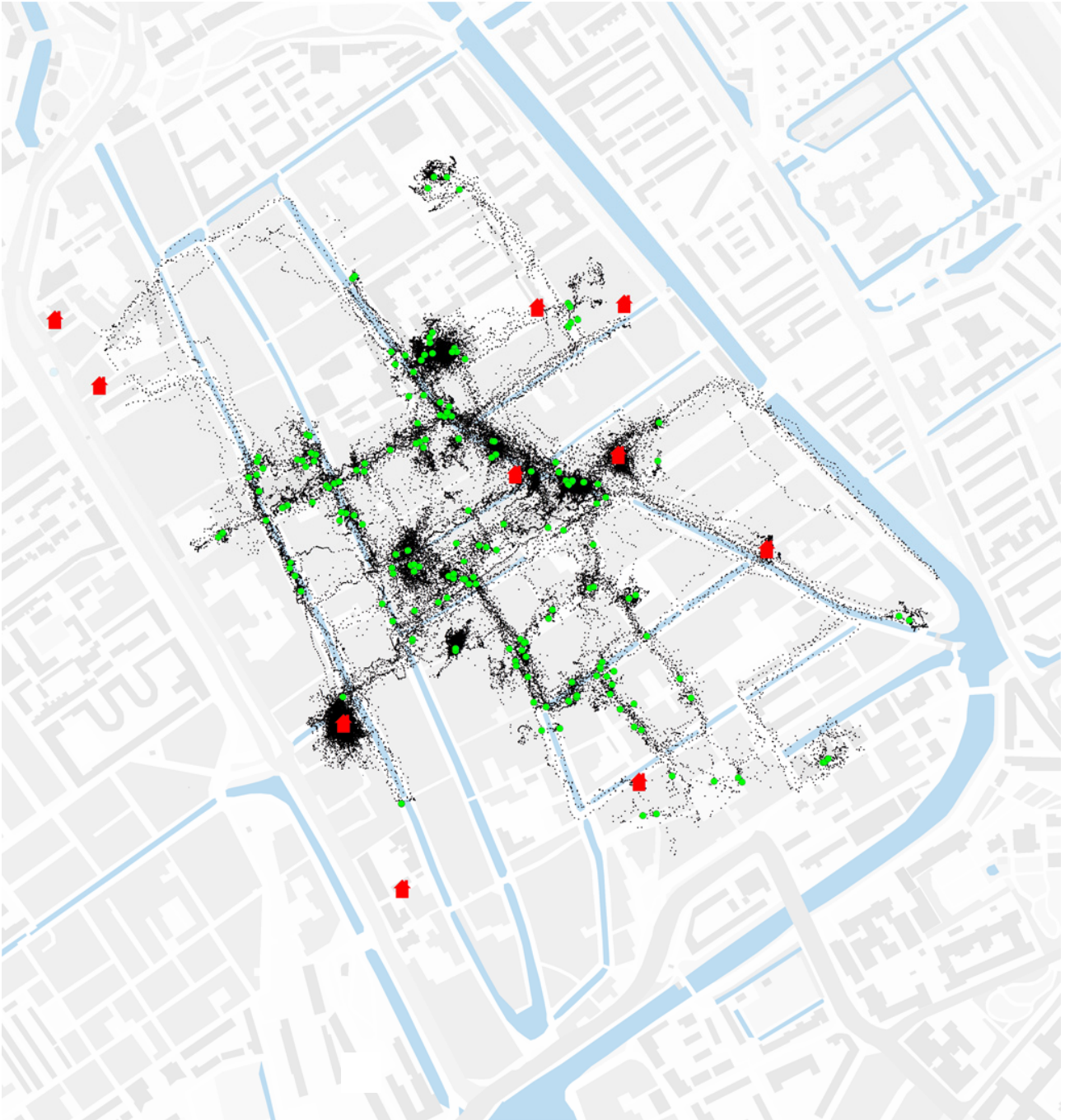


Measure, understand and improve cities

Visualizing pedestrian flows to improve inner city quality in Delft using GPS tracking technology

Tine van Langelaar



Colophon



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Cover: Cleaned GPS-trips from city centre inhabitants of Delft

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Preface

In November 2009 it turned out that I had signed up for a research project in my elective course. Previously, there were only fictitious design projects which did not really have my interest because I have poor design skills. Moreover, I missed the link with reality. The elective course focused on doing research, talking to people on the streets and analysing the obtained data. As it so happened, the first pilot project missed important geographical data so a second pilot was just waiting around the corner. It did not take me long to figure out what I wanted to do for graduation. Although a bit experimental, tricky and never been done before in a graduation project, I felt curious and thrilled. I finally found what I would like to do in the future: doing research. Or to quote from the introduction of the *Star Trek - Enterprise* sequence: "To boldly go where no man has gone before."

Herewith, I would like to thank my enthusiastic mentors Remon Rooij, Stefan van der Spek and Machiel van Dorst of the TU Delft for their inspiring, stimulating and eye opening advice. I really loved talking to and brainstorming with you all. The academic world was pretty new to me and I had to learn fast. You made this possible by advising and guiding me very well. Furthermore, I am obliged that Daan Vitner joined the group last minute as external examiner. Thank you. Moreover, I would like to thank Roberto Rocco de Campos Pereira for his critical opinion towards my Thesis Plan. His comments improved the quality of my report.

A very special thanks goes to Eppo van Nispen tot Sevenaer, former CEO of DOK Delft. His never ending sparkling enthusiasm and help provided us with the participants we needed in order to carry out the second research pilot. Second, I would like to thank Conrad Kickert, Inoek Brouwer, Wendy Tan, Egbert Stolk, Olgu Caliskan and Peter de Bois for their interesting discussions and sending me relevant literature. Third, I would like to thank both my parents very much for giving me the opportunity to do my Master degree at the TU Delft. After many years of searching for my place in the world, I finally found a home at Urbanism.

Last but not least I send my warmest regards to the following persons who helped me finding the right way through the enormous amount of literature: Rob van der Heijden (Radboud University Nijmegen), Martin Dijst (University of Utrecht), Harry Timmermans and Anastasia Moiseeva (TU Eindhoven), Andrew Mondschein and Daniel Montello (University of California).

Tine van Langelaar
April 2011, Delft

Reading guide

This integral Master Thesis is the result of two semesters working on the graduation project. It consists of three parts: Introduction, research project and references and appendices.

Part I, the introduction, explains the problem definition by theoretical underpinning, aims and final products of the graduation project, research questions, methodology and (scientific and societal) relevance.

Part II, the research project, deals with a case study, summarizes what draws people to a city centre, shows a newly developed tool (GPS-flowchart), preparation and execution of two research projects, results and conclusions of the two research projects, evaluation of the city centre, recommendations and interventions and lastly, suggestions for follow-up research.

Part III, references and appendices, give an overview of the used literature, it provides a summary of a literature review study with regard to the importance of walking, it discusses characteristics of good public space on three different scale levels (city centre, neighbourhood and street scale) and documents used for the preparation and execution of the two research projects.



14 December 2010 - Lichtjesavond, city centre of Delft

Woman 1: "I do not know where we must go!"

Woman 2: "We only have to follow the route of the coloured houses..."

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PART I: INTRODUCTION

1 Problem definition: wayfinding

1.1 Good public space

Urban planning and design deals with urban developments and its effects on people. One of the most important questions that urban planners and designers have to answer in order to solve spatial problems of a certain location is "What is good public space?"

There are many answers to be given since there is a lot of academic literature written about this topic. To prevent that you get lost in these large amounts of scientific books, papers and journals, one first can read a limited amount of general literature to understand different perspectives. Then, a subject is chosen and one zooms in on specific literature in order to find answers to research questions.

For this graduation project, first a general impression is gathered by studying literature that deals with city centres and dense urban areas. On three different scales views on good city life is developed; city scale, neighbourhood or district scale and street scale. Because one of the final products of the author will consist of making strategic spatial interventions on city scale this level is first discussed (top-down approach) in *Appendix A*. Subsequently, the focus will shift to district scale; Jacob's ideas (1961) are, amongst others, discussed in *Appendix B*.

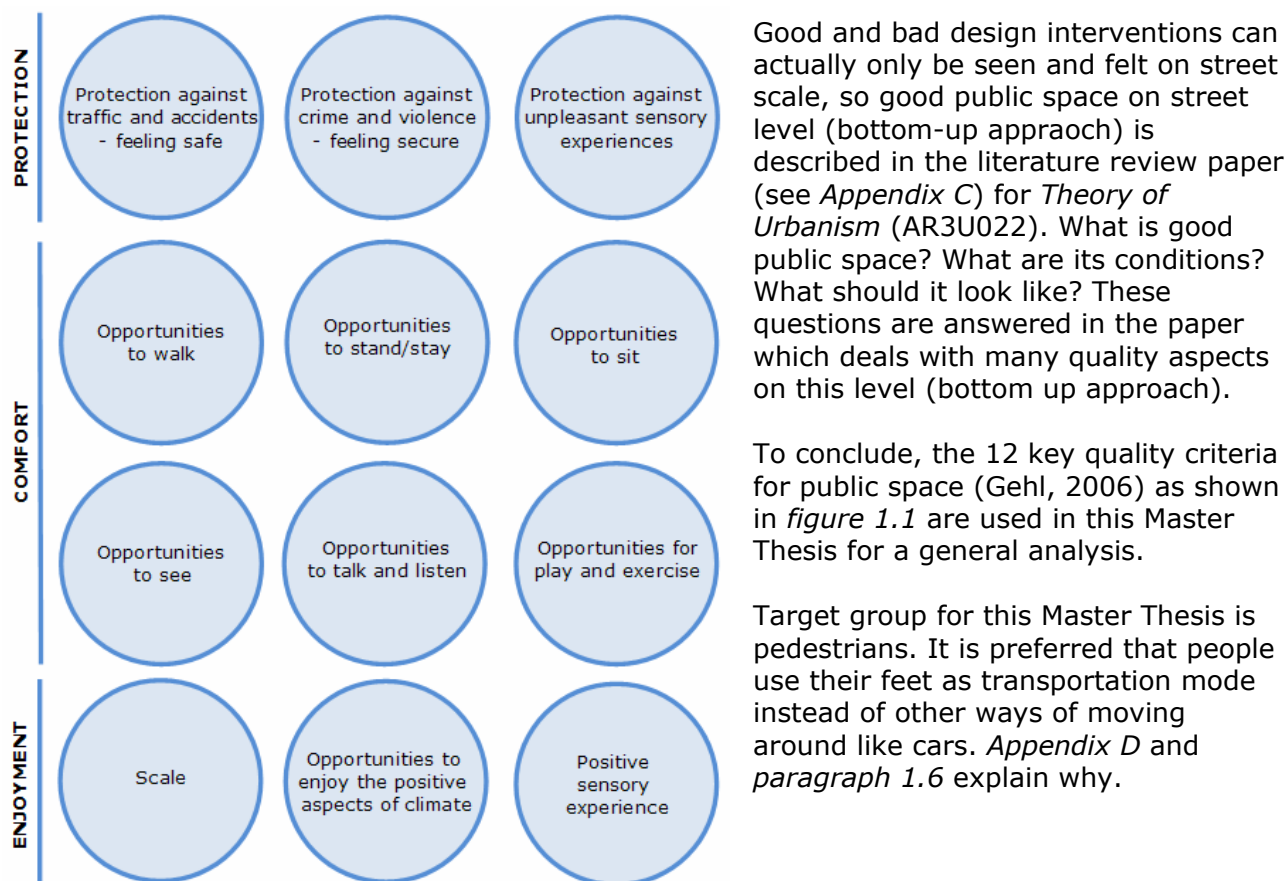


Figure 1.1: The 12 key quality criteria for public space (Gehl, 2006, p. 107)

1.2 Problem statement

Currently, the author lives in the city centre of Delft. Every evening she goes outside for a walk. *Figure 1.2* shows the route in red. Because the Phoenixstraat and Mijnbouwstraat are fast motorized streets the author also takes the green routes like the quiet Oude Delft and (occasionally) the Kanaalweg. The views are also nicer; traffic roads versus historic city centre and waterfront with its activities.

Regularly, the author is approached by people who do not know where they are and they do not know how they can reach their destination. *Figure 1.2* illustrates five encounters. For example, the following people were met: an elderly Dutch couple in a car (1), two walking young men from Lithuania looking for Central Station (2), two twenty-something Dutch girls looking for their salsa evening in Speakers (3), a Mercedes from Germany filled with Chinese people looking for a hotel (4) and a Dutch woman in a little car asking for directions for Pijnacker (5). At (2) there was also two times a male car driver that asked for Central Station.

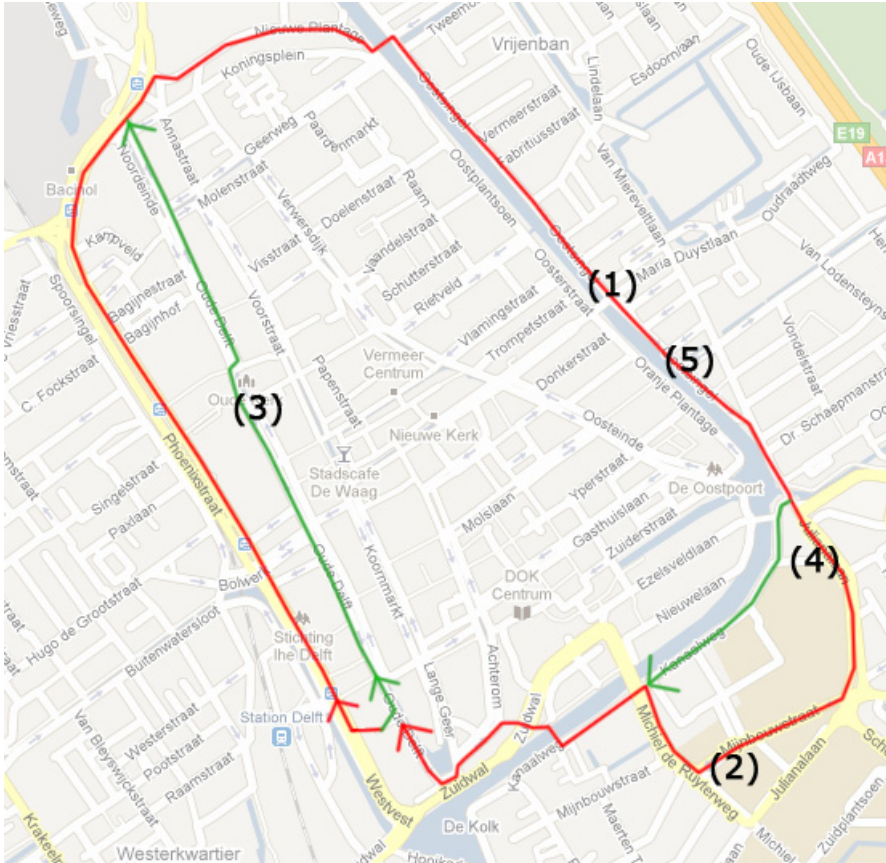


Figure 1.2: Walking route and five encounters in the city centre of Delft (source: Google Earth)

All people pulled over their car or came walking towards the author to ask for directions. In literature this experience of *social navigation* is confirmed. Even if environments are well designed with signage and maps, people will often turn to other people. This happens because people provide personal stories and experiences; "We find our way through spaces by talking to or following the trails of others" (Benyon, 2006, p. 14).

However, people should not depend on others to find their way. The urban fabric should be legible enough to find one's way. The problem statement of this Master Thesis is that people should wander and stroll through the urban fabric instead of getting lost. Consequently, for the graduation project we zoom in to one of the many aspects of "good public space", namely the element 'wayfinding'. What is good public space in relation to pedestrian's ability to orientate themselves in the historic city centre?

1.3 Wayfinding in general

Before a start is made about wayfinding, let's first take a look at its definition. What does literature say? Different views are found, however the most used definitions are as following:

- "The spatial orientation or the semantically more appropriate term of wayfinding be defined as cognitive processes comprising three distinct abilities: (i) a cognitive-mapping or information-generating ability that allows us to understand the world around us (ii) a decision-making ability that allows us to plan actions and to structure them into an overall plan (iii) and a decision-executing ability that transforms decisions

into behavioural actions. Both decision making and execution are based on information generated by cognitive mapping" (Passini, 1992, p. 46).

- "Wayfinding is the process of determining and following a path or route between an origin and a destination. It is a purposive, directed and motivated activity. It may be observed as a trace of sensorimotor actions through an environment. The trace is called the route. The route results from implementing a travel plan, which is an a priori activity that defines the sequence of segments and turn angles that comprise the path to be followed. The travel plan encapsulates the chosen strategy for path selection" (Golledge, 1999, p. 6).
- Conroy-Dalton state in 2001 that: "Wayfinding is the act of travelling to a destination by a continuous, recursive process of making route-choices whilst evaluating previous spatial decisions against constant cognition of the environment" (Rafailaki, 2007, p. 3).

People who first mention 'wayfinding' are governor Grey of South Australia (1841) who admires the fact that natives never seem to get lost in empty natural environments. He is followed by Darwin (1883) who studies the mystery of animal migration (Passini, 1992).

In the 1950s Lynch was one of the first researchers who studied wayfinding in cities like Boston, Jersey and Los Angeles. How did people find their way? How did they orient themselves? Lynch did research by sending out trained observers who secured visual spatial qualities and frailties by mapping them.

Beside this, interviews with local people were conducted in order to see how inhabitants remembered their city when they had to draw it on paper. The representation of the surroundings can be analyzed based on three components: "*identity* (recognition of an object), *structure* (a spatial relation between object and user) and *meaning* (the object has a practical or emotional significance)" according to Lynch (1960, p. 8). A clear representation of objects depends on their "imageability, legibility and visibility" (Lynch, 1960, p. 9).

The outcomes of the research are divided in "five physical elements" which form all together the urban portrait i.e. the image of the city: paths (also Jacobs, 1961), edges, districts, nodes and landmarks. It is important that the five elements do not stand alone but overlap and puncture. In order to design them, the group has to measure up to "ten form qualities": singularity, form simplicity, continuity, dominance, clarity of joint, directional differentiation, visual scope, motion awareness, time series, names and meanings (Lynch, 1960).

All these qualities are not working separately. The final effect is the strongest when designers combine the physical elements with the qualities. This creates unique combinations which will be remembered well by people.

However, it was concluded that Lynch only looked at the geometric presence of objects (Gifford, 1987; Haken and Portugali, 2003). A second way for city orientation is "social legibility" according to Gifford (1987, p. 36) depending on one's culture. In other words, the presence of "nongeometrical or semantic urban elements like symbolic, cultural and personal elements" (Haken and Portugali, 2003, p. 387).

"A short but comprehensive list of qualities or dimensions that makes up the image of an urban setting" is according to Gifford (1987, p. 78): Economic potential, diversity of land use, historic significance, fond memories, appearance of the built environment, natural features, movement and location and importance as an activity

A new overall picture of city division and recognition was also made by Haken and Portugali (2003, p. 404);

- Redundant artifacts:
 - i) Outdoor furniture like pavements, benches, lights, bus stops, trains.
 - ii) Buildings; not all identical but they form categories.
 - iii) Urban scenes; a configuration of buildings, urban furniture, roads, etc.



- iv) Road network; the iron grid from New York or the Old City of Jerusalem with its winding streets. The general character is easily recognized and remembered although it might be difficult to recollect separate streets.
- Unique artifacts:
 - i) Geometrically unique; the five elements provided by Lynch.
 - ii) Symbolically unique; geometrically singular objects that represent its city such as the Eiffel Tower in Paris.
 - iii) Legendarily unique; objects that have an urban legend attached to them such as the Golom of Prague and the Synagogue of Prague.

This can be summarized as *figure 1.3* shows. For the Master Thesis these criteria are used for specific wayfinding analyses.

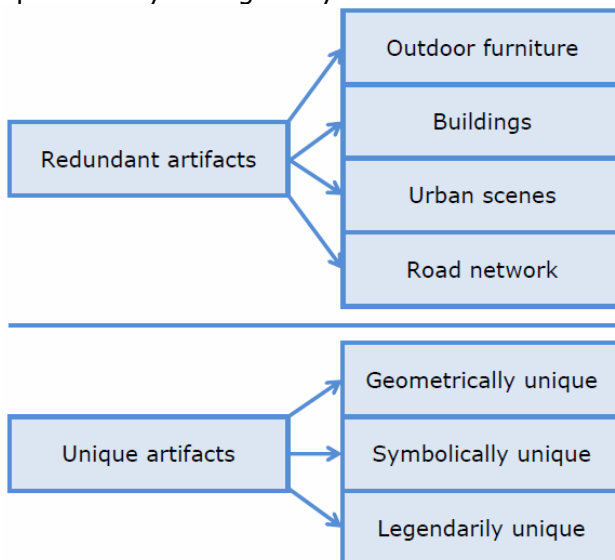


Figure 1.3: Wayfinding criteria for public space (Haken and Portugali, 2003, p. 404)

According to Millonig and Schechter (2008) human spatio-temporal behaviour research has shown that there are two main categories of behaviour influencing factors. The first are the internal (personal characteristics of individuals) factors like demographic attributes, culture, lifestyle, educational level, beliefs and attitudes. The second are external (characteristics of the environment) factors such as trip characteristics, infrastructure, environmental -weather- characteristics and route qualities like physical, emotional and cognitive qualities (landmarks). These features are summarized in *figure 1.4*.

