	Because they are "free" areas and it would require too much to build new facilities there and it is close enough to the station. Actually there is already a new one in B5!	Potential location, Being close to train station	3 / 14
G3	There is not enough space there, if you live on that side of town, it is a hassle to park your bike in the bicycle shed at C-D5	Need for more bicycle parking space	17
F3, G3	Because it is a very convenient location for me	Convenient location	16
E5	That square has no use at all, just fill it up with bicycles	Potential location	3
G3	lots of bikes parks there, but not enough facilities which automatically leads to a mess	Lack of appropriate bicycle parking facilities	23
C3, D3	Back of station, when coming from the North: Note it would require a North entry of the station (does not exist at the moment)	New entrance point to train station (from North)	24
C4, D4	The best spot	Potential location	3
D5, E5	Close to the entrance of the train station	Being close to train station	14

Recommendations, Suggestions, and Ideas

Given Answer	Interpretation	Code
Free space without a price	Need for more bicycle parking space	1
2nd bike rack above the 1st one	Need for more bicycle parking space	1
Make it possible to enter the platforms of the train station from the top floor of the sheltered bicycle parking. What I really missed as a factor in choosing were I park my bike, is the time I have to find a spot. If I'm late for my train, I rather just park it randomly and catch my train, instead of finding a safe/sheltering spot and miss it.	Make a connection between the first floor and platforms	9
I think making separate parking lots based on the time duration for parking can be helpful. I addition, parking areas for kids or even based on gender may lead to better supervision.	New parking facilities based on parking duration, gender, or age	10
Connects the covered bicycle shed directly with the platforms, instead of that you have to leave via the bike path, again up the stairs to the square and then again by the station Hall. Very frustrating!	Make a connection between the first floor and platforms	9

There is too little space in the covered bicycle shed	Need for more bicycle parking space	1
More capacity	Need for more bicycle parking space	1
Connection from the top floor of the garage directly to the station. Not only cycling cleaning the bicycles that are wrongly parked on the square, but also the wrongly parked bicycles in the bicycle racks. Bikes in the bicycle racks outside a rack are much more annoying than a few bikes against a tree	Make a connection between the first floor and platform, Removing the orphan bicycles	9 6
Direct access from the first floor from the covered bicycle parking to the platform. This will make more people motivated to park their bike upstairs in the stables/shed	Make a connection between the first floor and platform	9
Improving the security	Improving the security	11
Bicycle storage number 2: Many bikes will be parked over there for many weeks. Bicycles are parked on the stairs making it difficult to enter/exit of the bike shed. Many bikes are being placed at the (ordinary) staircase towards the station making it difficult to reach the stairs and parked bicycles are knocked over	Removing the orphan bicycles	6
More covered parking space	Need for more bicycle parking space	1
More is better	Need for more bicycle parking space	1
Just more storage facilities close to station, preferably indoor and free. The object that is now there is always full.	Need for more bicycle parking space	1
With bike racks with two floors and a connection to the platform of the station would be ideal	Make a connection between the first floor and platform	9
It would be nice if a bicycle shed is built next to the existing indoor (C5). This should be on the top floor (equal to the platform) have a transit to the station so that one does not have to walk. This would also improve the existing bicycle parking (C5)	Need for more bicycle parking space	1
From the 1st floor a direct way to the station	Make a connection between the first floor and platforms	9
A larger covered bicycle shelter. The current new shed is a missed opportunity	Need for more bicycle parking space	1
The first floor of the covered bicycle shed is located almost directly on the platform, but cyclists must walk quite a distance to reach the platform. It would be a lot faster if here is a direct link	Make a connection between the first floor and platforms	9
The unguarded bicycle parking on the top floor (2 floors) should get a transit to the station. The shed will be used much more	Make a connection between the first floor and platforms	9

More bike racks and more covered/guarded	Need for more bicycle parking space	1
It would be an improvement, if the current bicycle shed to the East would be expanded. Then there can be made a direct connection between the second floor of the bike shed to the platform	Make a connection between the first floor and platform, Need for more bicycle parking space	9 1
More covered bicycle shed	Need for more bicycle parking space	1
Remove more incorrectly parked bikes. This often leads to difficult situations regarding the access to the usual bike storage	Removing the orphan bicycles	6
More safety	Improving the security	11
Maximum parking time in storage, towing policy	Extending the parking opening hours	5
Kind of walkway from the first floor of the garage to the station, It irritates if I have to walk around	Make a connection between the first floor and platform	9
Rather think that they just have to wipe clean once in a while as there are so many stolen bikes parked	Removing the orphan bicycles	6
Underground parking directly in front of station (just like Groningen, Amsterdam-zuid)	Installing bicycle racks just in front of train station entrance	12
The organization of the bikes in public storage facilities should be better. Bicycles are parked haphazardly around the entrance so that it becomes inaccessible	Removing the orphan bicycles	6
The taxi stand in my opinion can be placed further away from the station, provided that there are good signage/signposts. Many big cities have this kind of facilities further away from the station. Also the current piece of parking on G3 could become a larger area/complex, for example indoor as with D5. This takes a little more effort and time to get your bicycle parked, but now it's at the bicycle racks at G3 always a huge mess and the parking your bicycle over there is not good for your bike Lockers are nice but not too much. For example, In the past a mistake was made when and a lot of lockers were placed at Drienerlo, while these were hardly used and the rest of the bike parking space was a mess. Lockers are nice, but people who want to have these can already use the covered bicycle shelter. There is just more normal parking space required. Furthermore, there should be more and stricter control on illegal/wild parking (and then not those people who use the ATM and put their bike in front of the station, but those who throw their bike down and go to the train). Especially, the bicycles in between the covered storage and the station	Replacing the taxi stand, Need for more bicycle parking space, Removing orphan bicycles, Organizing the mess of bicycles	13 1 6 3

cause a lot of nuisance as well as the fact that you cannot reach your bicycle as "neat" bicycle user. The motivation to not just drop your bicycle in front of the stations disappears in such a way. Why would you be neat and park further away if you need to survival in-between the incorrectly parked bicycles to reach the station?	
Earlier remove bicycles that are being parked already for a long time (this was last year have already done more than before)	Removing the orphan bicycles 6

Table 23: Interpretation of open-ended questions (train station)

APPENDIX C: BICYCLE PARKING CHOICE BEHAVIOR SURVEY (VAN HEEKPLEIN)

\<b\> Bicycle parking location choice behaviour (Van Heekplein)\</

Part A

Dear respondent,

I am an M.Sc student at the ITC faculty of the university of Twente. My thesis topic is about bicycle parking location choice behavior. Understanding the behavior could help considerably in planning the future bicycle parking facilities and organizing the current situation. As a part of my research I have made the following set of questions for investigating how bicyclists behave when park their bicycles at Van Heekplein. The collected data will only be used as an input for my research and treated strictly confidential. The questionnaire consists of two parts and containing open, multiple choices, rating scale, and ranking questions.

I kindly would like to ask you to give me just 10 minutes of your precious time and fill out the following survey.

*2. Do you normally park your bicycle at Van Heekplein?

◯ Yes   ◯ No

3. How often do you park your bicycle at Van Heekplein in working days?

	1	2	3	4	5
Working days per week	◯	◯	◯	◯	◯

4. How often do you park your bicycle at Van Heekplein at weekends (times per month)?

	1	2	3	4
Saturday	◯	◯	◯	◯
Sunday	◯	◯	◯	◯

5. If you have answered questions 2 AND 3 with 0, please indicate how many times you parked your bicycle at Van Heekplein during the past year?

[   ]

6. What is your age category?

◯ 15 - 24   ◯ 25 - 34   ◯ 35 - 44   ◯ 45 - 54   ◯ 55 - 65   ◯ > 65

7. Gender:

◯ Female   ◯ Male

8. Please indicate the postal code of your residential area:

ZIP/Postal Code: [   ]

9. What is the value of your currently used bicycle?

◯ <50 Euro   ◯ 50-200 Euro   ◯ 200-400 Euro   ◯ 400-600 Euro   ◯ >600 Euro

<b>Bicycle parking location choice behaviour (Van Heekplein)</

10. Have you experienced bicycle theft in last five years?

◯ Yes   ◯ No

11. How many times have you experienced bicycle theft in last five years?

12.