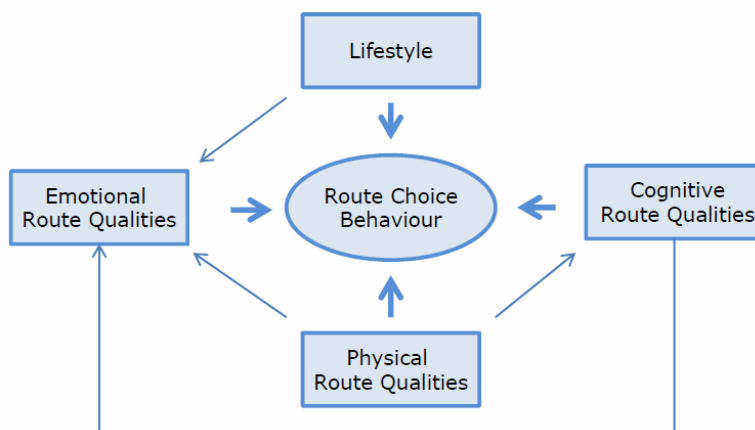


Figure 1.4: Effects on route choice behaviour (Millonig and Schechtner, 2008, p. 52)

It must be said that a city image of residents relies on *familiarity* of the urban fabric while a tourist route accentuates the *extraordinary* (Stieber, 2009). There are more differences that can be found with regard to wayfinding and different groups of people. Three stages of knowledge development can be found looking at an increasing experience of the environment: landmark, route and survey, as *figure 1.5* demonstrates (Bovy and Stern, 1990).

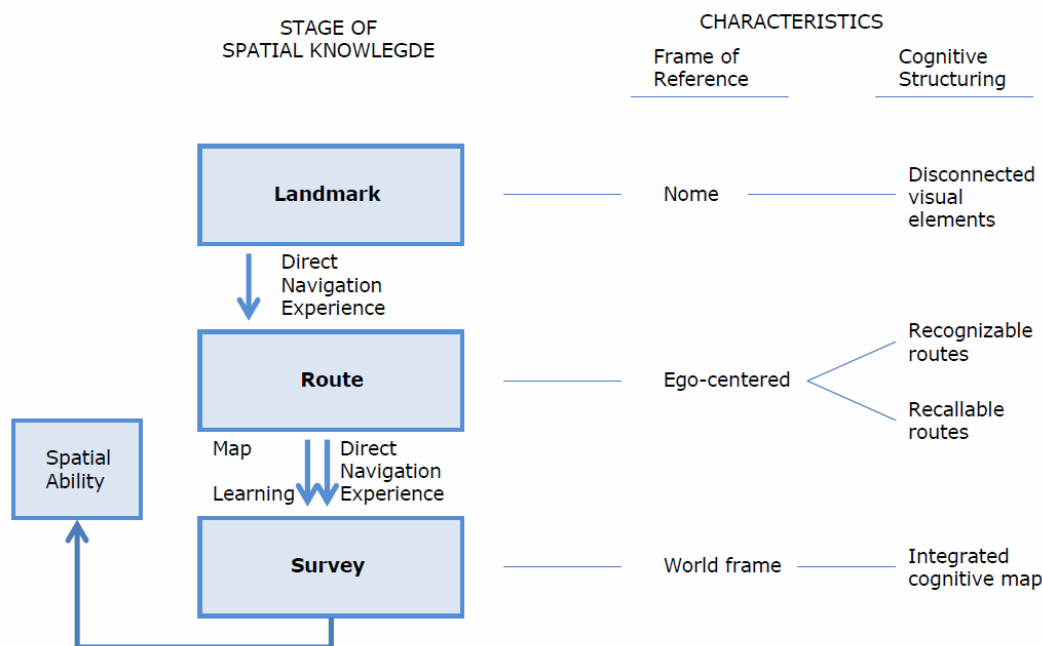


Figure 1.5: A three level model of acquiring spatial knowledge (Bovy and Stern, 1990, p. 42)

If a pedestrian walks through the area his new experiences will add more and more information to his current cognitive map. In addition, Rafailaki (2007) did research about three different pedestrian groups (locals, regional locals and visitors). He compared, analysed and registered their spatial knowledge in figure 1.6. Nota Bene: "allocentric" means 'object to object' whereas "egocentric" means 'body to object'.

	Landmark knowledge (Egocentric navigation) Local scale	Route knowledge (Egocentric navigation) Local scale	Survey knowledge (Allocentric navigation) Global scale
Locals	✓	✓	✓
Regional locals	✓	✓	
Visitors	✓		

Figure 1.6: Spatial knowledge and different criteria for three groups of pedestrians (Rafailaki, 2007, p. 4)

1.4 Wayfinding in Delft

The results of this graduation research are to be linked to existing theories and findings such as experience and route choice in the city centre of Delft by authors like Steffen and Van der Voordt (1979), Korthals Altes and Steffen (1988) and the Municipality of Delft (2009-b). So, what does literature say about spatial qualities and perceptions in the city centre of Delft? And are these findings in accordance with the author's results?

The purpose of research in the field of route choice behaviour is to make a contribution to the architectural and urban design of the road network. This involves the interaction between the environment variables and the route choice/route experience. Eventually, it is about the predictability of spatial forms and its effect on the psychological functioning of humans.

Steffen and Van der Voordt conducted research among (first year) TU/Delft students (thus sort of comparable with the author's visitor/tourist research with regard to the familiarity of the city centre) as well as inhabitants of Delft. They state that the elements that largely determine the structure image of Delft have some common characteristics (1979, p. 11):

- Located in a multi-functional area
- Located in the oldest, western part of the city
- Historical meaning and symbolic value
- Part of a continuity
- High amenity value (wealth of information, atmosphere, aesthetic appearance)

Qualities (or *satisfiers* - Korthals Altes and Steffen, 1988, p. 14) that are appreciated by inhabitants are: historical character, presence of the canals, the good atmosphere of the city centre, Delfts blue and the market. Other remarks are: small, diverse, historically grown (spatial qualities), cosy, intimate and feelings of familiarity (perception characteristics) (id., p. 25).

Unattractive elements (or *dissatisfiers* - Korthals Altes and Steffen, 1988, p. 14) in the centre that are not appreciated by participants are: the form (too straight, too square), material (concrete), colour, lightning, scale (too big, too high), bad integration of new buildings in the current urban fabric. With regard to the perception characteristics people refer to not pretty, cheerless, cold, impersonal and boring (id., p. 26). Desired improvements are: One wants better accessibility of the city centre, no or fewer cars in the centre, better parking facilities and more attention to the pedestrian (id., p. 28).

It is striking that after thirty years this vision still matches current thoughts as well. The Municipality of Delft (2009-b) conducted research asking both visitors and residents of the city centre whether they find it more enjoyable to stay in the established restricted-traffic area because there are a lot fewer cars. A large majority of 70% agrees, 19% indicates to notice no difference and 6% has the opinion that it has become less pleasing. Everyone is asked whether the restricted-traffic policy should continue to be established. Seven out of ten respondents answers here in the affirmative.

Opinions on enlargement of the established restricted-traffic policy are some more divided, but still, almost half (48%) welcomes the idea. About the theorem: "The entire city centre must be car free" the opinions are quite different: 33% (very) agrees, 25% nor disagrees or agrees and 40% (very) disagrees. The research states that the city centre residents move mainly by walking (94%) and cycling (89%) in the town centre. A small proportion (5%) used the car and mobility scooter (1%) (Municipality of Delft, 2009-b). With the creation of the restricted traffic of the city centre one tries to preserve and strengthen the unique cultural and historical values, to improve the quality of the residence climate and to strengthen the economic functioning.

Steffen and Van der Voordt point out that two out of three students sometimes have problems orientating in the city centre. Most of the problems are caused by uniformity in buildings (50%), unfamiliarity with the area (17%), traffic engineering measures (15%) and complexity (11%). In order to prevent getting lost, students look for landmarks (churches, houses and shops), streets (name plates and locations relative to each other) and identifiers (bridges, bus stations and tourist boards). Of the residents, most have no problems since they know the city very well. Slightly less than half indicates that they consult maps or district boards in some areas. This has mainly to do with the traffic plan in the downtown area for car traffic (1979, pp. 26, 27).

With regard to route-choice the author, while processing the data, noticed something remarkable. This is confirmed in literature: "Most participants continue walking as far as possible following a straight line between start and end points. They depart only when a barrier such as a canal so requires" (id., p. 16). Moreover, Golledge's research found out that there is a ranking of criteria with regard to route selection. From most frequent to least frequent use these criteria are: (1) shortest path (2) first noticed (3) fewest turns (4) shortest leg first (5) most turns (6) least time (7) longest leg first (8) different from previous route taken - variability (9) most scenic or aesthetic (10) many curves (1999, p. 29).

Korthals Altes and Steffen (1988) did a second research under freshman students of the Faculty of Architecture. The first aim of the study was to identify spatial quality factors that affect route choice of pedestrians in the inner city. In addition, the perceptual, cognitive and emotional amenities were captured. In summary, the choice motives for routes can be classified into four main categories (id., p. 13):

- Spatial aspects (60%): visual-spatial attractiveness, space perception, arousal and orientation.
- Functional aspects (29%): liveliness, shops, cultural-historical interest, naming associations and directional pressure from pedestrian flows.

- Traffic livability aspects (9%): odor, noise, road safety, sidewalk width, crossover availability, psychological obstacles of fast traffic
- Network aspects (2%): targeting, distance, traffic lights

Due to the fact that spatial aspects are the most important elements of route choice, this will be the accent in the chapter "Recommendations and interventions". Second of importance are functional aspects.

Formats regarding the perception of aspects at routes can be made as following (id., pp. 100-103):

- Emotional responses (36%):
 - o Spatial aspect: nice, boring or ugly, boring
 - o Functional aspect: lively, attractive or chaotic, poorly
 - o Traffic livability aspect: safe or unsafe, crowded, noisy
- Meaning (27%):
 - o Culture-historical significance: lanterns, gates, doorsteps, canal houses
 - o Personally-emotional meaning: faith, power, water, shop, bus stop
 - o Name bound: savings bank, coffee shop, shopping centre
 - o General-functional: library-culture, church-religion, station-arrival
 - o Personally-functional: ice-cream parlours, antique shop, bookstore, barber
- Landmarks (26.5%) of which:
 - o Distant landmarks (38%): buildings that stand out high above the rest
 - o Singular landmarks (43%): unique elements in a street
 - o Urban landmarks (18%): squares, trees, bridges, etc.
- Problems of interpretation (10.5%):
 - o Urban and architectural functional problems: unclear or uncertain thoughts when reading the streets (e.g.: intention of a square)
 - o Network technical problems: is there a continuous route?
 - o General functional problems: what is the origin of a street name?

"The aspect spatial orientation is closer related to the need for security than to safety. Security is about preservation of the time (do not get lost); safety concerns self-preservation (do not be attacked). Safety seems to be a more fundamental basic need than certainty" (id., p. 110).

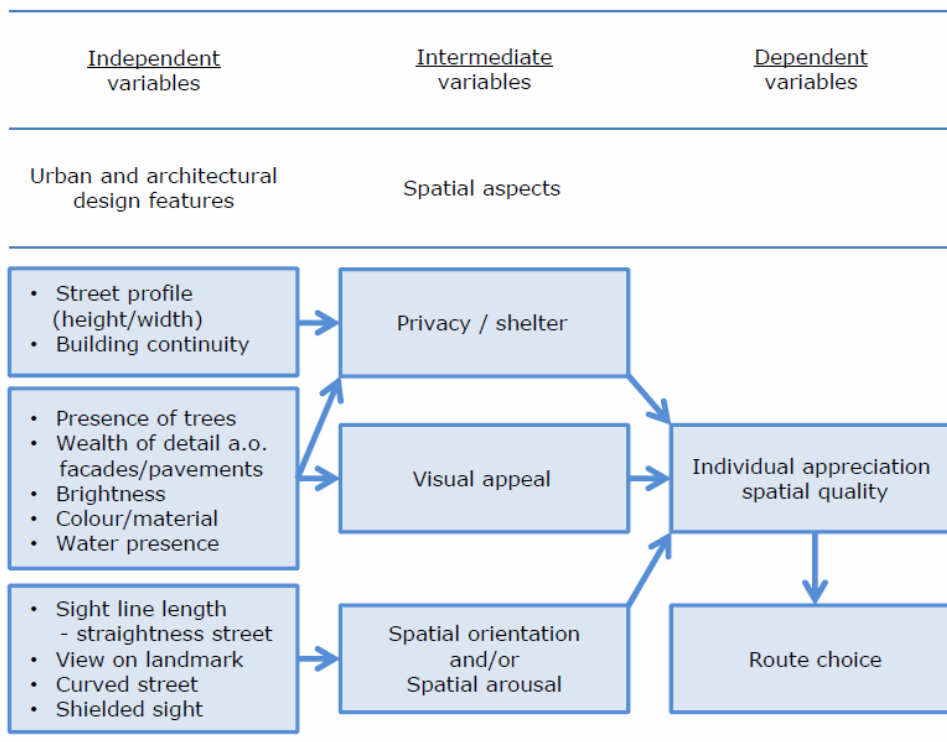


Figure 1.7: Design features, spatial qualities and appreciation (Korthals Altes and Steffen, 1988, p. 119)

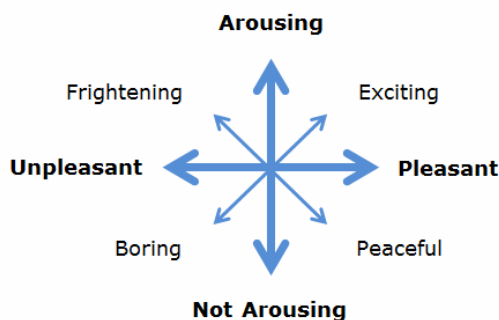
Privacy/shelter and visual attractiveness often go together in practice. However, this is not the case with arousal and orientation. A curved, narrow street can be exciting but usually provides no good orientation. On the contrary, a straight, wide street offers good guidance yet is usually not exciting. Streets which contain both qualities are more highly appreciated, provided they are also welcoming (Korthals Altes and Steffen, 1988, p. 118).

Privacy and shelter are prerequisites for a good pedestrian route, visual appeal strengthens the previous and spatial orientation indicates whether the urban fabric leads a pedestrian the way. This is summarized in *figure 1.7*. An urban designer can use this schedule by asking: "Which spatial aspects fail this specific public space currently?" The research results and analyses provide an answer to that question in order to formulate specific design tasks like: "Which materials for paving can ensure that the visual appeal of the square becomes more attractive?" (Korthals Altes and Steffen, 1988).

1.5 Environmental psychology

Environments shouldn't become too predictable. They will be boring then. A bit excitement is needed. Lynch states that "It must be granted that there is some value in mystification, labyrinth, or surprise in the environment. (...) This is, however, only under two conditions. First, there must be no danger of losing basic form or orientation of never coming out. (...) Furthermore, the labyrinth or mystery must in itself have some sort of form that can be explored and in time be apprehended. Complete chaos without hint of connection is never pleasurable." (1960, p. 5-6).

Consequently, getting lost is acceptable since it is an exciting and surprising part of city experience and discovery. However, a person should be able to find his way back again at some point.



Preference matrix

UNDERSTANDING	EXPLORATION
Coherence	Complexity
Legibility	Mystery

Figure 1.8: Russell's circumplex (Gifford, 1987, p.85) Figure 1.9: Preferences (Kaplan et al., 1998,p.13)

Gifford (1987) underlines the arousal of Russell's circumplex, see *figure 1.8*, which shows an emotional responds to settings. The pleasure and arousal form give many possible combinations. They are based on environmental and personality variables. In addition, Kaplan et al. (1998) formulate that an environment needs coherence and a good legibility in order to make sense. When the area is well organized, complexity and mystery can tempt people to walk into an unknown street in order to explore it. *Figure 1.9* summarizes the preference matrix. "When people feel orientated and confident that they can find their way around, their eagerness to explore an area is increased and their general anxieties are lessened" (id., p. 49).

Wayfinding is supported by coherence. If a pedestrian can survey the streets and comprehend its profile, the area will be well remembered. The amount of details that will be reminded depends on a person's knowledge and experience of the surroundings. Visitors / tourists of the city centre that are unfamiliar with the urban fabric are best served by a map which contains a review of the most prominent visual elements underlining most important landmarks with a clear road network connecting them. It must also provide legible choice points where pedestrians can follow their desired route and information about distance and time demands. For pedestrians who are very familiar with the surroundings maps with more details can be provided assuming that unwanted information will be ignored (Kaplan et al., 1998).

A broad, straight, manageable street with a sight line on a landmark is highly appreciated on the orientation aspect. The counterpart of this is the aspect spatial excitement ("arousal"). This indicates whether the street raises the curiosity of the passer-by which tickles for further exploration. A narrow street with a turn or kink, a partially by visibility hidden look-through as a result of a leap in the building line or a half-transparent canopy, are highly appreciated on the aspect of arousal. *Figure 1.10* demonstrates a spatial example. The left picture plans straight lines (perpendicular, parallel) whereas the right picture features playful accents (pendulum / buckling lines, diagonally, multiplicity of heights) (Palmboom, 1990).

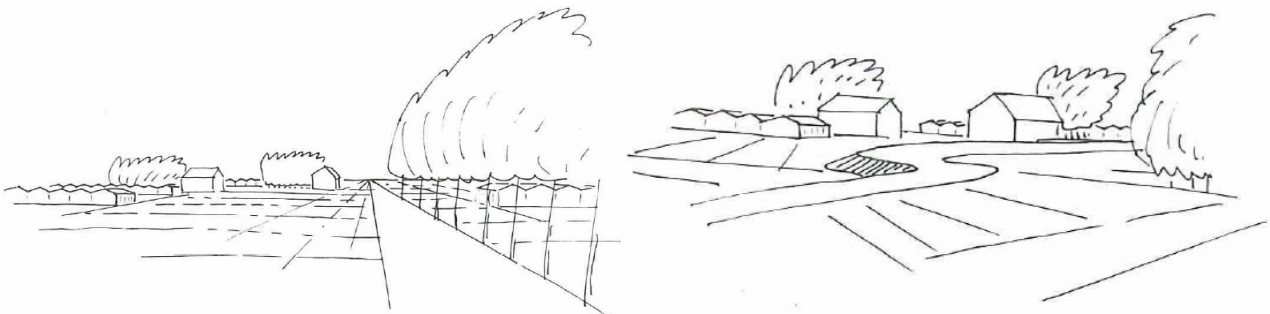


Figure 1.10: Mathematical raster landscape vs. patchwork: picturesque effects (Palmboom, 1990, p. 29)

The need for knowledge can be connected with the arousal motive: we want to know where a street leads, we want to meet up with the research urge and we want to understand the architecture and urban structure. Different environmental types have a different aesthetic effect. Differences in visual functioning form starting points for strengthening the spatial identity of the area.

1.6 Urban economy

Aside from spatial and functional aspects the urban economy is also influenced by pedestrian's ability to find their way. Van der Hoeven et al. state that "Cities are chaotic places. Tourists, visiting business people, shoppers and even local residents rarely have a clear or coherently expressed view of what a city has to offer geographically or thematically. People's stay is shortened by their lack of overview of or information on what a town can actually offer them. (...) Medieval street patterns are the product of spontaneous urban growth and lack the sometimes rigid clarity of modern planned developments" (2008, p. 5-6).

The same research tells us that people who stay 6 – 7 hours in a city centre spend an average of £ 150. If this is reduced to 4 – 4.5 hours an average of £ 100 is spend. A duration of 2 hours means that only £ 50 will be put out (id.). In addition, new research shows that pedestrians spend more money than people who travel by other transportation modes (Plowden, 2010). This is demonstrated in *figure 1.11*:

	Walk	Bicycle	Bus	Car	Train	Tube	Total
Mean in £	136	114	105	95	89	87	109
Sample size	1184	103	103	799	295	450	4637

Figure 1.11: Average monthly spend, by mode in sample of London town centres (Plowden, 2010)

Consequently, like Gehl said: "A good city is like a good party: people stay longer than they planned to because they are enjoying themselves" (Bliss, 2010). So, not only do happy people spend more time in the city centre, bringing more vitality and quality to a place they also spend more money which stimulates the urban economy.

2 Aims and final products of the graduation project

The aims of the graduation project are:

- (What) To better understand how people navigate in cities...
- (Why) ...in order to develop recommendations for urban planning and design...
- (Who) ...to make city visits more enjoyable, engaging and involving for pedestrians.

The final graduation products will consist of:

- (How) i A checklist for active use of "good" public space (see *Appendix C* for 'general public space' advice and *paragraph 1.3, 1.4 and 1.5* for detailed 'wayfinding' and 'environmental psychology' criteria).
- ii Develop (improve) an instrument (screenplay, scenario, tool) for future use of GPS-tracking projects where the process can follow a certain structure so that you don't have to reinvent "the wheel" every time (see *chapter 8: Tool – GPS flowchart*). Reasons and advantages to use GPS-tracking devices as a method are explained in *paragraph 4.3* and *paragraph 5.1*.
- iii Strategic spatial design interventions in the (slow) network, city centre scale of Delft, based on two GPS-tracking research pilot projects (see *chapter 12: Recommendations and interventions*).

The symbol for spatial planning and plan preparation is the planning cycle as is demonstrated in *figure 2.1*. This graduation project deals with three out of the four plan cycle phases. Practice research is done in which pedestrian movement is **analysed**, additional city centre evaluations are made to understand and explain pedestrian movement, conclusions are noted and advice in the form of **strategic** spatial design interventions is given, ready to hand over to an urban **designer**. And, of course, the entire plan is **evaluated** in order to check whether the main research question is answered. *Figure 2.2* shows the end of the graduation project: it just touches the "design" phase.

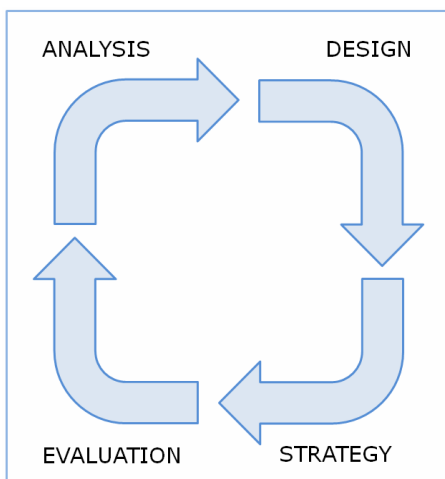


Figure 2.1: Plan cycle

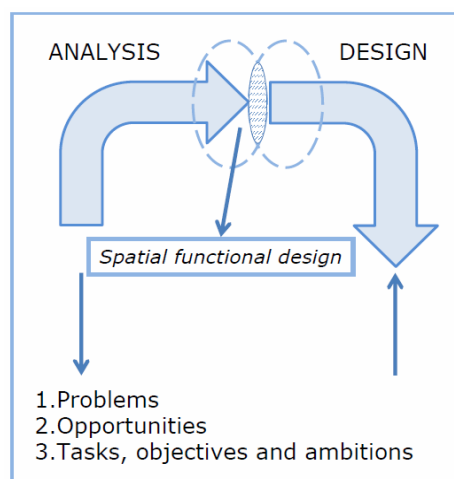


Figure 2.2: End of graduation (Hulsbergen and Kriens, 2007, p. 8)

3 Research questions

3.1 Main research question

The main research question of the graduation project is:

Which strategic spatial design interventions can improve public space for the slow traffic network in order to retain city visitors in the city centre of Delft?

With regard to 'city visitors' the target group *pedestrians* is intended. This is a very diverse group because it consists of visitors/tourists, city centre inhabitants and neighbourhood residents.

To be able to answer the main research question the work is split in smaller sub-research questions. The answers of the sub-research questions will step for step lead to an answer for the main research question.

3.2 Sub-research question 1

What is good public space? Which criteria make streets enjoyable, engaging and involving for pedestrians? What should streets in city centres look like in order to contain all the right qualities? What has already been researched, experienced and written previously in (academic) literature?

These questions lead to sub-research question 1:

What are criteria for successful public spaces looking at pedestrians walking in city centres?

3.3 Sub-research question 2

What does it look like on the streets at this moment? Which spatial qualities can be found in the city centre of Delft?

These questions lead to sub-research question 2:

What is the current quality of the streets and built environment in the city centre of Delft?

3.4 Sub-research question 3

How much time do pedestrians spend in the public space? Which areas are poorly used or used heavily? How long are people on the move? Which routes do people take in order to reach their destinations? What are the destinations that people visit? Why do people use certain routes? Do they stay in the public space or do they only use the street(s) for transportation? What are interesting case studies which track pedestrians in historic city centres?

These questions lead to sub-research question 3:

Do pedestrians (visitors/tourists, city centre inhabitants and neighbourhood residents) use the public space in the city centre of Delft differently?

3.5 Sub-research question 4

How can the city centre of Delft be made more attractive for (different groups of) pedestrians? How to reinforce the slow traffic network in the city centre of Delft?

These questions lead to sub-research question 4:

How can the criteria for successful public spaces, the analysis of the current situation and the conclusions of how people use the city centre be embedded in strategic spatial (navigational) recommendations for the city centre of Delft?

The next chapter "Methodology" explains how these questions will be answered.



4 Methodology

This chapter zooms in on the previously mentioned sub-research questions in order to answer the main research question. Each sub-research question ends in a product. In order to gather the required information to answer the research and sub-research questions, a combination of different methods and techniques are used.

4.1 Sub-research question 1

The first sub-research question "What are criteria for successful public spaces looking at pedestrians walking in city centres?" will be answered by studying relevant (academic) literature in order to gather knowledge how the quality of city centres can be improved for pedestrians and make streets more lively. These criteria will be discussed in the **literature review paper**, see *Appendix C*, of the course *Theory of Urbanism* (AR3U022); one of the three required end products of the graduation project.

The outcome of this paper contains primary theoretical elements of good public space on the street scale. In *Appendices A and B* the district and city scale are added in order to complete various visions on different scales of good city life. The main research question looks at the slow network on city scale so some strategies are necessary as well. Subsequently, a list of relevant criteria for the graduation project are made and discussed.

From the European *Spatial Metro* project (Van der Hoeven et al., 2008) **3 wayfinding case studies** (Bristol, Rouen and Biel/Bienne) are analysed in order to learn which conclusions and interventions improved public space quality in those historic city centres. If Delft shows the same problem(s) as in one of the other cities, she might benefit from already found solutions.

4.2 Sub-research question 2

The second sub-research question "What is the current quality of the streets and built environment in the city centre of Delft?" will be answered by using the checklist criteria from the first sub-research question in order to **evaluate** the city centre of Delft. By making this evaluation more methods and analyses are used due to the fact that you cannot understand and explain human behaviour based only at pedestrian movement. Second, methods and analyses can be compared now. In this way you can monitor if their results are pointing in the same direction or that differences can be noted.

First, a **program analysis** is made to find out what the city centre can offer people with regard to urban facilities. Second, the **1-2-3 step analysis** is made from several departure or 'anchor' points in order to analyse how well the location is connected to the entire network. Third, previous research shows that pedestrians do not walk much further than **400-800m** from their departure point (Van der Spek, 2008-b). Is this the case for Delft as well? The **visibility graph analysis** will show how well streets are mutual visually connected. If you can not see a street, you will most likely not enter it, unless you know what to find there. This could be a finding when the three target groups are compared. The different analyses will result in connectivity maps of the city centre of Delft.

In order to understand why the city centre has its current structure, a quick **urban morphology analysis** is made. Here, the history of Delft is mapped and evaluated. Hence, developments with its qualities can be concluded. Subsequently, a **visual (perception) analysis** of the city centre of Delft is made. The author walked around in the city centre of Delft and took pictures of people (walking, standing, sitting, lying, running, et cetera), public spaces and the built environment. A mental map is made of the city centre of Delft, telling in images what qualities and problems the area contains. The images will be annotated by using the checklist. Last, a **density analysis** is made to figure out if pedestrians remain longer on the streets if these contain good spatial quality than areas with bad spatial qualities.

4.3 Sub-research question 3

4.3.1 Method and software

In this paragraph the research method GPS-tracking and software programs such as ArcGIS and SPSS are mentioned. The next paragraph explains what these concepts are all about.

The third sub-research question "Do pedestrians (visitors/tourists, city centre inhabitants and neighbourhood residents) use the public space in the city centre of Delft differently?" will be answered by analyzing **GPS-tracking data** from two researches (tourists/visitors from November 2009 and inhabitants from April/May 2010) combined with **questionnaire surveys** (demographical background information) and **trip diaries** (what did people do, where did they go). In this way, the 'Research' part of the graduation project is accomplished.

The research data needs to be inserted in GIS and SPSS software in order to 'translate' the dots and lines into usable information. **GIS** is used for mapping (visualising) the GPS-tracks. **SPSS** makes statistics (graphs and diagrams for example) from the questionnaire survey answers. The product of this sub-research question consists of maps, showing similarities and differences in movement between the three different target groups (visitors/tourists, city centre inhabitants and neighbourhood residents) accompanied by facts and figures.

4.3.2 GPS, GIS and SPSS explained

What are GPS, GIS and SPSS? And what can they do for us, researchers? A short overview:



GPS stands for *Global Positioning System*, originally conceived as an American military navigation system in the 1990s. In the year 2000 the system became available for civilians and commercial companies (Shoval, 2008). A GPS device works best when it is connected to 4-5 satellites. The more satellites, the better the position can be determined. GPS devices register time (in seconds), space (in meters) and data like the travelled route, speed, mode of transportation, length of the trip, destination(s) and (type of) activities of the object (car/person). *Figure 4.1* shows the GPS device that was used in the tracking research.

Figure 4.1: Example of a GPS device; Qstarz BT-Q1000X Travel Recorder

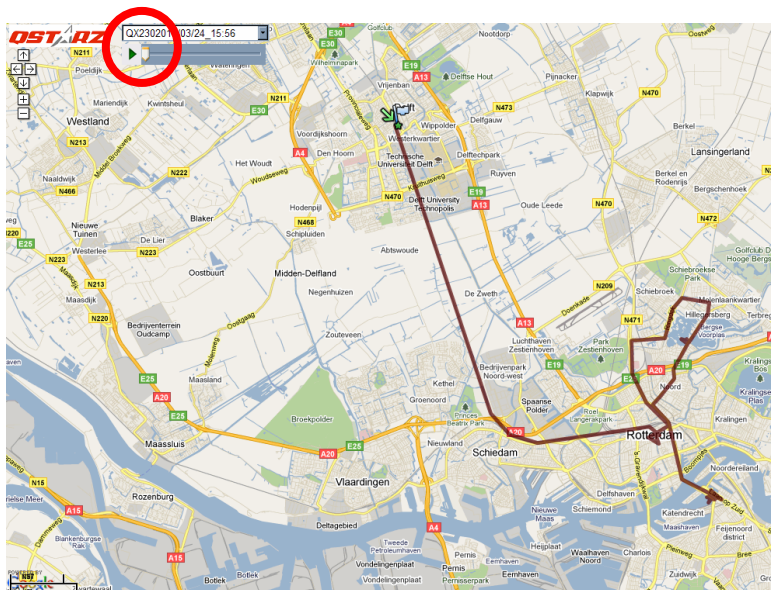


Figure 4.2 shows an example. On 24 March 2010 the author went from Delft to Rotterdam Central Station (train), met a friend (walking) and went to the Bergse Plas together (car and walking). From there a trip to a construction site in Rotterdam South was made (car and walking).

As *figure 4.2* shows, on the left a "PLAY" button (red circle) can be seen. You can play your track in Google Maps to see at what time the train actually arrived at CS or how long the walk around the Bergse Plas took.

Figure 4.2: Registration of a test track Delft – Rotterdam (image by author and QTravel software)

Geographical Information Systems (GIS) gives visual representation, analysis and modelling of complex spatial environments by “exploring spatial relationships, patterns and processes of geographical, cultural, biological and physical phenomena” (Nijhuis, 2010, p. 2). Computer and data do not make sense without the knowledge of the user.



There is a demand for more, faster and accurate geo-information due to various developments (Van Lieshout et al., 2003):

1. Intensification of land use (monitoring of processes, projects and developments): limited space requires the development of new or restructured infrastructure which needs accurate topographical, impact-oriented and object-oriented information
2. Increasing claims on spaces need a multidisciplinary approach: more information is needed in order to make the right impact analysis and decisions
3. Business like just-in-time deliveries rely on continuous and reliable information: optimize the use of time (traffic, route but also leisure time) is important economically

Figure 4.3: Example of GPS-tracks from two different groups of pedestrians

GIS is a process for looking at geographical patterns in spatial data and at relations between features; it combines many layers with information. Basic analyses are (Nijhuis, 2010): mapping where things are, mapping most and least, mapping density, finding what’s inside or nearby, mapping change and movement and mapping visibility.

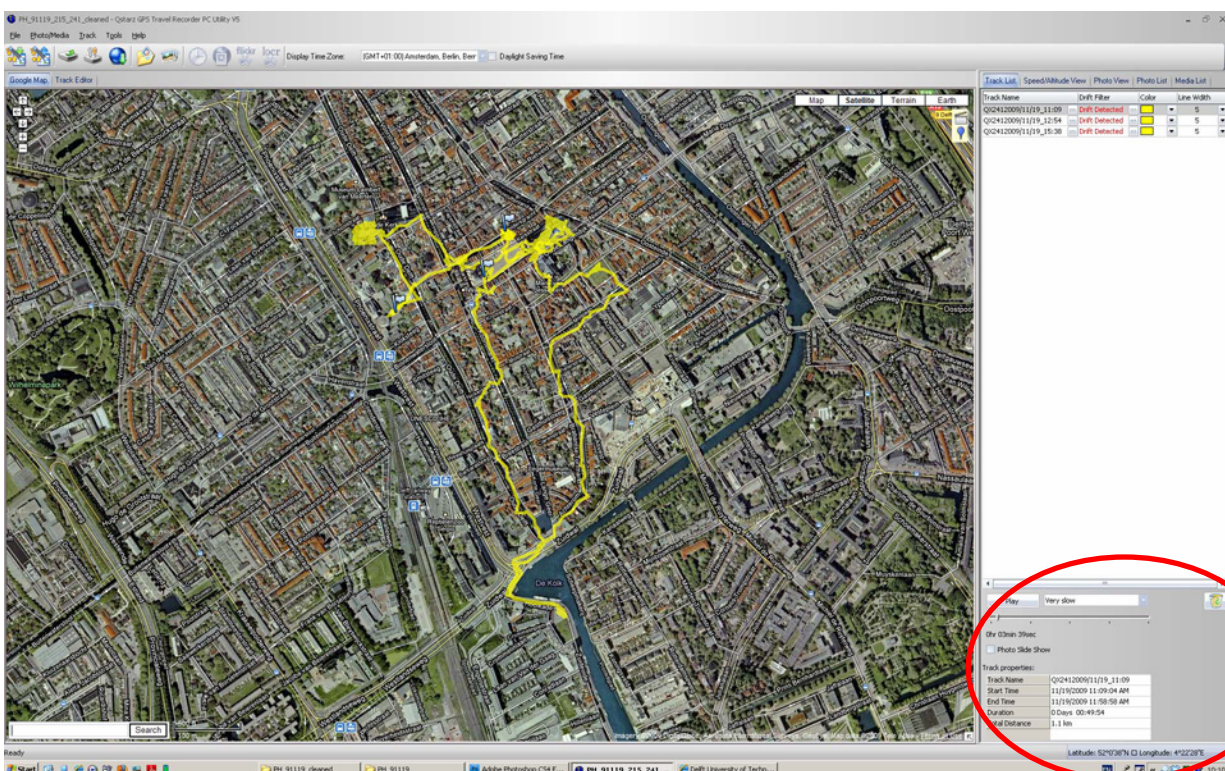


Figure 4.4: Example of a (cleaned) GPS-track from one pedestrian

This information can be collected by GPS devices. GIS + GPS = an informative tool which contains elements to explain and understand human behaviour. The black tracks in *figure 4.3* show a selected group of pedestrians of the first of the two tracking projects in the city centre of Delft. *Part II* of this report zooms in on all the details of both research projects.

Groups can be formed by days, parking garage, age, gender, trip duration, et cetera. In this way it becomes clear on which days the city centre is used most frequently. And what hot spots or ignored areas are. Male and female trips can be compared; do women spend more time in the city than men? Where do men go? Do women visit the same destinations? Do single people spend as much time in the public space as families? All sorts of questions can be answered when the right tracks are selected.

Figure 4.4 shows a track from one pedestrian. Trip data can be analysed by person as well. A detailed look of the walking speed, destinations, direction, et cetera can be registered. The red circle indicates the travelling speed, the travelled distance and the trip duration with start and end time. In this way you can analyse how much time people spend on a street or destination.

Statistical Package for the Social Sciences or **SPSS** is a program for statistical analysis in social science. Statistics include descriptive statistics like cross tabulations and frequencies. Cross tabulations could be, for example, linking weather conditions to the amount of time people spend in the city centre on that day. Here, one could conclude that if it rains, people do not spend a lot of time in the city centre. *Figure 4.5* illustrates an example where the amount of people visited Delft weekly, monthly or yearly. The pie chart shows which day attracted the most people.

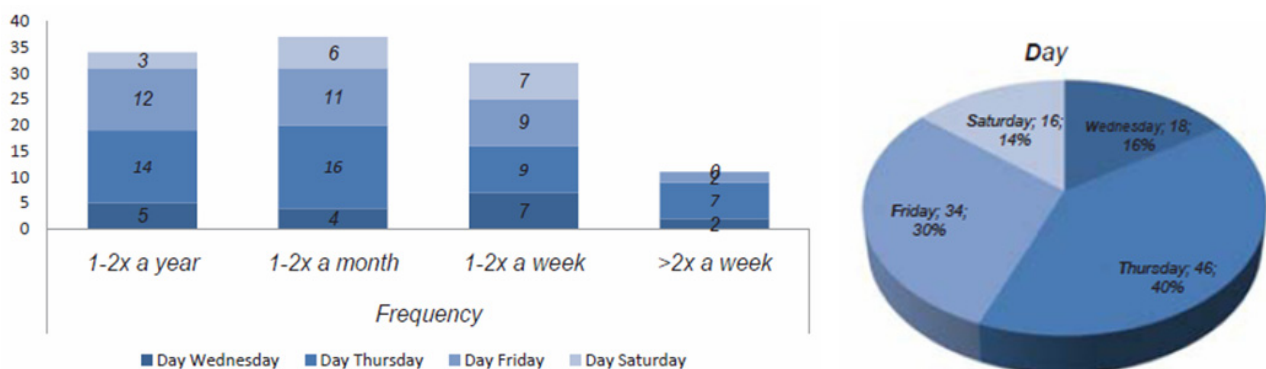


Figure 4.5: Examples of frequencies made by SPSS

Cluster	TI-1	TI-2	TI-3	TO-1	TO-2	TO-3	TO-4
No. of subjects	10	14	30	7	15	13	14
Gender: female	40%	35.7%	66.7%	71.4%	53.3%	69.2%	14.3%
male	60%	64.3%	33.3%	28.6%	46.7%	30.8%	85.7%
Age: < 30	50%	35.7%	20%	57.1%	33.3%	30.8%	28.6%
30–60	50%	64.3%	63.4%	42.9%	60%	61.6%	71.4%
> 60	0%	0%	16.6%	0%	6.7%	7.7%	0%
Average age	25–30	30–35	35–40	25–30	35–40	30–35	30–35
Average speed	1.19 m/s	0.61 m/s	0.24 m/s	0.25 m/s	0.63 m/s	1.04 m/s	1.35 m/s
Av. no. of stops (max.)	0.3 (3)	1.36 (2)	3.57 (13)	4.14 (11)	2.93 (7)	2.23 (5)	0.71 (4)
Av. duration of stops	6.97 s	2.58 min	4.66 min	4.43 min	1.83 min	32.97 s	11.34 s
Visited shops/facilities	food store	no main focus	fashion, specialities, drugstore, bookshop	fashion and accessories	no main focus	tendency to specialised /exclusive shops	no main focus

Figure 4.6: Tracking-cluster descriptions (Millonig and Gartner, 2009, p. 85)

Questionnaire surveys and GPS tracks sometimes show two different outcomes. When questioned, people tend to give the most socially desired answers instead of the truth (Millonig and Gartner, 2009). The GPS-tracks however display what actually did happen, the so called *actual action space* (Dijst, 1995). This contradiction can be found in the research pilot Tracking Delft 2, see *paragraph 10.2*.

With GPS-tracking and SPSS the three pedestrian groups (visitors/tourists, city centre inhabitants and neighbourhood residents) can be analyzed if they show different or similar characteristics. In this way tracking clusters can be composed; each with their own features. *Figure 4.6* shows an example of previous research. These features gain comprehensive insight to human spatial-temporal behaviour patterns. They can be used in future (mobile) navigation services to provide customised route suggestions and location based information. Moreover, they serve as a basis for determining parameters for pedestrian simulation models.

Compared to existing methods, GPS tracking contains added values like providing accurate and valid information of quantitative spatio-temporal data. Therefore, it makes a clear contribution to the lack of knowledge about processes (movement patterns of people) while it improves static and dynamic visualisation. Changes in behaviour can be measured before, during and after investments in public space. Tourist behaviour in time and space, or geovisualisation, is also extensively discussed by Shoval and Isaacson (2010). The outcome of this GPS-research contains the use, or actual action space (Dijst, 1995) of the city centre of Delft.