Where do you park your bicycle normally at Van Heekplein?

○
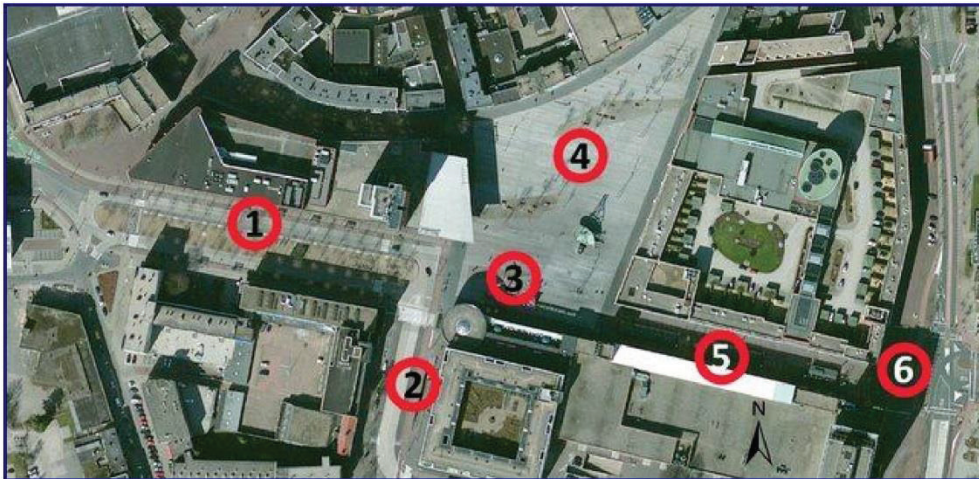
1. Bicycle racks (West side)

○

4. The public square

○

2. Van Heekplein supervised bicycle parking

○

5. Bicycle racks (East side)

○

Other locations

○

3. In front of V&D

<b> Bicycle parking location choice behaviour (Van Heekplein) </

13. Which of the following options best indicates your reason for Not parking your bicycle at the supervised bicycle parking facility? (More than one answer is possible)

☐ The opening hours do not suit my schedule

☐ It is far from my usual destination

☐ It is not easy to find a parking location over there

☐ It is NOT easy to enter and exit the facility

☐ I don not know that there is a supervised bicycle parking in Van Heekplein

☐ I have not thought about that

Other (please specify)

```
                                                              ▲
                                                              ▼
```

14. Why do you park your bicycle in your preferred location? (More than one answer is possible).

☐ It is close enough to the (initial) destination

☐ There are always lots of places free here

☐ My bicycle is safe here

☐ The place is supervised and free of charge

☐ It is convenient to park my bicycle here

☐ My bicycle is now protected against rain and snow

☐ I do not want to make any inconvenience for others

☐ I just follow others

☐ I don't know

Other (please specify)

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<b>Bicycle parking location choice behaviour (Van Heekplein)</

15. For how long do you usually park your bicycle at Van Heekplein?

☐ Less than one hour

☐ 1-5 hours

☐ More than 5 hours

☐ One day

☐ More than one day

Other (please specify)

[   ]

16. What is the usual time of bicycle parking at Van Heekplein?

◯ 0:00-6:00

◯ 6:00-9:30

◯ 9:30-13:00

◯ 13:00-17:00

◯ 17:00-20:00

◯ 20:00-24:00

17. What is the usual pick up time of your bicycle from Van Heekplein?

◯ 0:00-6:00

◯ 6:00-9:30

◯ 9:30-13:00

◯ 13:00-17:00

◯ 17:00-20:00

◯ 20:00-24:00

18. After parking your bicycle you would usually go to:

◯ your work

◯ another location because of my work

◯ school / university

◯ shop(s)

◯ recreational / cultural activities

◯ your home

or another place (please specify)

[   ]

19. How important are the following factors for you in choice of a bicycle parking location? Please indicate on a scale of 1 (Not important at all) to 4 (Very important)

	Not important at all	A little bit important	Important	Very important
As close as possible to the destination	○	○	○	○
Minimize risk of theft	○	○	○	○
Parking price	○	○	○	○
Parking duration	○	○	○	○
Availability of proper parking space	○	○	○	○
Avoiding the mess of bicycles	○	○	○	○
Bicycle parking opening hours	○	○	○	○
Supervised bicycle parking	○	○	○	○
Sheltered bicycle parking	○	○	○	○
Not obstructing anybody else in her/his movement	○	○	○	○
Following other parked bicycles	○	○	○	○

<b> Bicycle parking location choice behaviour (Van Heekplein)</

Part B

20.