4.4 Sub-research question 4

The fourth sub-research question "How can the criteria for successful public spaces, the analysis of the current situation and the conclusions of how people use the city centre be embedded in strategic spatial (navigational) recommendations for the city centre of Delft?" will be answered by making a **tool** that will guide the making of strategic spatial **design** interventions for pedestrians, scale inner city of Delft. In this way, the 'Design' part of the graduation project is fulfilled. The tool and its explanation can be found in *chapter 8*. This paragraph shows the process that, in the end, led to the creation of the tool (GPS-flowchart).

So, how do we connect the GPS-tracking data to design interventions? "***If you can not measure it, you can not improve it***", as Lord Kelvin stated in the 19th century (Zapato, 2008). What can and what do we measure in order to improve city life?

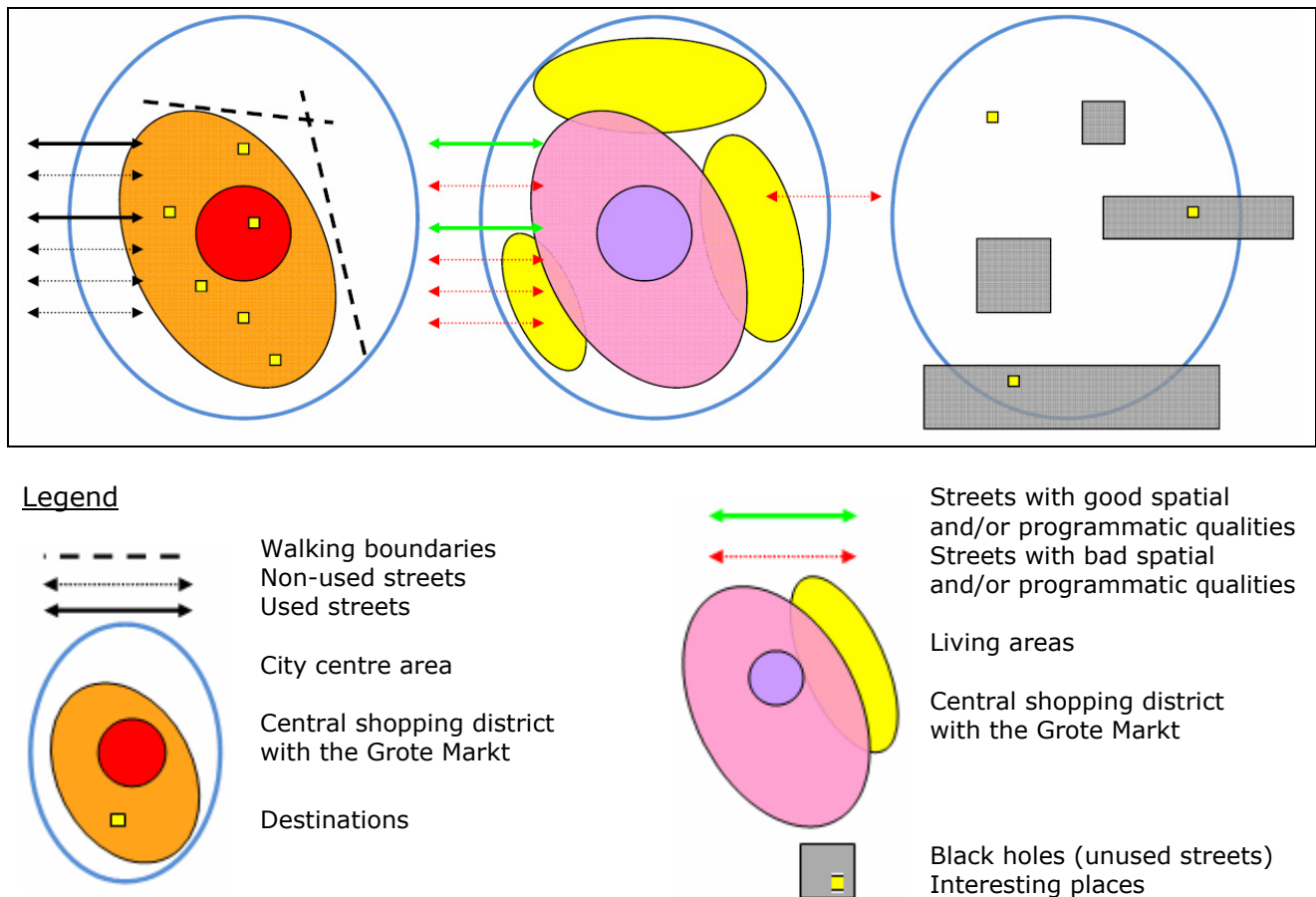
In the ideal situation there should be two tracking researches. The first pilot would be used to analyse the current use and quality of public spaces. The second research should be done after the strategic spatial design interventions are carried out in order to check if the changes lead to the desired results. This is the wanted scenario where the graduation project is working towards.

The three target groups (visitors/tourists, city centre inhabitants and neighbourhood residents) will presumably all have their own characteristic movements. If research proves that, for example, only the group of first time visitors do not use certain streets it is likely that people do not know the existence of these areas. In this case, more attention needs to be paid for route (navigational) aspects. In the current situation one measures the use of the city centre to trace people; where do they go, how do they go there (route and transportation mode), how long do they stay on the streets and what is their walking speed? This analysis is compared with the wishful scenarios. If they do not match, spatial interventions should provide for changes on street level in order to meet the required visions.

It should be noted that not every street has the function to attract a lot of people. For example, small alleys simply form short cut connections to main routes. And main routes are not designed to make pedestrians reside. First, streets need to be analysed what kind of function they represent before they are subjected to a checklist. Sometimes, it is the other way around. Despite their small dimensions and unattractiveness some streets are used heavily. They usually function as the fastest route from arrival point A to destination B.

The text above can be summarized in a process-sketch. *Figure 4.7* shows the words of Lord Kelvin translated in a scheme for the graduation process: Measure, understand and improve.

Figure 4.7: From left to right - Measure, understand and improve



Measure means tracking and mapping pedestrian movement. In this way city centre use can be visualised by looking at the GPS-tracks. This will answer questions like:

- Which streets are used? Which streets are not used?
- Routes, destinations and boundaries can be mapped.

Understand means that you know how the city centre is used. In order to understand and explain *WHY* the city is used by pedestrians, additional knowledge must be gathered regarding street quality and checking what academic literature has to say. The additional analysis contains:

- City centre evaluation: What are push and pull factors? (map program: living vs. shops)
- Street quality analysis: What are satisfiers and dissatisfiers? (attractive vs.unattractive)

Improve means that you take a look at the 'black holes' and think about which strategic spatial design interventions could better the area. The next steps are to be considered:

- Where are 'black holes'? (= unused streets)
- What are the 'black holes' exactly? (Why are these streets unused?)
- Is it wishful to improve their quality? (Thus, should these streets attract pedestrians? If yes, how?)

The product of this sub-research question consists of a map with strategic spatial design interventions (or *urban acupuncture*) for the inner city of Delft. End products of the graduation project will be a tool for future use of GPS-tracking interpretation and the map as previously mentioned. The graduation project process will be: question – research – result – testing in design; or mainly 'design by research'.

4.5 Strategic approach

Due to the fact that one of the end results consists of making strategic spatial interventions, two images below summarize what this actually means for the approach and process. In companies usually a pyramid in the form of mission, vision and strategy can be found. The purpose of an organization is of course to realize a certain amount of profit in order to make sure that the company can continue to exist. This translation, however, can also be made to cities. In the author's opinion, a city is a living organism that wishes to remain healthy. On the one hand, profit can be transferred in money (the urban economy). On the other (more important) hand, features of a healthy city are expressed in many and long-term public space stays and activities.

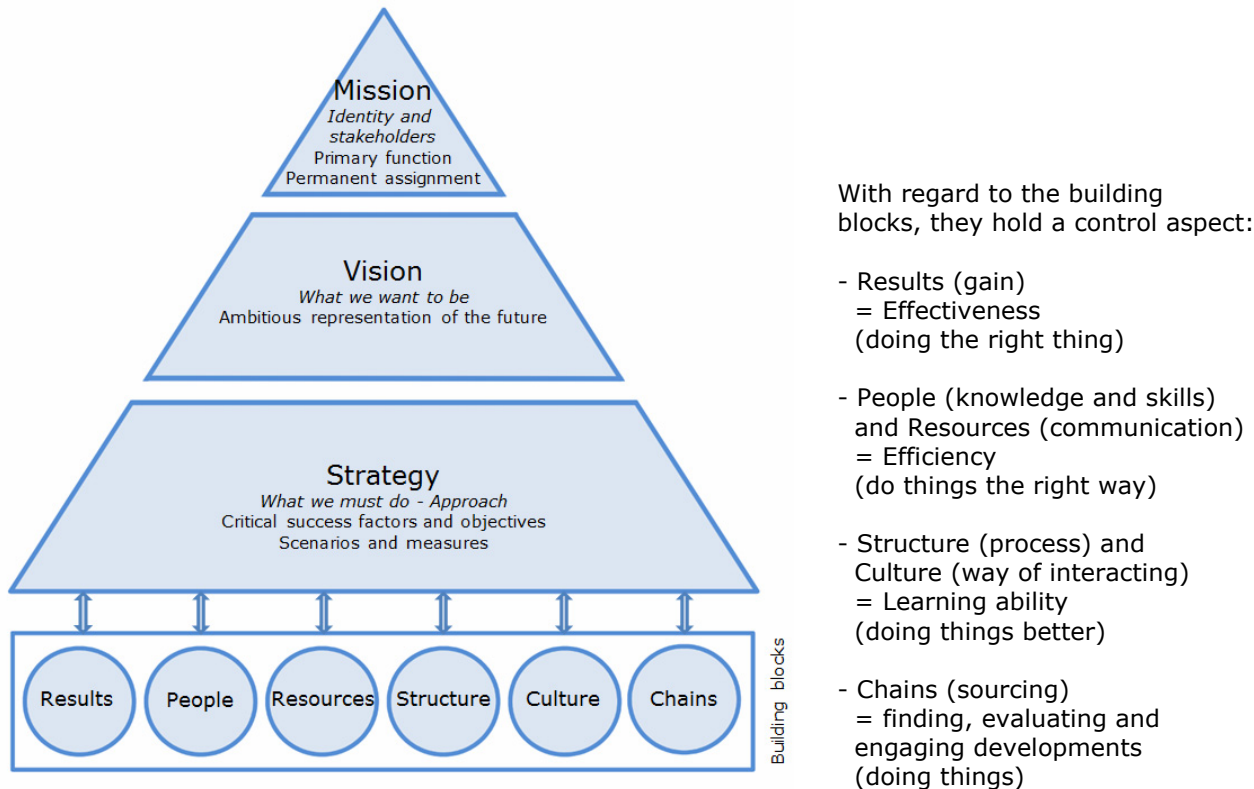


Figure 4.8: Strategic approach (Nieuwenhuis, 2008)

Figure 4.8 demonstrates the author's mission, vision and strategy for the city centre of Delft with regard to the spatial interventions. Figure 4.9 shows how the phases of the plan cycle, the research questions and the strategic approach of the graduation project are connected.

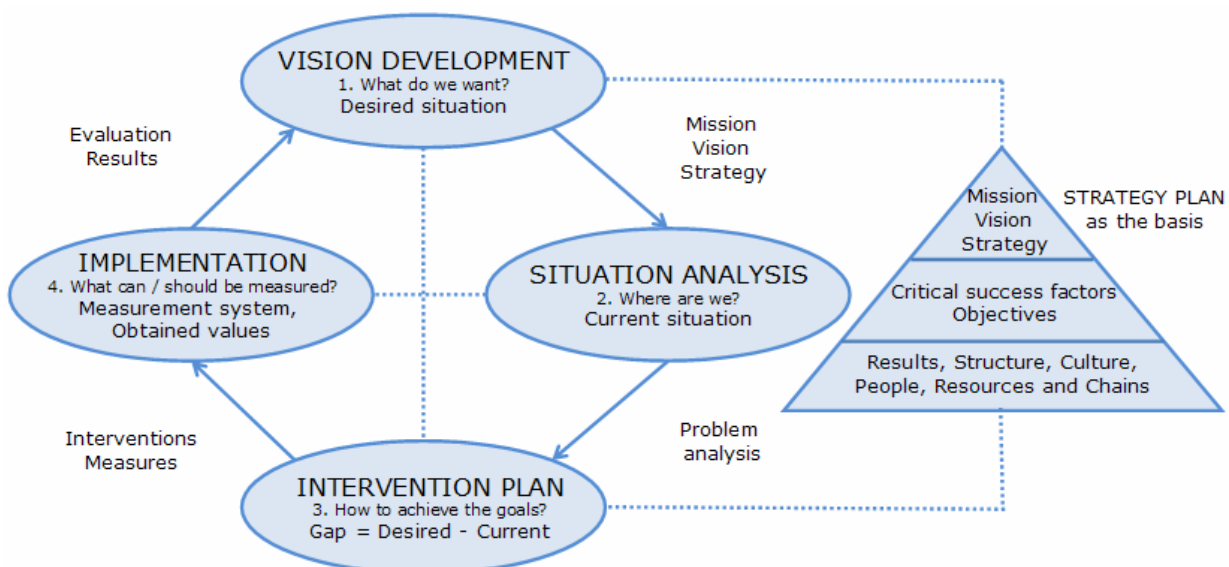


Figure 4.9: Strategic approach graduation project (Nieuwenhuis, 2008)

4.6 Relation research questions, methods, products and time line

Figure 4.10 shows the relationship between questions, methods and (end) products. A global planning can be found in figure 4.11. In Part II of the report detailed planning schedules of the research projects Tracking Delft 1 and 2 are added.

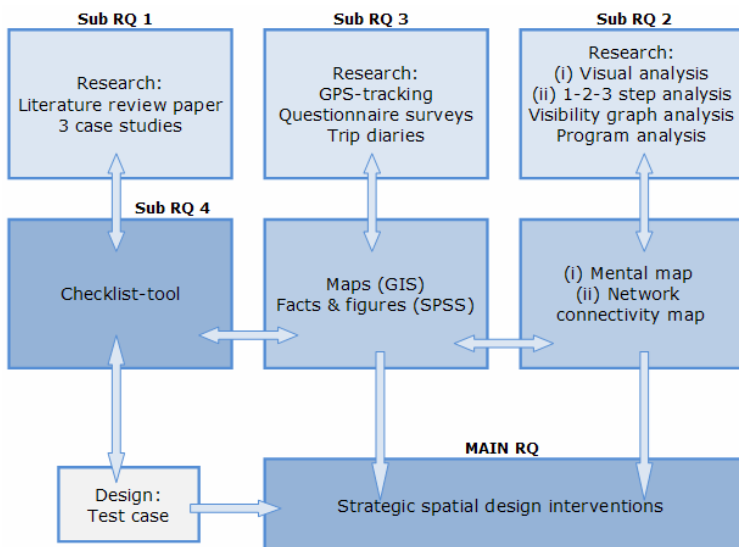


Figure 4.10: Relationships between sub-research questions and (end) products

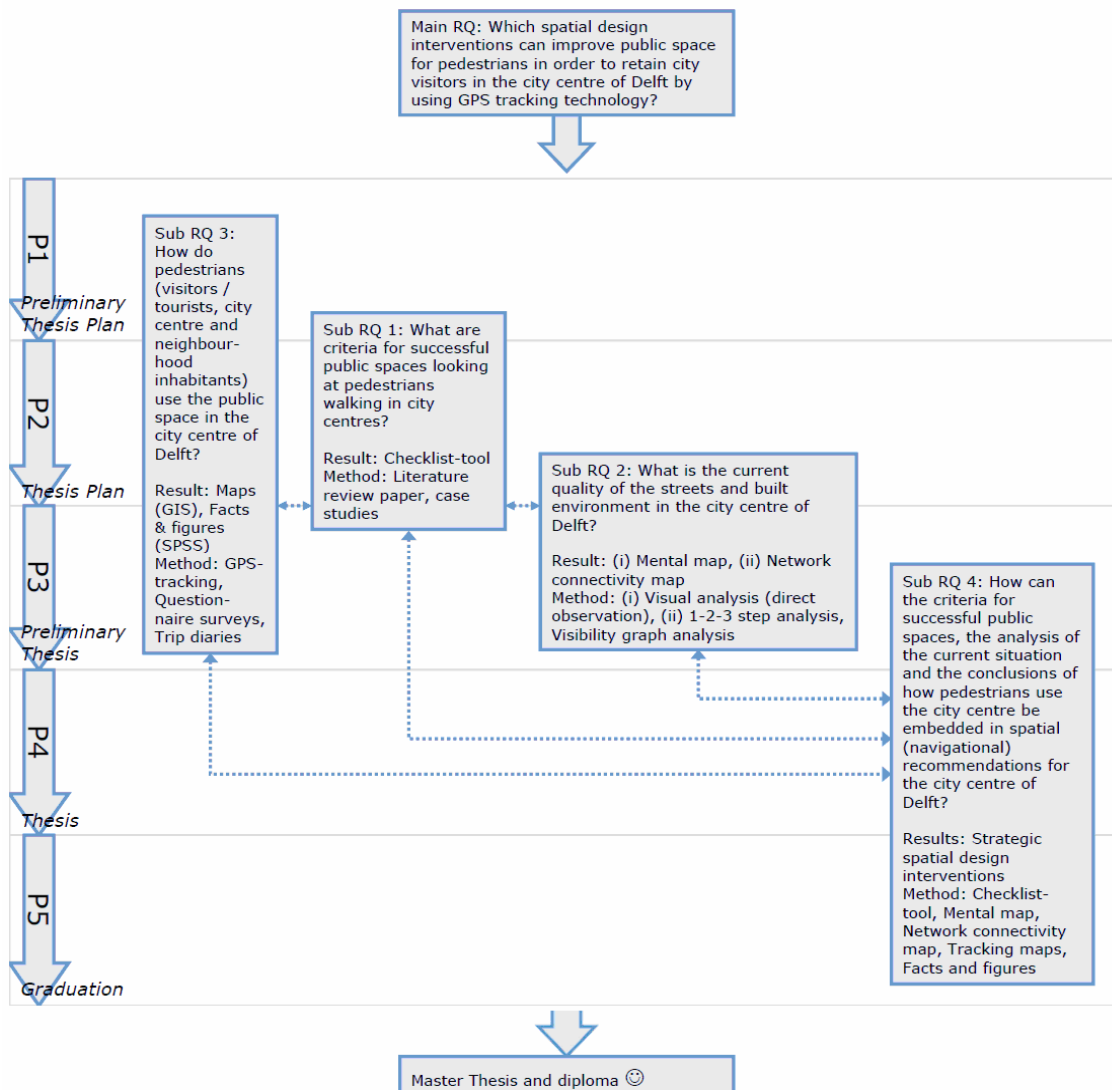


Figure 4.11: Global planning graduation project



5 Relevance and disciplines

5.1 Scientific relevance

People's behaviour of a certain area is measured and mapped in order to gain knowledge about their movements or actual action space (Dijst, 1995). Every environment has its own characteristics and people react personally to that structure; in an interactive, passive or avoiding way. How pedestrians (visitors/tourists, city centre inhabitants and neighbourhood residents) move through the city centre of Delft, what their routes and destinations are and how much time they spend on the streets is unknown yet. This research is adding information about another yet unexamined historic European city centre in the idea of the *Spatial Metro* project (Van der Hoeven et al., 2008) context. Delft has the same organic European historic city centre structure and is about the same size as the European *Spatial Metro* cities; approximately 100,000 inhabitants.

A current inner city report (Walen and Bos Eyssen, 2005) only deals with counting people on four busy points in Delft. Pedestrians were not followed to see how they walked (route) through the centre and what destinations were. The visitors' surveys were only held on Friday day- and night-time and Saturday on 8 strategic locations. Both days attract another public than a normal weekly day does ('shoppers' from other areas). Their goal was to count the amount of people moving around; not how and why people used the streets.

This research is adding knowledge to the previous investigation. Compared to existing methods, GPS-tracking contains added values like providing accurate and valid information of quantitative spatio-temporal data, as is previously described in *paragraph 4.3.2*. Therefore, it makes a clear contribution to the lack of knowledge about processes (movement patterns of people) while it improves static and dynamic visualisation. Changes in behaviour can be measured before, during and after investments in public space.

The mapped research results lead to understanding and explaining of pedestrian behaviour. Eventually, pedestrian models for urban environments can be made to predict behaviour and guide it in desired directions.

5.2 Societal relevance

If human behaviour in relation to the context is better understood, then all sorts of governments can manage and design city centres in such a way that street life will be attractive for visitors and inhabitants. Pedestrians feel more at ease, are happier and enjoy being in a city centre over a longer time period. Longer walks are good for the health, reduce stress and exciting experiences will be told to friends who will also come to the city and have a good time.

Street life will flourish and city centres will become more safe because there are more eyes on the street (Jacobs, 1961; Gehl, 1971; Alexander et al., 1977; Bosselmann, 2008). Urban economics will improve as longer visits and more pedestrians mean more money spending (Van der Hoeven et al., 2008; Plowden, 2010). More room for pedestrians and human activity in the public space means less polluting cars, cleaner air and less stress. Give the streets back to the people. Street activity and quality are critical for a vital urban life (Gehl et al., 2006).

PART II: RESEARCH PROJECT

6 What draws people to a city centre?

Why do people actually visit city centres? What are they looking for? Previous research shows that 44% of the people come to inner cities for mostly pleasure. Only 24% is mostly working. Visitors like the atmosphere (22%), people and life (21%) and narrow streets (15%) best of inner city attendance. This can be seen in *figure 6.1* which shows some facts & figures about the city of Copenhagen, Denmark. About 50% of the visitors disliked traffic, pollution, graffiti and dirt the most (Gehl et al., 2006).

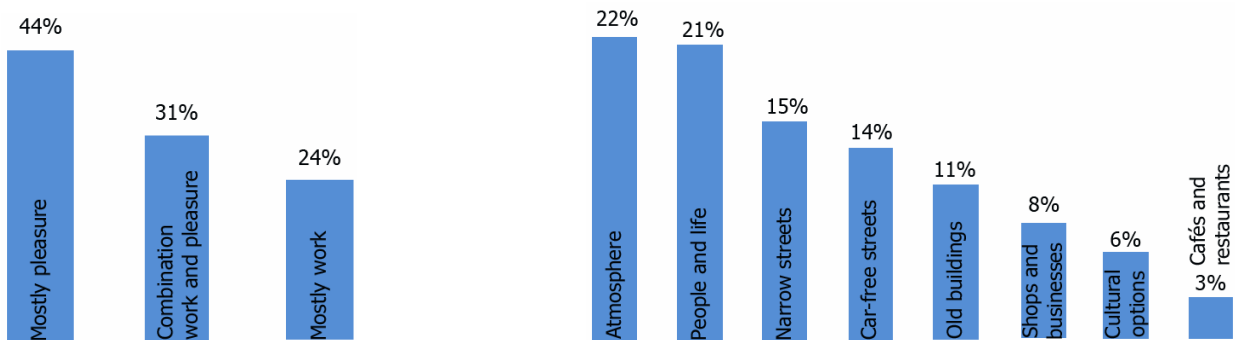


Figure 6.1: (L) Why do people visit inner cities? (R) What do people like best? (Gehl et al., 2006, p. 90)

Similar research has been done in the Netherlands; comparing the 4 biggest cities (The Hague, Amsterdam, Rotterdam and Utrecht) with each other. Results are illustrated in *figure 6.2*. Shopping is the most important reason followed by culture and leisure.

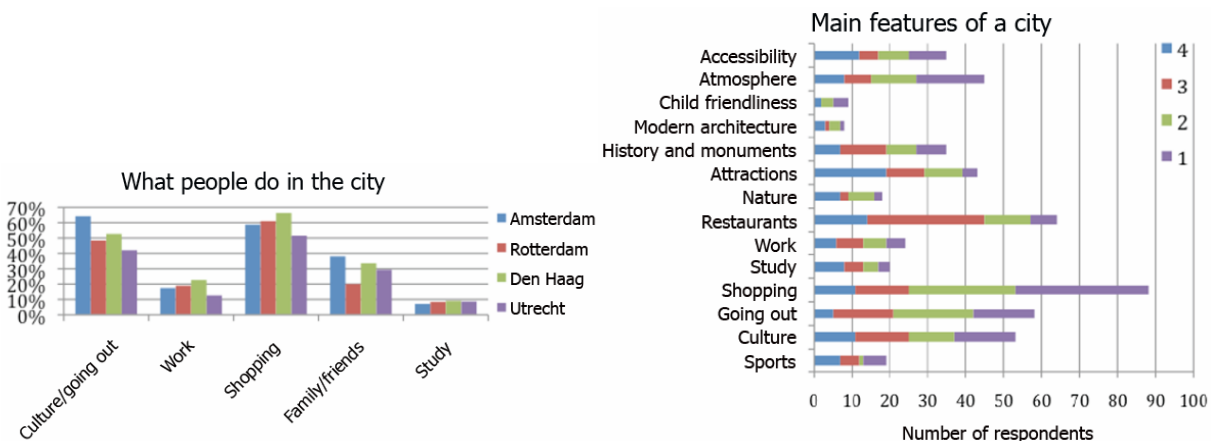


Figure 6.2: (L) Why do people visit inner cities? (R) What do people like best? (Van Santen, 2008, p. 26)

With regard to the case study cities of the European *Spatial Metro* project, the following numbers are noted in *figure 6.3*;

Location	Main purpose: shopping	Main purpose: leisure
Norwich (St. Andrews)	80%	12%
Norwich (Chapelfield)	90%	08%
Rouen (Vieux Marché)	69%	18%
Rouen (Haut Vieille Tour)	66%	21%
Koblenz (Löhr-Center)	75%	22%
Koblenz (Görresplatz)	48%	43%

Figure 6.3: Main purposes of city visits (Van der Spek, 2008-b)

When we take a look at Delft and its city centre, we see corresponding developments. In the left image of *figure 6.4* can be seen that industry, services, education and care score the highest for Delft. However, when zoomed in on the city centre (the dark green colour) it becomes clear that most jobs can be found in services, retail and leisure activities.

For Delft the share for education and care are significantly higher than the national average, slightly higher for shopping and leisure slightly lower. The right picture shows which activities score best in the city centre of Delft compared to the rest of Delft (Louter and Van Eikeren, 2008).

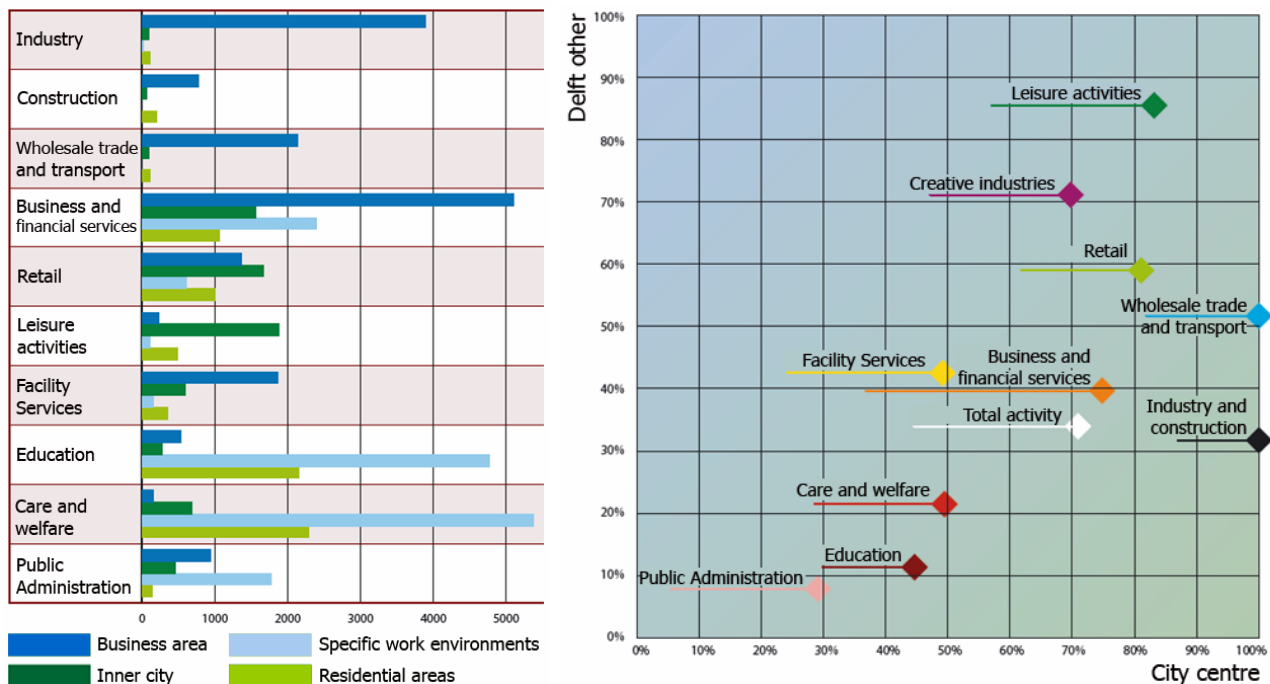


Figure 6.4: Number of jobs 2007 by sector and region type (Louter and Van Eikeren, 2008, pp. 18, 38)

Consequently, it can be stated that people mainly visit Northern European city centres to relax, shop and for leisure activities. This has caused that people *choose* very consciously where they want to go in their free time. Or, in other words, people will decide critically if they want to visit a specific city centre or not. If streets are experienced as satisfying by the majority of the visitors there is a big chance that people will come back and spend more time. This increases street vitality & quality and money spending.

7 Case study: Wayfinding in three European cities

Besides the literature review paper, also this chapter provides an answer to the first sub-research question "What are criteria for successful public spaces looking at pedestrians walking in city centres?" Here, a look is taken at previous experiences with regard to wayfinding.

As written in the previous chapter, both approaches are merely focussed on objects or stories. But they don't inform you about what is going on in the city. A total different approach can be found at street scale which helps and notifies individuals. The European Union *Spatial Metro* project "aims to provide a way of making city centres legible and navigable for visitors and local people" (Tan, 2008-a, p. 141). This is realised in several ways but most solutions use (new) techniques.

First, in Rouen (France) a light plan was made which is activated after sunset. The lights create an artistic route which guides people through the city. Moreover, a feeling of "safety, comfort and orientation" is provided (Van der Spek, 2008-a, p. 22).

Second, in Bristol (England) visitors are welcomed and can come familiar with the city using "pedestrian direction signs, on-street information panels with city and area maps, printed walking maps, visitor information identity and arts projects" (Gullam, 2008, p. 36).

Third, in Biel/Bienne (Switzerland) adjustments in the physical network were made such as decreasing possibilities for cars in combination with expanding territory primarily for cyclists and pedestrians while improving public transport connections and quality. Besides, paper town maps as well as interactive plans shown on touch screens which will print the route to your destination are available. "Other types of information will also be available: bus route numbers and times, national rail times and information provided by the town council" (Burkhard et al., 2008, p. 49). The way-find information is shown on big vertical plateaus all around the city.

Moreover, a group of young men developed the "Stationary Info System" and its brother "Outdoor Info System" that both provide information for visitors (Furbach et al., 2008, p. 76). The first can be found on public places like train stations; the second is situated next to important buildings or sights. Furthermore, the "Mobile Info System" (id.) uses Bluetooth applications to send subject-matter information about points of interests and events for free. Visual identity is of great importance in all projects. They do not necessarily cost a lot of money, time and maintenance provided that plans are well thought-out.



In addition, an augmented (=based on) reality tool is developed recently that is not predicated upon image recognition but looks at the location. If you point a smartphone (accommodated with GPS and compass) at an object the phone uses information from the internet to provide you with information of the object. Extra buttons appear on your screen and you can choose which data to use.

Based on the position of the smartphone and the direction of the camera, the phone knows what it is looking at and can link the right information to the object.

This is called *geocoding*; linking a location - coordinates- to data (Van Lieshout et al., 2003, p. 21). Figure 7.1 shows an example. The system is accurate to a radius of approximately 5 meters; enough to refer to larger objects (Meijer, 2009).

Figure 7.1: Geocoding (Meijer, 2009, p. 23)

8 Tool: GPS-flowchart

This chapter answers the fourth sub-research question: "How can criteria for successful public spaces, the analysis of the current situation and the conclusions of how people use the city centre be embedded in strategic spatial (navigational) recommendations for the city centre of Delft?"

It is the first time that a graduation project at Urbanism, TU Delft, uses GPS-tracking as a method. However, more experimental GPS-tracking pilot projects have been carried out in the past by TU Delft students at the elective course "*Urban Design: People, Pedestrians & Public Space*". The author hopes that, due to its enormous amount of highly valuable information, there will be many more of these GPS-research projects. Not only in the academic world but more important in real life; all sorts of organizations such as commercial companies, environmental or health authorities and municipalities will sooner or later realize the great potential and impact this method provides.

For everyone who works with GPS-data and studies human activity in built environments, the author came up with the idea to create a simple and flexible tool which guides amateurs as well as professionals in the process from dealing with the data towards strategies for better city life. This tool is shown in *figure 8.1* and has become a GPS-flowchart. Important for the graduation project is the fact that all four sub-research questions are processed in the GPS-flowchart which will, by applying the tool, automatically lead to answering the main research question or: strategies for spatial interventions and recommendations.

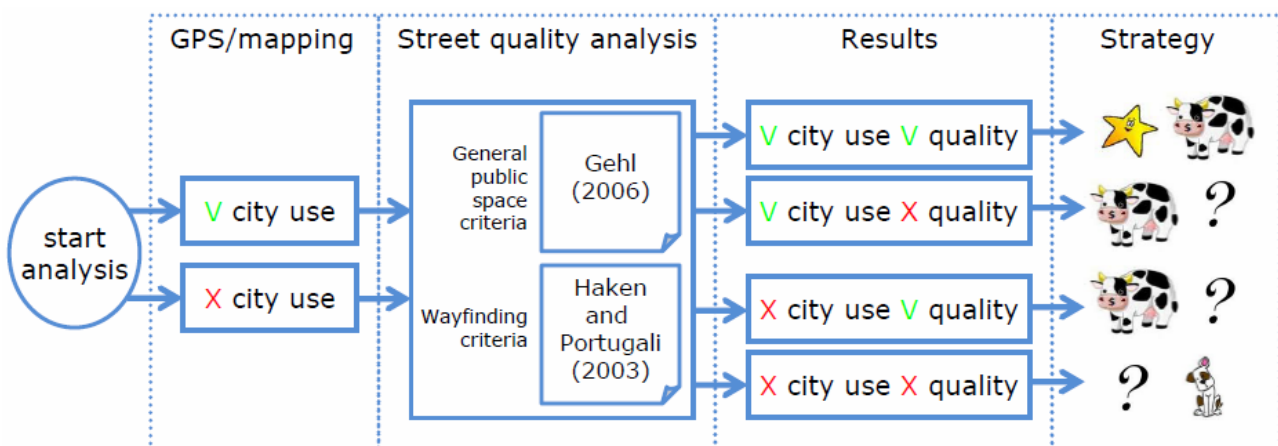


Figure 8.1: Tool = GPS-flowchart

How does the GPS-flowchart in *figure 8.1* work? First, practise research in the real world has to be done. **GPS-tracks** are mapped and images show whether streets are used or not used (make a choice in the first box).

At the same time theory derived from academic literature provides a clear overview which suitable quality criteria for good public space should be used for **street analyses**. This is shown in the second box. To evaluate the built environment the general public space criteria of Gehl (2006) is used. The graduation theme focuses on wayfinding, so in the box an element of wayfinding can be found. It should be noted that this box is flexible due to the fact that every research will focus on a specific theme; wayfinding can easily be replaced by another theme.

The **results**-box combines the first two boxes: how is the city centre used and what is the quality of the streets? There are four possible outcomes which are demonstrated in the third box.

Finally, decisions must be made. What are we going to do with a street or area? This is demonstrated in the last box **strategy**. This part is also flexible to interpret due to the fact that every street is characterised by its own unique spatial and programmatic quality. You first decide what kind of street you are dealing with; is it a busy shopping street, a street that

connects main roads or a quiet alley, for example. Depending on what kind of function the street represents, one analyses what kind of 'problems' (the black boxes) there are. In order to define a strategy one must look at the current street quality combined with the wishful future street vision. In the box the four segments of the **BCG-matrix** can be identified by the sharp-eyed reader. For readers who do not have a background in management (PR & marketing) the matrix and its elements will be explained below.

The BCG-matrix model, see *figure 8.2*, is a portfolio analysis and planning model developed by Bruce Henderson of the Boston Consulting Group in the early 1970's. The BCG model is a portfolio management tool used in product life cycle theory. It is often used to prioritize which products of the company get more funding and attention.

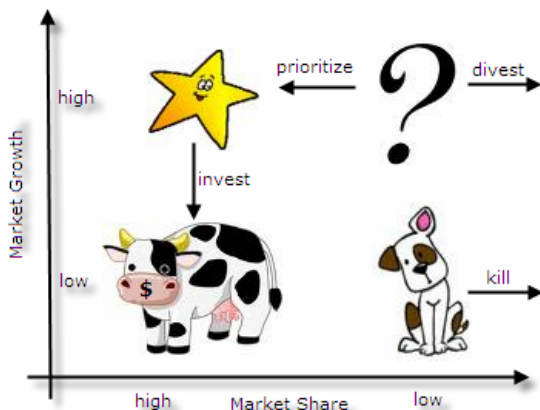


Figure 8.2: BCG-matrix model (Maxi-Pedia, 2010)

In *figure 8.2* four segments can be found (Maxi-Pedia, 2010):

- A **star** features high growth and high market share; it is likely to grow into cash cows.
- A **cash cow** which is marked by low growth and high market share. They have high profit margins and generate a lot of cash flow; promotion and placement investments are low.
- A **question mark** is known for its high growth and low market share. These are new products where buyers have yet to discover them; the strategy is to get markets to adopt these products, invest heavily in them to gain market share or to sell them (or they will become dogs).
- A **dog** is characterized by low growth and a low market share. They should be avoided and minimized; expensive turn-around plans usually do not help.

Translating these four marketing segments into an urban environment needs a flexible and creative view. Streets that are both used and have good spatial quality and program can be divided into stars and cash cows. No large spatial or programmatic interventions are necessary because the areas already function very well. If city use is lacking while quality is present one can analyse *WHY* and apply the question mark which (if wishful) can turn into a star with the right strategic interventions. The same applies to streets with good city quality while no pedestrian goes over there.

When both street use and spatial and programmatic quality fail, one can point out that these streets are dogs. In urban planning this does not mean that the areas will be 'killed'. With regard to alleys, for example, it means that investments only should be made to prevent that the area becomes a creepy ghetto environment by applying minimal maintenance (keep walls and street clean from garbage and graffiti). Moreover, monofunctional living areas do not need to be made highly attractive with lots of commercial program. Here, residents enjoy the calm and quiet environment; they do not want lots of tourists sauntering through their streets.

To summarize, one or two (combined) strategies can be as following:

- Star = hold strategy
- Cash cow = harvest strategy
- Question mark = build strategy
- Dog = divest strategy

9 Research projects: Preparation and execution

In order to answer the third sub-research question “Do pedestrians (visitors/tourists, city centre inhabitants and neighbourhood residents) use the public space in the city centre of Delft differently?” practice research is done using GPS-tracking technology, questionnaire surveys and trip diaries. Results will consist of maps (GIS) and facts & figures (SPSS). With regard to data collecting, two different research pilots (Tracking Delft 1 and 2) were carried out. The Tracking Delft pilots also have a website: <http://bk.tudelft.nl/trackingdelft>

9.1 Tracking Delft 1

From Wednesday 18 November – Saturday 21 November 2009 a group of 10 TU Delft students (including the author) were standing in the Phoenix (200 cars) and Zuidpoort (900 cars) garage in Delft, see *figure 9.1 and 9.2*, to hand out GPS devices. It should be noted that the Koepoort garage (350 cars) was still under construction at the time; it opened mid 2010.



Figure 9.1: Distributing GPS devices in Phoenix and Zuidpoort garage (Pictures by Stefan van der Spek)

The distribution and collection of GPS devices was located near the pedestrian's entrance/exit of the parking garages. For Zuidpoort this meant the location was underground near the escalators so the devices could not be switched on until the persons were above the ground. In the Phoenix garage the point for the distribution and collection was on ground level near the paying machine as *figure 9.1 (left)* shows. The equipment on both locations included a table, a poster and flyers. The team consisted of 2 students from the TU Delft. The teams were equipped with 45 GPS devices and questionnaires which the pedestrians had to fill in after returning their GPS device.

People leaving the parking garage were asked to contribute to the research. If they belonged to the target group of shopping or leisure pedestrians were offered a flyer explaining the background and setup of the research pilot. When people accepted to participate, the GPS was handed over. Further, it was obligatorily to sign a contract for lending the GPS device. This contract (or intake form) consisted of contact information in case that a person forgot to return the GPS device. The contract was restored directly after returning the GPS device. To understand the behaviour better, a questionnaire had to be filled in on return. The questionnaire focussed on demographical data (age, zip code home, family situation, profession) and purpose of the trip such as shopping (retail) and leisure (culture, heritage, drinking or dining).

Participation was absolutely anonymous: No private information of any participant was kept. Therefore, all requested private information to assure return of the device was kept separated from the background information. The intake form containing contact information was restored in return of the GPS device. After that, the data of every participant got a unique number. A total amount of 325 pedestrians (= also number of tracks) participated in the research.

Three documents were available for the (potential) participant. The first document was a flyer explaining the background of the project. The second was the intake form, a contract that stated that the GPS device is property of the TU Delft including contact information in case the device was not handed back. The third document was the questionnaire. This is the key document making it possible to understand, analyse and segregate data. All documents can be found in *Appendix E*. The planning of the quarter is shown in *figure 9.4*.