At what location(s) would you like to see new/more bicycle parking facilities? You can indicate more than one location;for example: A1, B2, C3 etc.
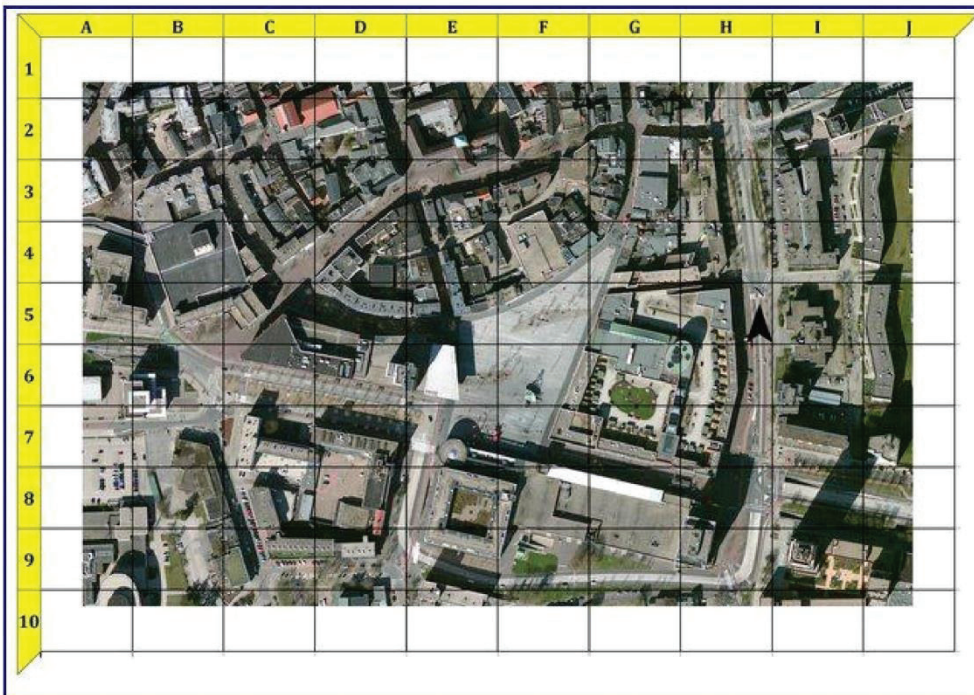
21. Why did you choose that specific location?

<b> Bicycle parking location choice behaviour (Van Heekplein)</

22. What kinds of facilities would you prefer generally in the indicated locations? Please rank the following in order of importance to you.

[ ]	Bicycle parking rack	[ ] Do not care
[ ]	Supervised bicycle parking	[ ] Do not care
[ ]	Sheltered bicycle parking	[ ] Do not care
[ ]	Bicycle locker	[ ] Do not care
[ ]	Automated bicycle storage system	[ ] Do not care

23. If you have any further suggestion or recommendation for improving bicycle parking at Van Heekplein, please comment here.

24. If you would like to receive the feedback of this survey please in the fields below indicate your name and Email address.
I would like to take this opportunity to thank you for taking the time to complete the survey.

Name:

Email Address:

*25. This is the end of survey please select the Finish option in order to end it.