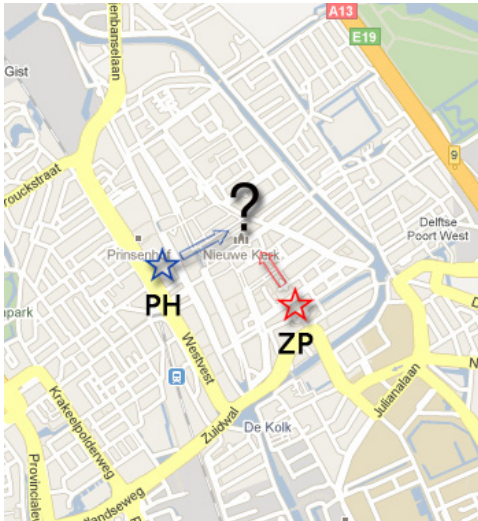


Figure 9.2: Phoenix and Zuidpoort garage

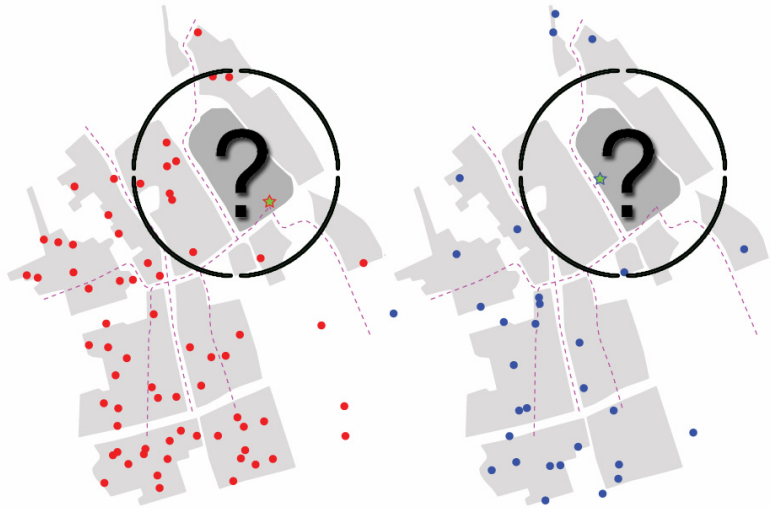


Figure 9.3: Research 1 shows a gap in the collected data

When the zip code data (origin of visitors) was mapped, it was striking that from the people who arrived by car no one lived in the city centre or in the surrounding neighbourhoods of Delft, as can be seen in *figure 9.3*.

Consequently, it was still unknown how inhabitants of the city centre of Delft and the direct districts were moving around. There was a need for a second research to gather additional information in order to monitor pedestrian movement for all city walkers. An expression is "One fool can ask more than ten wise men can answer" (Van Lieshout et al., 2003, p. 31). The more you know, the more clear it becomes what you still would like to know or do. So, the first research led to the second research pilot which is called Tracking Delft 2.

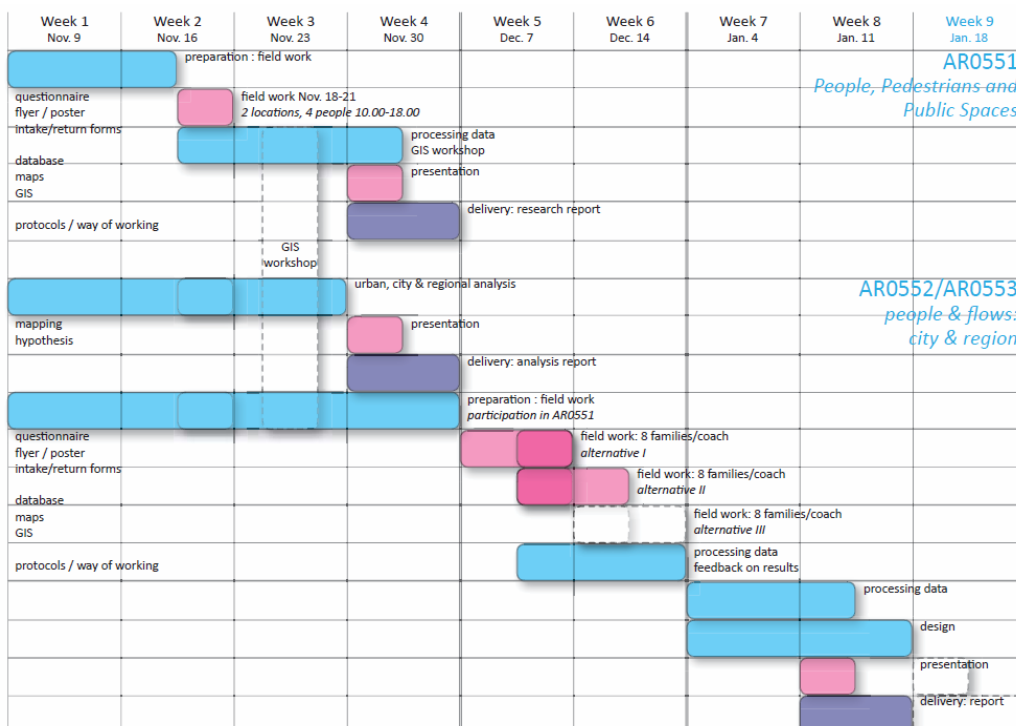


Figure 9.4: Planning Tracking Delft 1 (made by Stefan van der Spek)



9.2 Tracking Delft 2

From Monday 26 April – Monday 3 May 2010 a group of 18 TU Delft students (including the author, who also fulltime helped preparing the research) visited a total amount of 78 residents (42 households) from the city centre of Delft and its neighbourhoods to hand out GPS devices.

The process was different than the previous research. In Tracking Delft 1 the preparation time was only one week because people will visit a parking garage anyway. The second research needed to be carefully organised in advance because it was unknown which residents wanted to join the research. We needed to make sure that a large group of inhabitants was gathered in time.

DOK (a fusion of **D**iscoTake, **O**penbare bibliotheek Delft and **K**unstcentrum Delft, since January 2006) became our partner in crime in the second research pilot. DOK is the most modern library in the Netherlands and works with new technologies in different ways. From a technological point of view they are interested in GPS tracking with regard to people moving around in the city centre of Delft (where DOK is located currently). DOK offered and provided the candidates for the research.



Figure 9.5: Posters and flyers in DOK – at the entrance (left) and next to the stairs (right)

From 10 March 2010 on a lot of preparations and activities were done and forms were created by the author for the research. All products can be found in *Appendix F*:

- An instruction letter to DOK employees for approaching DOK members (inhabitants of Delft) from their database
- A welcome letter for participating DOK members
- A return envelope for DOK members; this was replaced by a digital online registration form which can be found on <https://spreadsheets.google.com/viewform?formkey=dDU5TmphSHBNMjcySEtzV21JVE9hTXc6MA> The form consists of four parts: (i) adress information and family situation (ii) private data (iii) private data from his/her partner (iv) communication information
- A1 posters for promotional purposes (hanged in DOK during 2 weeks) at the entrance in DOK en near the stairways, as *figure 9.5* shows.
- A4 flyers for promotional and contact purposes (lied in DOK during 2 weeks) as *figure 10.5* shows.
- A GPS manual for both students and residents
- An intake form that residents received a GPS device and would take very good care of it
- A diary: residents keep track of where they go
- A weather registration report
- A questionnaire for residents after the tracking days

After DOK contacted their members, enthusiastic people who wanted to participate as a volunteer in the research pilot signed up online. A total amount of 52 households were registered in the end. Not all households were located in the right geographical location. Moreover, several households turned out to be with vacation during the research period.

Consequently, eligible participants were selected and non-selected applicants were contacted that maybe they could join for a next research. With a group of 42 households, which represents 78 adults, the pilot started in April 2010. *Figure 9.6* illustrates what kind of households participated and where the households are geographically located.

Due to the limited amount of available students the target group was set on preferably 2 adults per household. Single households or single parent households were also welcome to register of course; they ended up on the reserve list. One student visited 3 households in total.

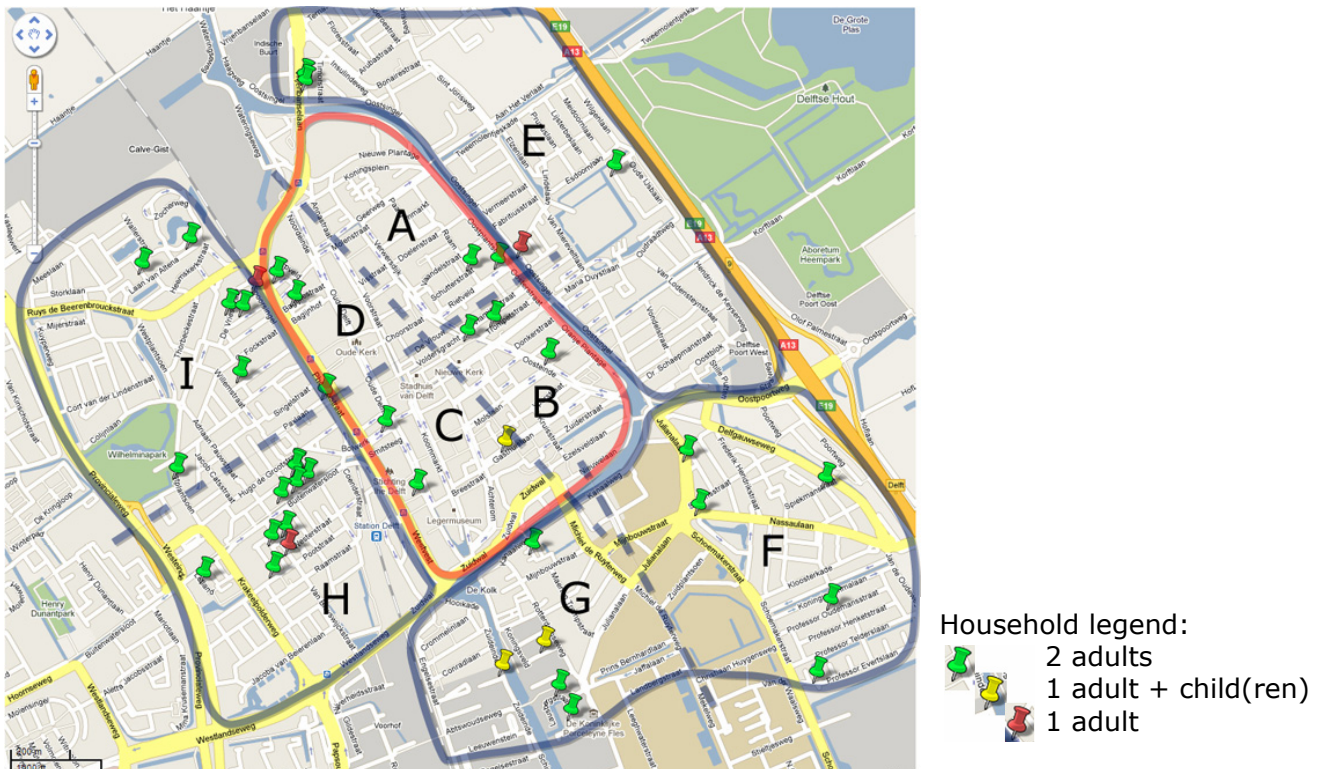


Figure 9.6: Geographical research of Tracking Delft 2 (city centre in red, neighbourhoods in blue)

The GPS devices were distributed by TU Delft students to the DOK members at home. DOK members were informed in advance who their contact person (student) was. The student then called to make an appointment with the participants.

On Monday 26 or Tuesday 27 April inhabitants received an instruction (verbally and written), GPS device with charger, empty trip diary and weather forms. From Wednesday 28 April – Saturday 1 May occupants carried a GPS device to collect data with them whenever they left their house. On Sunday 2 and Monday 3 May the devices and forms were collected at the homes. Inhabitants then filled in a questionnaire for additional information (demographics, experience, forgotten days, destinations city centre, used transportation modes, an empty map to colour good and bad spaces). Tuesday 4 May all data was transferred to computers.

From 6/7 May 2010 GIS workshops were given in order to let students learn and exercise with the software. From that moment on the data was processed and interpreted. A small group of 5 students worked on the Tracking Delft 2 data. (Other students were working on data from Tracking Delft 1 and the third group participated in the tracking research of the *Veldacademie* in Rotterdam.) Final presentations were held on Friday 18 June 2010 in DOK.

A total of 570 trips (be at home > leave home for activities > get back home = 1 trip) is gathered. There is an average of 8.3 trips in 7 days with a maximum of 10 trips per day.

The planning from the preparation in quarter 3 (Q3) and execution in quarter 4 (Q4) can be found in *figure 9.7 and 9.8*

TRACKING DELFT II		today	week di 16 mrt	3,04 ma 01 mrt	3,05 ma 08 mrt	3,06 ma 15 mrt	3,07 ma 22 mrt	3,08 ma 29 mrt	3,09 ma 05 apr	3,10 ma 12 apr
appointments	DOK			X						
criteria	for DOK	who? where?					X			
letter	for DOK	information: criteria, goal, way of working, data, etc					X			
questionnaire	feedback							X		
flyer, poster	for DOK	promotion					X			
distributie										
tracking										
return										
data processing										
data retrieving										
data processing										
PROJECT										
kick-off	start education/research within COURSE									
instruction	GPS/equipment/procedure									
instruction	GIS/software									
data collection	instruction/reminder									
mapping										
data processing										
questionnaire										
results										
presentation										

Figure 9.7: Research preparation Q3; February-mid April (image by author and Stefan van der Spek)

TRACKING DELFT II		4,01 ma 19 apr	4,02 ma 26 apr	4,03 ma 03 mei	4,04 ma 10 mei	4,05 ma 17 mei	4,06 ma 24 mei	4,07 ma 31 mei	4,08 ma 07 jun	4,09 ma 14 jun	4,10 ma 21 jun
appointments	DOK										
criteria	for DOK										
letter	for DOK										
questionnaire	feedback										
flyer, poster	for DOK										
PREPARATION		p									
PR campaign											
selection of participants											
confirmation of participants											
data collection											
distributie			X								
tracking			X								
return				X							
data processing											
data retrieving				X							
data processing				X							
PROJECT		START	R	R	R	-	-	-	-	P	
kick-off	start education/research within COURSE	X									
instruction	GPS/equipment/procedure	X									
instruction	GIS/software		X								
data collection	instruction/reminder		X								
mapping			X								
data processing				X	X	X	X	X	X		
questionnaire				X	X	X			X		
results									X	X	
presentation										X	

Figure 9.8: Research execution Q4; mid April – July (image by author and Stefan van der Spek)

9.3 Dealing with the data

For both pilot projects the data was collected into two different sources:

- Track logs (from the GPS devices) resulting in temporal-geographical information
- Questionnaires and diaries resulting in social-geographical information

Processing the data consisted of 5 steps: (i) trip validation (ii) cleaning the tracks; an example can be found in *figure 9.9* (iii) individual analysis (iv) collective analysis based on questionnaire (v) findings and conclusions (Van der Spek, 2008-b, p. 88). For data management reasons and to keep all data anonymous a unique code was allocated to every entry. This unique code consists of six numbers, representing the day, the location, the device id and the participant id.

The results of the questionnaire were entered into a specifically designed database (Microsoft Access). The database includes sets of predefined lists and interfaces for processing and accessing data and can be linked to GIS. Before the raw files were cleaned, an analysis was made with an interpretation of the tracks. This resulted in a map with the actual route and the destinations of the participants. These maps were checked by a different person before we started cleaning the corresponding GPX file. GPS tracks, especially from pedestrians in dense urban environments, often look like drawings from a 4-year-old. The signal is often disturbed and reflected by glass and buildings. Sometimes it is unclear what the exact route is.

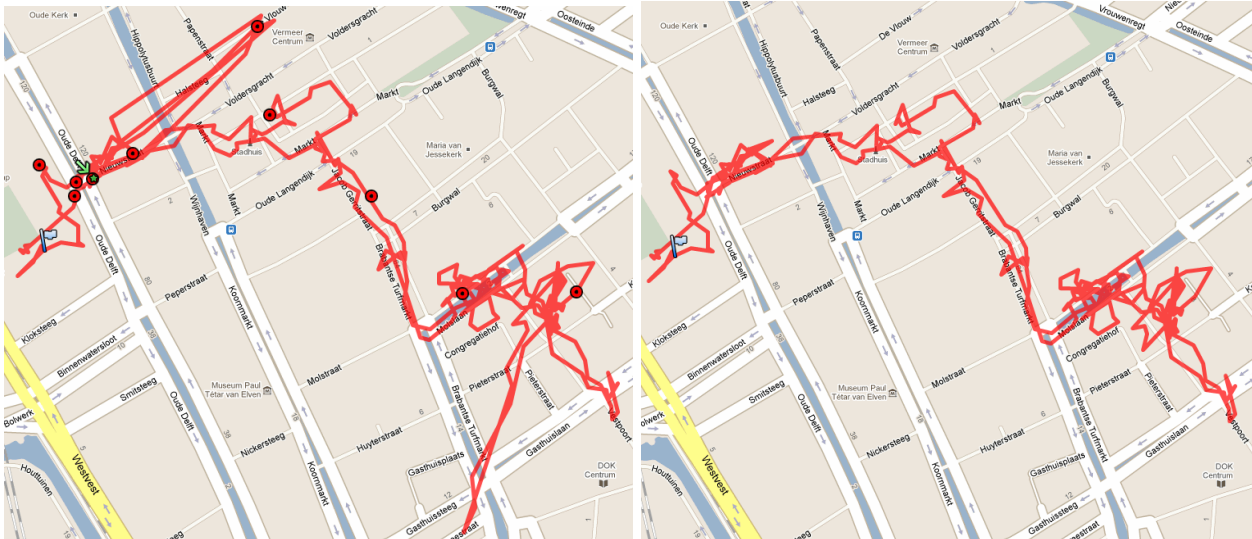


Figure 9.9: Example of a cleaned trip: before cleaning (left) and after cleaning (right)

The assessment of tempo-geographical data was based on the existence of track date, match between track data and the questionnaire, readability and consistency of the track. If all the points were fulfilled with a positive response, the file was marked valid. Otherwise, data was removed or adjusted to create a valid track. Valid tracks were exported and converted into compatible files for GIS. In GIS the database containing the social-geographical information of the questionnaires was connected to the tracks. In this way it is possible to select tracks with specific social-geographical features. Figure 9.10 shows how the groups are dealing with data.



Figure 9.10: Working with the data – Tracking Delft 1 and Tracking Delft 2 groups (picture by Stefan van der Spek, 2009)

(picture by author, 2010)

All data was collected with a frequency of 2 seconds (Tracking Delft 1) and 5 seconds (Tracking Delft 2) seconds. This means that every dot on the map represent 2 or 5 seconds. Point density represents the time sent on location. Density drawings were made for different types of themes. Using these drawings makes it able to draw conclusions and make suggestions for improvement.

The background data in the questionnaire was also analyzed using statistical software: SPSS. Frequency tables and cross tabulations provided more insight in the behaviour of people.

All outcomes must be considered as results of the participating population. The study does not give insight in the background and behaviour of all city visitors but only for the selected group.

10 Research projects: Results and conclusions

This chapter answers the third sub-research question "Do pedestrians (visitors/tourists, city centre inhabitants and neighbourhood residents) use the public space in the city centre of Delft differently?" It begins with a selected amount of information with regards to the results of both research projects. Due to the fact that there are three groups of pedestrians (visitors/tourists, city centre inhabitants and neighbourhood residents), the results per group are discussed in three different paragraphs. Thereafter, a conclusion map is made followed by conclusions of additional analyses to understand and explain the use of the city centre.

10.1 Results Tracking Delft 1: visitors/tourists

10.1.1 Statistics: some facts & figures

To show some facts & figures of the participated pedestrians, a few statistics demonstrate a little background information. For both garages the household situation of 'partner without children' was the largest category (*figure 10.1*). Pedestrians went into the city 'alone' (34% Phoenix and 30% Zuidpoort) or 'with partner' (33% Phoenix and 35% Zuidpoort). The biggest group of pedestrians that visited the city centre was aged 40 – 55 years old (*figure 10.2*).