◯ Finish

APPENDIX D: OPEN-ENDED QUESTIONS (VAN HEEKPLEIN)

Indicated reasons for Not parking in supervised bicycle parking facility

Given Answer	Interpretation	Code
Laziness	Laziness	1
I don't think it is necessary to park there	Not being mandatory to park in supervised bicycle parking	2
I am there just for a limited period; so it is not worth it	Short parking period	3
Too short period for market and shopping visit	Short parking period	3
Too much effort. I never had problems with parking elsewhere	It is inconvenient to park there	4
Costs too much time	It is time consuming	5
Wrong side of the square during open market hours	It is inconvenient to park there	4

Indicated reason for parking in the preferred parking location

Given Answer	Interpretation	Code
Last possible site before destination	Personal preference	6

Reasons for choosing the specific location for future bicycle parking facilities

Indicated Location	Given Answer	Interpretation	Code
E7, E5	Close to routes to home and university of Twente	Being close to bicycle paths	1
G3	Very close to the most of the stores I routinely visit	Being close to shops	2
E6	Because it is close to the market, shops etc. and on the weekends normally a mess of bikes out there	Being close to shops	2
D6, B5	No buildings	Potential location	3
E4, F7	Near shops	Being close to shops	2
G4	Convenient for route home- work and vice versa	Being close to bicycle paths	1
F5	Strategic position can be found easily	Potential location	3
D6	It's always full during weekend	Potential location	3
E5, G4	These are points where you enter the plein	Entrance points to Van Heekplein	4
G4, D2, B2	The places don't have proper safe parking for bikes and are far from the parking on Van Heek plain and parking near Werk plain	Lack of appropriate bicycle parking facilities	5
D6	Closer to where I go to do my activities	Potential location	3

G4	Closer to shops	Personal preference	6
F6	It's a convenient place to go to all the shops at the Van Heekplein	Being close to shops	2
H8, C6, D6	Close to the shopping	Convenient location	7
G7	Close to shops I often go to	Being close to shops	2
E7, F7	Here I put always my bicycle	Personal preference	6
E7, E8, F7, F5,F4	Close to the shops, within sight of many people	Being close to shops	2
F5	Close to the shops	Being close to shops	2
D5, E5	From the origin as from 7622BJ to the open market	Being close to shops	2
E6, E7, F7	Nicely close to the door (e.g. Bijenkorf; close to open market stands)	Being close to shops	2
-	Not necessary. Plenty of parking places. You have to walk a bit further. It is healthy	No need for more parking places	8
E6	Easy access to the open market	Being close to shops	2
G5	Other side of the square, close to Blokker	Being close to shops	2
D6	I live over there	Personal preference	6
D6	There is already space to park the bicycle. Arrange this space more attractive and more people will do it. It seems easier to reach than the underground parking	No need for more parking places	8
G5, G6	Inside the Klanderij	Potential location	3
F6	Close in the neighbourhood of everything. Wide environment so not much disturbance	Being close to shops	2
F4, F5, G4, G5	No possibility to park bicycle, but many shops that I often visit	Being close to shops	2
G4	Close to the shops	Being close to shops	2
F4, G4, G7, G8	Many shops. Many bicycles are being parked here, irrespective if there parking sites. Then just put parking facilities, as this is apparently what people want	Being close to shops	2
G7, D5	Close to van Heek, place with a lot of space; not in the way of the open market	Being close to shops	2
F6	It is central close to many shops; where presently there is many space available	Being close to shops	2
G2, H2	No proper bicycle parking over here, but close to the shops that I often visit	Being close to shops	2

G7, G8	There is Albert Heyn ('Appie')	Being close to shops	2
G5	Close to the shops that I often visit	Being close to shops	2
F5, F6	Entrance of the Klanderij	Entrance points to Van Heekplein	4
E6	In-between the Old market and van Heek. I park usually my bicycle close to the old market, but that was no option	Personal preference	6
G7	Because it is very full over there	Potential location	3
F6	Closer to the shops	Being close to shops	2
F5, E6, F4	Close to the final destination; often many bicycles are being parked in an unordered/disturbing manner	Personal preference	6
-	There is the parking that I always use; more than sufficient space	Personal preference	6
-	There is enough space	No need for more parking places	8
G4, G2	Entrance of bicycle free zone. It is often unordered because careless parked bicycles	Potential location	6
-	I have never had problems with the present bicycle parking locations on the van Heekplein	No need for more parking places	8
F7	Presence of shops	Being close to shops	2
E5, H8	The final ends of the square, logic place to put your bicycle en continue further by foot	Personal preference	6
E5	Central located in the city and close to the shops	Being close to shops	2
-	I don't consider parking the bicycles around the van Heekplein so annoying or disturbing. Besides, close to the covered bicycle shed or finds the largest clustering of bicycles. So an extra parking facility would not help	No need for more parking places	8
-	I find the picture very unclear and cannot properly assess where what is located. You could better place clear identification marks. I would like to see more parking facilities close to the Casino that is easy to reach from my origin; and you don't have to cycle through the city centre to park your bicycle and still close to everything	Personal preference	6
-	No idea where I would like to see a new one	No specific preference	9
F7, G7	There I park always my bicycle	Personal preference	6
H8	At the edge of the shopping are; good accessible	Being close to shops	2