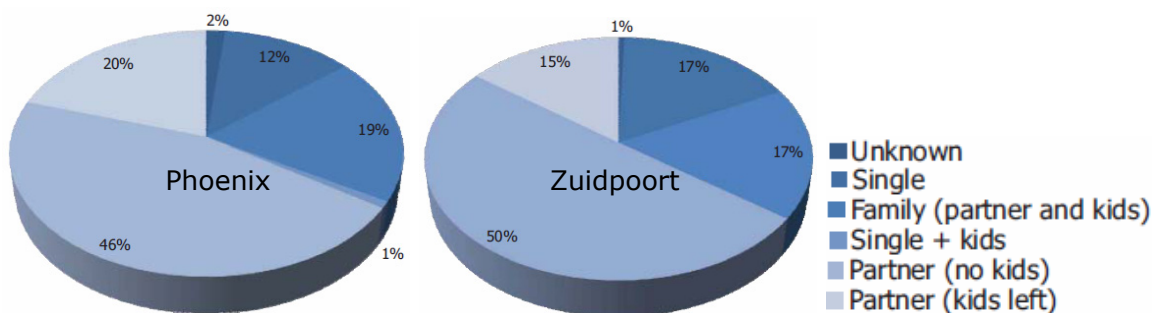


Figure 10.1: Household situation participants

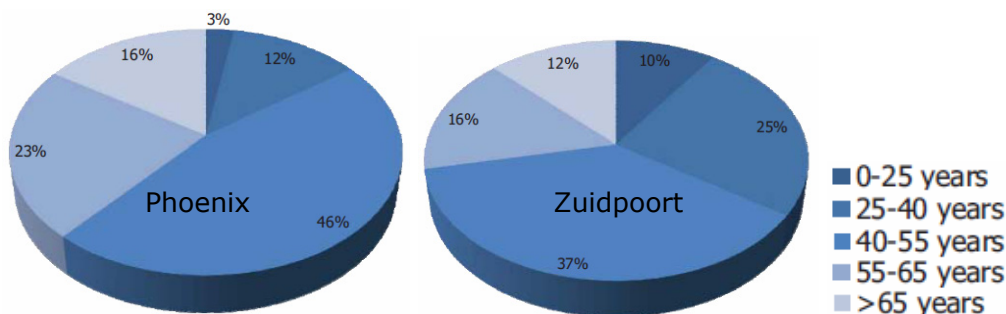


Figure 10.2: Age of participants

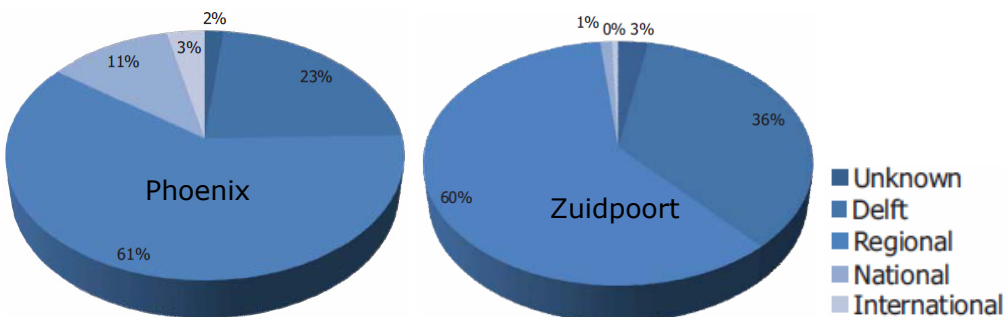


Figure 10.3: Participants - Origin of visitors

Statistics show that both garages are visited mostly by regional inhabitants (*figure 10.3*). From the national visitors a percentage of 23% (Phoenix) and 36% (Zuidpoort) lives in Delft. The largest part of 50% (Phoenix) and 54% (Zuidpoort) do not live in The Hague, Rotterdam or Rijswijk. Most of the visitors did not have a specific purpose in the inner-city (*figure 10.4*). Most pedestrians visited the city centre for a duration of 1-2 hours (*figure 10.5*).

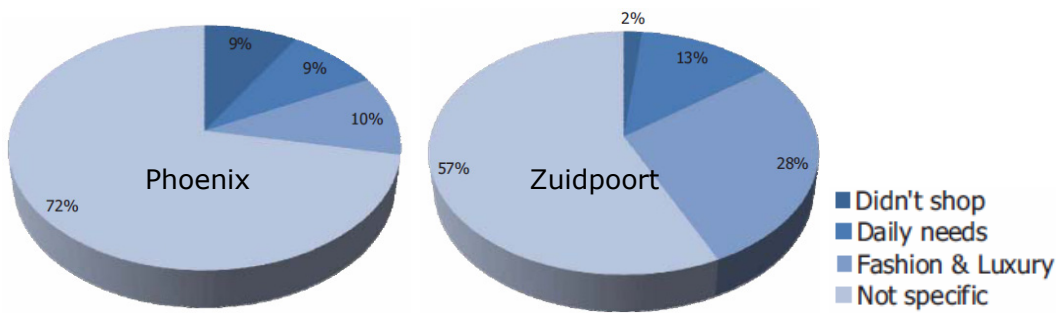


Figure 10.4: Purpose of participants

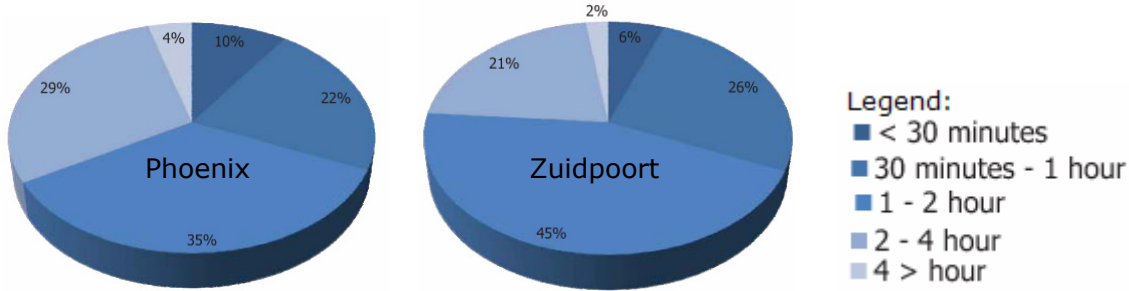


Figure 10.5: Trip duration of participants

10.1.2 Visualisation GPS-tracks

The pictures below represent the results of the first research pilot (November 2009). The followed target group is pedestrians who parked their car in the Phoenix or Zuidpoort garage and continued their journey into the city centre on foot. This group contains tourists from other countries, Dutch inhabitants who live far away from Delft and Dutch residents who live in and around Delft yet not close to the city centre.

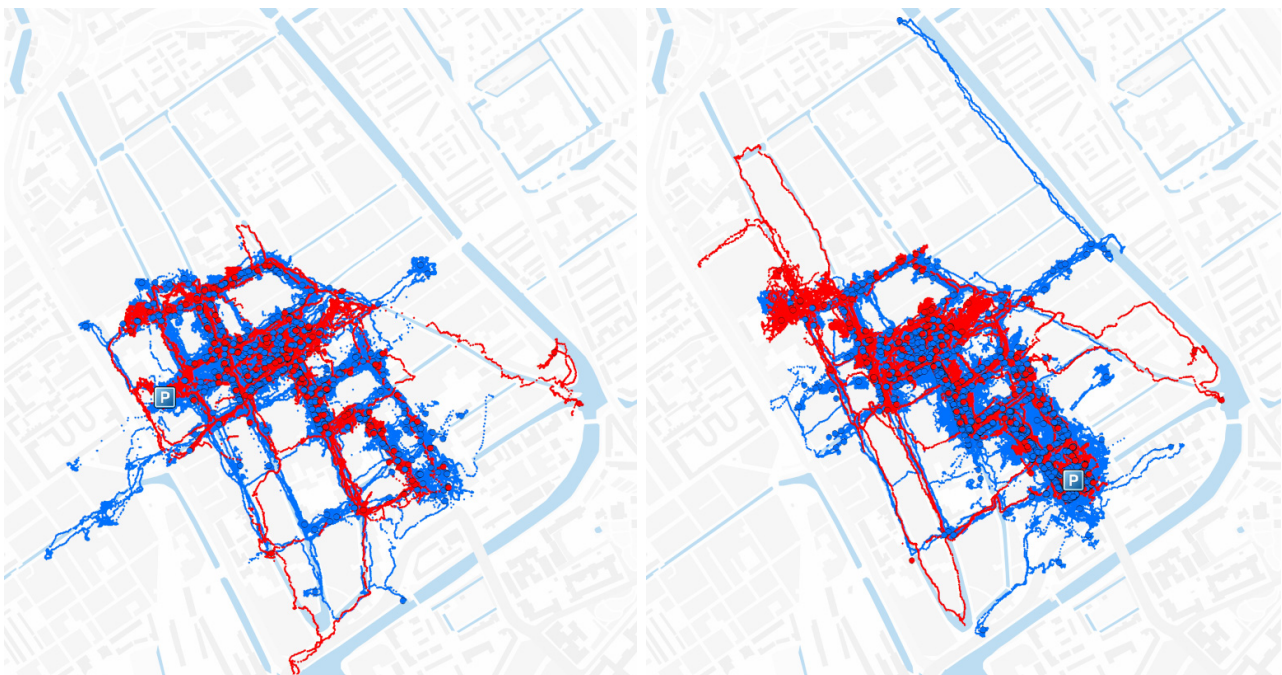


Figure 10.6: First time visitors (red) and familiar visitors (blue) of Phoenix (L) and Zuidpoort (R) garage

Figure 10.6 shows all pedestrian trips from the first research pilot of the Phoenix (left image) and Zuidpoort (right image) garage. They visualize first time visitors (trips and destinations in red) and pedestrians who visited the city centre of Delft previously and are therefore more familiar with the environment (trips and destinations in blue). A total amount of 325 trips was gathered; 285 trips turned out to be valid.

It is striking that first time visitors use the urban fabric only slightly different than frequent visitors. First time visitors walk towards Vermeer's view on Delft and make a small detour towards the Doelenplein (*figure 10.6, left image*) whereas other first time visitors make a boat trip through the Oude Delft canal and take a look at the Bagijnhof (*figure 10.6, right image*). Both images clearly demonstrate that only first time visitors walk towards the Oostpoort and its area.

Frequent visitors dare to walk a bit further. As *figure 10.6, left image* visualizes, pedestrians walk to the Buitenwatersloot, Nieuwe Langendijk and Hambrug. Foot passengers from the other garage, *figure 10.6, right image*, turn to the Zuidwal, living areas of the Zusterlaan and Ezelsveldlaan, shopping street Nieuwe Langendijk and all the way along the Oostplantsoen towards the Nieuwe Plantage.

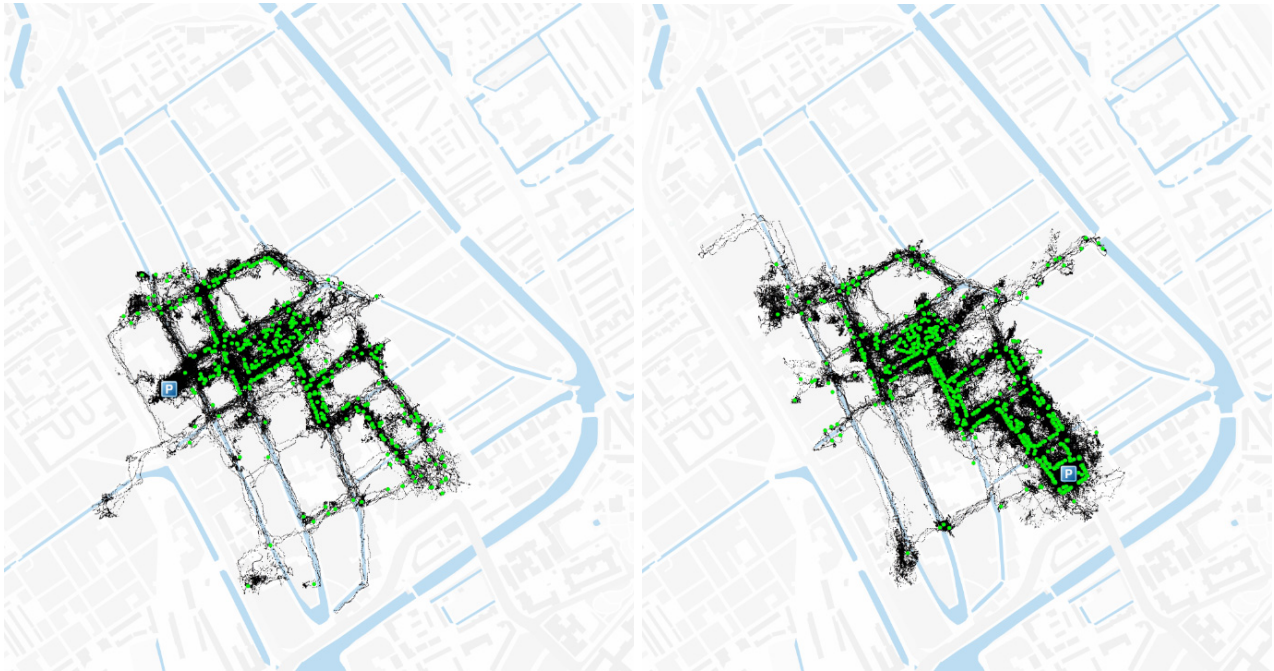


Figure 10.7: Pedestrian trips and destinations of the Phoenix (L) and Zuidpoort (R) garage

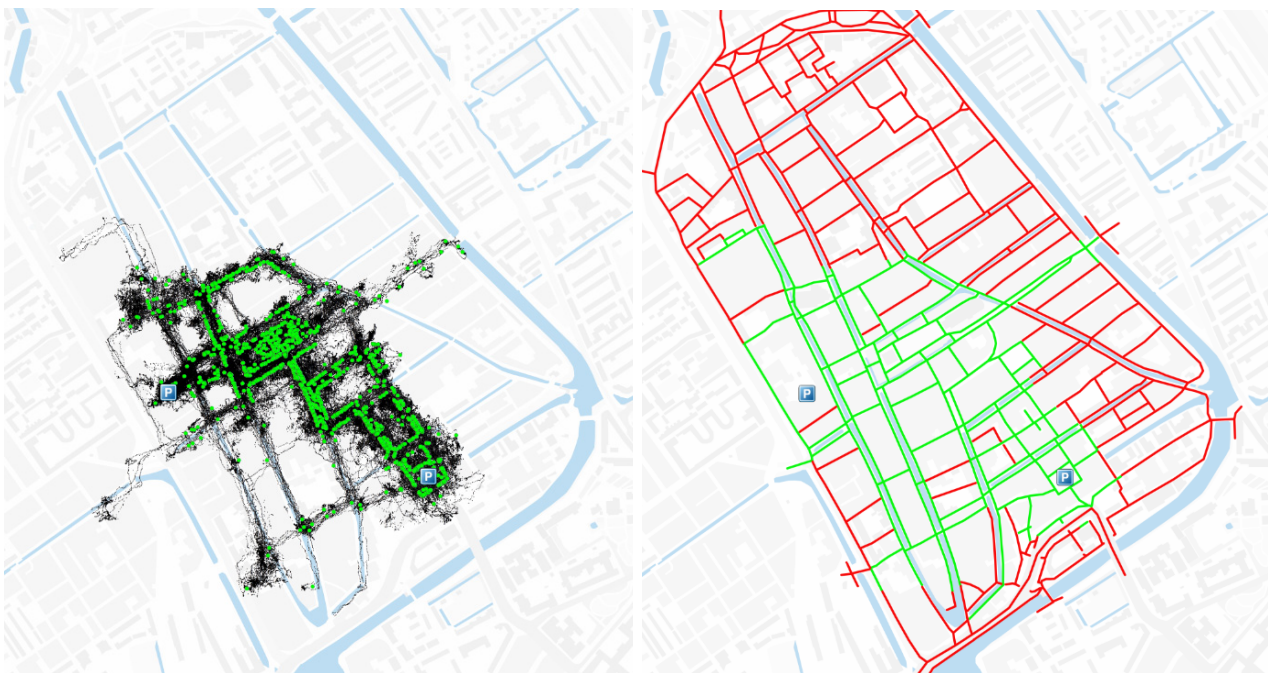


Figure 10.8: Pedestrian movement of both garages (L) translated in use and non-use of streets (R)

It must be noted that there are no real big differences between first time visitors compared with those who know the surroundings quite well. Moreover, when we look at the numbers, we

see that the trips previously named are only visited by a few individuals. An amount of 112 people participated at the Phoenix garage (11% is first time visitor; 89% is frequent visitor). For the Zuidpoort garage 173 pedestrians took part in the research (8% is first time visitor; 92% is frequent visitor). Because this research focuses on the analysis and understanding of group behaviour, divergent individual movement will be left out.

Consequently, after filtering the tracks, different pictures appear. Streets that were visited by two persons or more are demonstrated now. Streets that only saw one person appear are left out. *Figure 10.7, left image* shows group trips (black dots) and destinations (green dots) made from the Phoenix garage. Thus *figure 10.7, right image* visualizes trips and destinations of the Zuidpoort garage.

Due to the fact that the first research is considered as one target group, namely "visitors", the data is merged into one file; *figure 10.8, left image*. Subsequently, an analysis of used (green lines and dots) and non-used (red lines) streets can be made as *figure 10.8, right image* shows.

10.2 Results Tracking Delft 2: city centre inhabitants

10.2.1 Statistics: some facts & figures

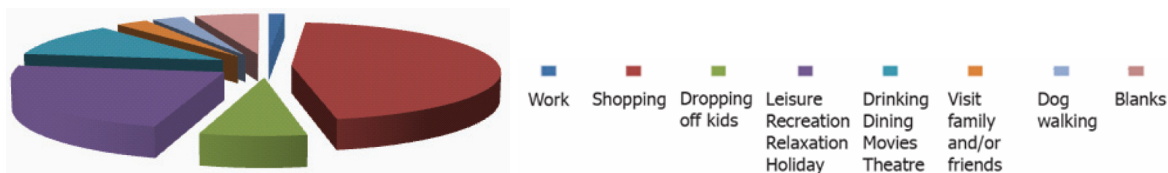


Figure 10.9: Destinations of trips inside the city centre by inhabitants of the city centre of Delft

To show some facts & figures of the participated pedestrians, a few statistics demonstrate a little background information. *Figure 10.9* demonstrates the destinations of trips inside the city centre of Delft by its city centre inhabitants. Residents mostly go shopping, followed by leisure and drinking & dining. *Figure 10.10* looks at destinations in the city centre of Delft by its city centre inhabitants by means of the slow network transportation. It can be concluded that inner-city residents prefer visiting nearby destinations going by foot. Examples are leisure, drinking & dining, dog walking and work. However, when residents go shopping their favourite transportation mode is a bike.

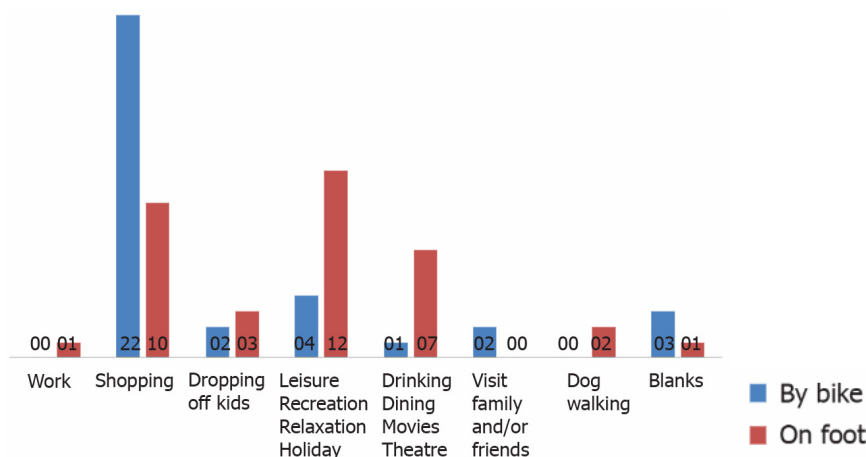


Figure 10.10: Destinations in the city centre by inhabitants of the city centre, organized by bike and foot

Nota Bene, with regard to city centre and neighbourhood inhabitants: The question what the favourite transportation mode for trips to the inner city of Delft is, received contradictory answers. First, the questionnaire: 87% on foot, 11% by bike and 2% gave no answer. Second, the GPS data: 25% on foot, 68% by their bike and 7% by car. Questionnaire surveys and GPS tracks sometimes show two different outcomes. When questioned, people tend to give the most socially desired answers instead of telling the truth (Millonig and Gartner, 2009).

10.2.2 Visualisation GPS-tracks

The pictures below represent the results of the second research pilot (April/May 2010). The followed target group is inhabitants who live in the city centre of Delft. The gathered data was divided into pedestrian trips and other trips (by car, bike, train, et cetera). In this research 10 households with 18 GPS devices (= 18 persons) participated. All 10 households and 17 of the 18 (persons) GPS devices had valid pedestrian tracks. A total amount of 72 trips is registered. This is a relatively high percentage which could be explained by the fact that most destinations are located at walking distance in the area of the dwellings.