Recommendations, Suggestions, and Ideas

Given Answer	Interpretation	Code
In particular bicycle parking close by or additional bicycle parking on the open market days	Need for more bicycle parking space	1
Location in front of V&D is improper to park bicycles; that are disturbing and cluttered. Dilemma is that if you place racks it will become a real location, while around the corner you find an excellent covered bicycle parking location	Need for more bicycle parking space	1
Cameras against bicycle theft. My bicycle has been stolen 14 times during the last 5 years	Installing cameras to prevent bicycle theft	2
Many people suffer from the bicycles in front of the Albert Heyn. Guide the people more into the desired direction by creating clear parking facilities and the	Organizing the bicycle parking situation	3
Cyclists who come from Zuiderhagen or in the direction of the Casino often put their bicycle on the corner Kruidvat/Men at work. A bicycle parking on that location and/or signs pointing to a bicycle parking would help to avoid crowdedness on that spot.	Need for more bicycle parking space	1
More bicycle racks in front of V&D and albert heijn	Need for more bicycle parking space	1
Throughout the entire city centre more racks should be placed. In that case people will park their bicycle in the rack.	Need for more bicycle parking space	1
Multiple bicycle parking locations	Need for more bicycle parking space	1
A supervised bicycle parking better accessible from bus stops, so not first climbing the stairs	Improve the accessibility between bus stops and supervised bicycle parking	4
I never park my bicycle during the weekends on the vHeekplein, but that I could not indicate in the survey. Furthermore I park my bicycle particularly in front of the shop that I visit and subsequently I cycle to the next shop, so a supervised bicycle parking on a central place would not help really	-	-
Create more bicycle parking facilities on the spots where you enter the city by bicycle or where the bicycle free zone starts. On the bicycle (and by car) one prefers to park as close as possible to the final destination	Need for more bicycle parking space	1
No additional storage facilities, possibly some additional *brackets*, but this need not be. As I have already pointed out, the problem is much less marked than on the railway station and in addition, this is only short-term parking. Further you'll see that the largest accumulation on busy days occurs just before or at the indoor bicycle parking, in short this is not	No need for more parking places Making more bicycle parking underground	7 8

working or does not motivate people to make use of them if they are in a hurry. Furthermore, the parking facilities in front of the Alphatoren/behind the Klanderij all helped greatly confront illegal/wild parking at the fringe of the city centre. In addition, people should not *whine*, (complain), here it is just not a problem, we are a bicycle country, then this is what you can expect. And otherwise just remove the car parking garage under the main square and create partly a bicycle storage		
I think around the van Heek square more bicycle parking are needed, or especially bike racks. Many bikes are put down at the Bijenkorf, with which they, in my opinion, are not always happy	Need for more bicycle parking space	1
The covered bicycle shed at the Van Heek square has very tight opening times, for example the late night shopping until 22: 00, if you still want to go for a drink after the late night shopping, you cannot park your bicycle over there	Extend the supervised parking opening hours	5
Regularly remove the orphan bicycles	Removing the orphan bicycles	6
More bike places	Need for more bicycle parking space	1
More racks, one clearly indicated place to park my bike	Need for more bicycle parking space	1
Make sufficient parking space available at the direct entry points of the shopping areas; H8: much more space is required (possibly underground); make use the space in the centre of the street at C-D6	Need for more bicycle parking space	1

Table 24: Interpretation of open-ended questions (Van Heekplein)