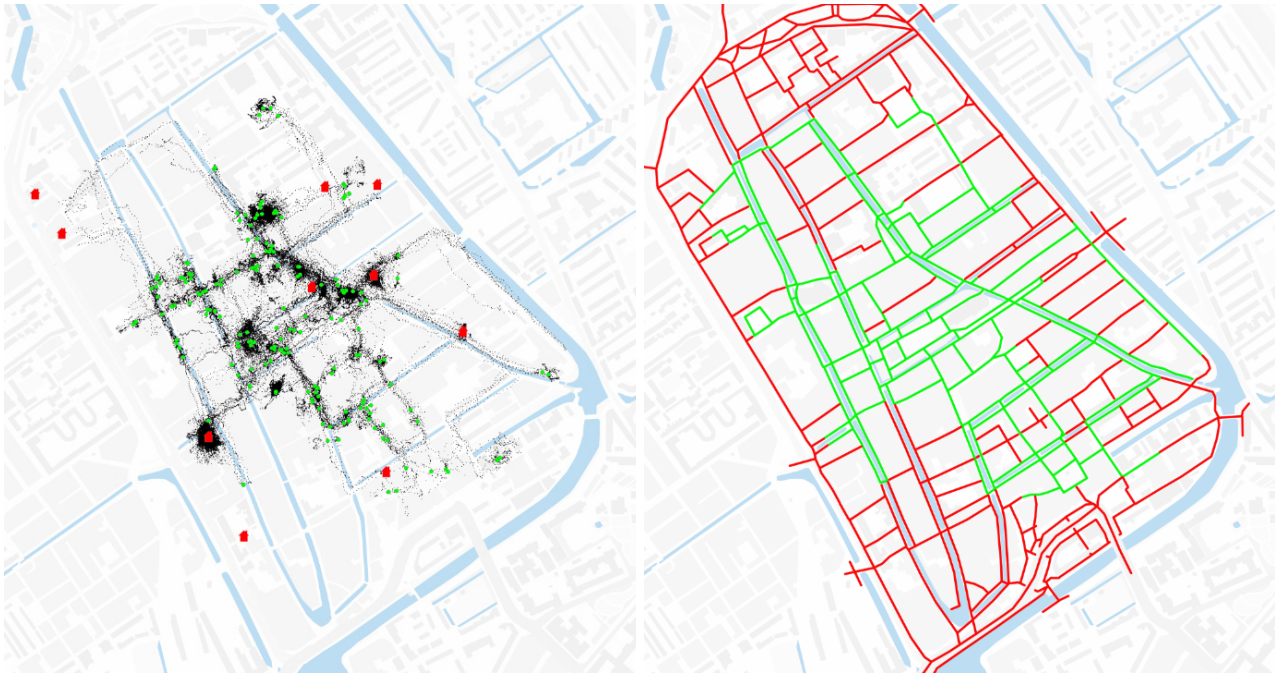


Figure 10.11: Trips and destinations city centre inhabitants (L) Used and non-used streets (R)

Figure 10.11, left image shows the trips (black dots) and destinations (green dots) of city centre inhabitants (houses in red). Here, the tracks have been cleaned as well in places where only one participant walked. The large version of this image can be seen on the front page. Used (green lines) and non-used (red lines) streets can be found in figure 10.11, right image.

City centre inhabitants use the same streets as visitors. However, they don't use the southern part of the Oude Delft and the Phoenixstraat. On the other hand, city centre inhabitants do use Verwersdijk, Paardenmarkt, Oranje Plantage, Kolk, Molenstraat, Doelenplein, Doelentuin area, the entire Molslaan and Trompetstraat while visitors do not.

10.3 Results Tracking Delft 2: neighbourhood residents

10.3.1 Statistics: some facts & figures

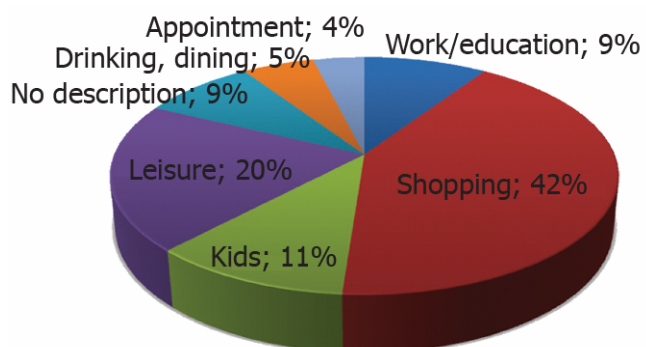


Figure 10.12: Purpose of trips

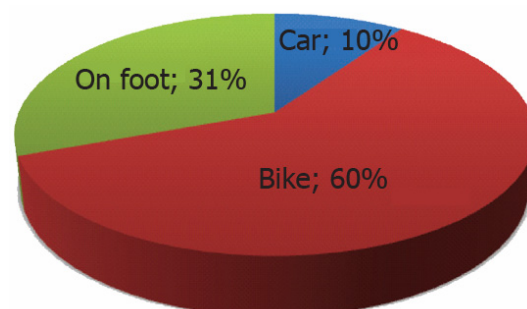


Figure 10.13: Transportation mode to city centre

To show some facts & figures of the participated pedestrians, a few statistics demonstrate a little background information. *Figure 10.12* demonstrates the destinations of trips inside the city centre of Delft by its neighbourhood inhabitants. Residents mostly go shopping, followed by leisure (specifically on Queensday) and activities related to their children. *Figure 10.13* deals with the choice of transportation mode to the city centre from the surrounding neighbourhoods. Most favourite travel mode is going by bike (60%) followed by walking (31%). There still is a group of 10% that uses the car for this short movement.

10.3.2 Visualisation GPS-tracks

The pictures below represent the results of the second research pilot (April/May 2010). The followed target group is inhabitants who live in the neighbourhoods surrounding the city centre of Delft. The gathered data was divided into pedestrians trips and other trips (by car, bike, train, et cetera). In this research 29 households with 52 GPS devices (= 52 persons) participated. An amount of 19 households and 33 GPS devices contain valid pedestrian tracks.

A total amount of 55 trips is registered. This is a relatively low percentage which could be explained by the fact that most destinations are located too far away to walk from the dwellings. Statistics show that most trips of city centre and neighbourhood inhabitants are made by bike (60%), while walking covers 30% and car trips 10%.

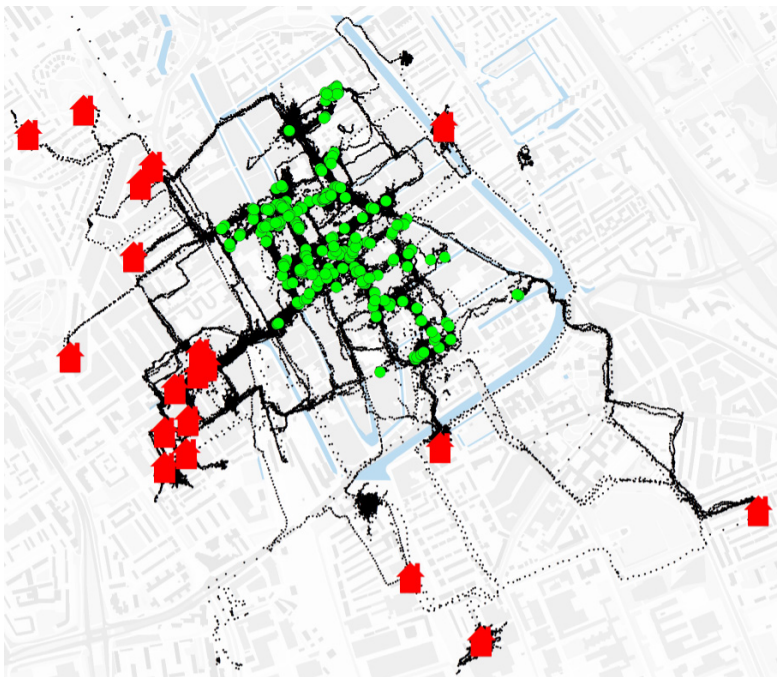


Figure 10.14: Uncleaned pedestrian trips and destinations of neighbourhood residents

Due to the legibility of the city centre scale (1:5,000) not all households can be seen on *figure 10.15, left image*, therefore *figure 10.14* provides all locations on a bigger scale (1:8,000). Here, the uncleaned pedestrian trips are shown as black dots, destinations are green dots and households are the red features.

Figure 10.15, left image shows the trips (black dots) and destinations (green dots) of neighbourhood residents (houses in red). Here, the tracks have been cleaned as well in places where only one participant walked. Used (green lines) and non-used (red lines) streets can be found in *figure 10.15, right image*.

Neighbourhood inhabitants use the same streets as visitors. However, they do not use the Nieuwe Langendijk, Bagijnhof and Achterom. On the other hand, neighbourhood inhabitants do use Dirklangenstraat, Kolk, Molenstraat, Verwersdijk, Paardenmarkt, Doelenplein, Raam, Rietveld, Vlamingstraat, Vrouwenregt, Oosteinde, Oostpoort with its bridge, Schoolstraat, Zusterlaand, the Hambrug and Van Leeuwenhoeksingel while visitors do not.

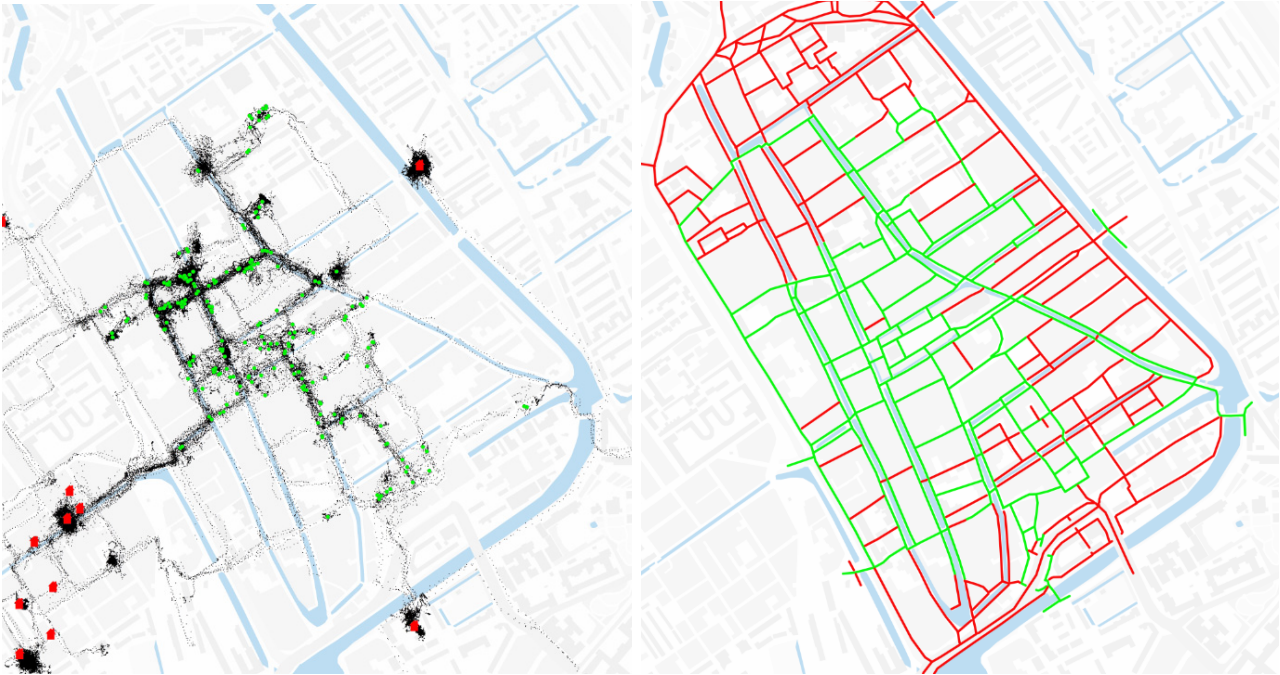


Figure 10.15: Trips and destinations of neighbourhood residents (L) Used and non-used streets (R)

10.4 Conclusions and synthesis map

It is striking that when both maps of the city centre and neighbourhood inhabitants are compared, no big differences can be seen. Both pedestrian groups use the central shopping area, southern part of the Paardenmarkt (but only on Queensday!), Binnenwatersloot and Oosteinde. Both groups do not use the entire northern living area around Geerboogerd, direct area of the Sebastiaansbridge, Koepoortbridgde, Kampveldweg, only half of the streets surrounding the Beestenmarkt and most of the eastern part of the living areas above Oostpoort.

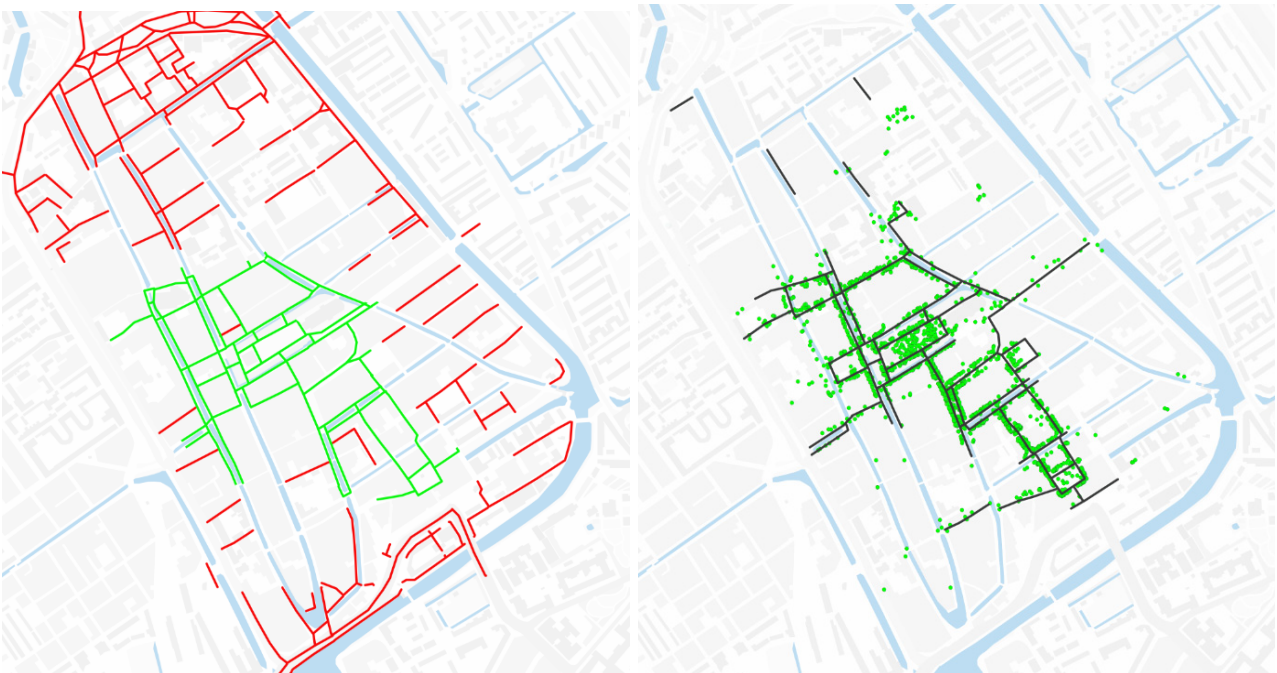


Figure 10.16: Synthesis map used and non-used streets (L) Destinations and central shopping area (R)

Looking at the plan of the city centre, the hypothesis was formulated that visitors/tourists use the streets of the urban fabric least (thus moving around very concentrated at limited locations), inhabitants of the districts use the city a bit more and downtown residents visit most places.

It is striking that after making the maps, it can be concluded that only the first part of the thesis is confirmed; the visitors-group used the least streets of the network. We see that the inhabitants of the neighbourhoods use the most streets. This can be explained by the fact that many streets are used as access streets in order to reach a destination. If the trip towards the destination is longer, more streets will be used. Downtown inhabitants live closer to their destinations, leaving them no or less run-up streets than the inhabitants of the districts.

Figure 10.16, left image represents the used (green lines) and non-used (red lines) streets of all three previously mentioned target groups. *Figure 10.16, right image* shows all visited destinations in green dots. Black lines represent the central shopping area and other streets with urban functions as will be explained further in the *next paragraph*. Most destinations can, logically, be found in streets that belong to the central shopping area.

As *figure 10.16, left image* clearly demonstrates, the middle of the city centre is used very well. The areas around the Oude Kerk, Choorstraat, Grote Markt, Binnenwatersloot, Oude Delft, Brabantse Turfmarkt, Burgwal, Molslaan, Beestenmarkt, Vestpoort, Bastiaanpoort and Bastiaansplein thus attract all sorts of people.

Meantime, the entire northern and parts of the eastern and southern areas are neglected. Streets that turn up red are for example the Wateringsevest, Nieuwe Plantage, Koningsplein, Geerweg, Kantoorgracht, Voorstraat, Oostplantsoen, Nieuwelaan, Zuidwal, the area around the Army Museum and a lot of small horizontal local streets which form short cuts for the ongoing streets.

11 City centre evaluation

This chapter zooms in on the second sub-research question: "What is the current quality of the streets and built environment in the city centre of Delft?" Evaluations of the city centre of Delft are made with regard to urban facilities, offered program, distances, quality and connectivity in the city centre. This information will be used to draw conclusions about pedestrian movement since GPS-tracks alone do not make us understand why people use or do not use streets. Besides, one could compare several analyses with the GPS-data; are they accurate?

11.1 Summary city centre evaluation

Due to the fact that this is a large chapter, the first paragraph summarizes the most important conclusions of the city centre evaluation. If you are interested to read more detailed information with regard to a theme you can go to the concerning paragraph. With regard to the **program evaluation** (*paragraph 11.2*) it can be concluded that streets which lack urban facilities, especially a linked chain with different programs, are not or much less visited by pedestrians. The program evaluation is in line with the GPS-data.

With regard to the **Three-Step analysis** (*paragraph 11.3*) it can be concluded that even if anchor points are well connected, it is not a guarantee that pedestrians will visit the place. Locations with low network integration sometimes attract more pedestrians than destinations with high network connectivity. A reason that pedestrians only rarely visit qualitative good public places can be found in the fact that there is no(t enough diversity of the) program offered at a location. The Three-Step analysis is not always in line with the GPS-data.

With regard to the **walking 400-800m analysis** (*paragraph 11.4*) it can be concluded that the vast majority of pedestrians leaving the Phoenix or Zuidpoort garage do not walk more than 400-500 meters. The only exception is made for one shopping & leisure offering street that can be reached by walking circa 700 meters. This evaluation is in line with the GPS-data.

With regard to the **visibility graph analysis** (*paragraph 11.5*) it can be concluded that the method has considerable deviations when compared to the actual trips made by pedestrians as measured by the GPS-devices. Public spaces with good visibility are not used and streets with bad visibility are used. The visibility graph analysis is not always in line with the GPS-data.

With regard to the **history of Delft: morphology analysis** (*paragraph 11.6*) it can be concluded that the hard core has hardly changed over the years. It is clear that the Zuidpoort area was only added to the city centre area until late in the history of Delft. It has a different spatial form due to breaking down the authentic historical houses and replacing them by new buildings with modern architecture and a broad road which replaced two canals. Important streets and meaningful landmarks from ancient times are still the main attractors for today's visitors, although most of the original functions have been replaced by modern ones. The analysis is in line with the GPS-data. The city centre consequently contains timeless qualities.

With regard to the **quality perception analysis** (*paragraph 11.7*) it can be concluded that the city centre of Delft offers a lot of very attractive public space areas where a lot of pedestrians go. Even more qualitative good places exist yet no pedestrian goes over there. This is probably due to the fact that it is too far for walking and most places lack a mixed-use program. Negative factors were found in the fact that there are too much barriers (mostly canals, buildings and wide car roads) blocking the natural walking routes pedestrians could and would use. Moreover, some streets have bad visibility, poor maintenance buildings and evoke unsafety feelings in narrow or curved alleys. Lastly, poor quality of the ground floor facades can be found in the shopping area. The evaluated perception is not always in line with the GPS-data. Nota bene: some streets are indicated attractive as well as unattractive...

With regard to the **density analysis** (*paragraph 11.8*) it can be concluded that compared to the street quality analysis pedestrians do stay longer in streets with high spatial quality. Streets with low(er) spatial qualities are mostly used as a route and not as a place to stay. Exceptions are made when attractive programs tempt people to come on over.

Consequently, looking at the theory derived from previous research it can be concluded that the results processed from the questionnaires indeed mainly describe spatial and functional aspects (see *paragraph 1.4*). Looking at perception, reactions predominantly describe emotional responses (see *paragraph 1.4*). As the GPS-results and the questionnaires clearly demonstrate, pedestrians (or: people in general) rarely use streets that they find visually unattractive or streets that are too far away. In contrast: due to certain attractive programs the unattractive areas will be visited as well. However, it is the question whether people will stay in the public space there or that they only use the streets for transportation.

Since there is a big trend which started already over 30 years ago it is striking to discover that visitors and inhabitants still want the same thing: give the streets back to the people. Cars are welcome but very temporarily and only when they really have to be there. Half of the participants of the research of the Municipality of Delft (2009-b) indicate they think positive about the idea of expanding the pedestrian zone in the city centre yet the area should not cover the entire inner-city. In order to make sure that this pedestrian zone is expanded successfully all the other aspects of urban design must also be taken into consideration (for example: attractive program, nearby distance, good accessibility, et cetera).

11.2 Program: urban facilities

This paragraph zooms in on the offered program: Which urban facilities can be found on the ground floor? The author took a ground plan of the city centre and mapped all functions in this area in September 2010. The findings of the urban facilities are demonstrated in *figure 11.1*

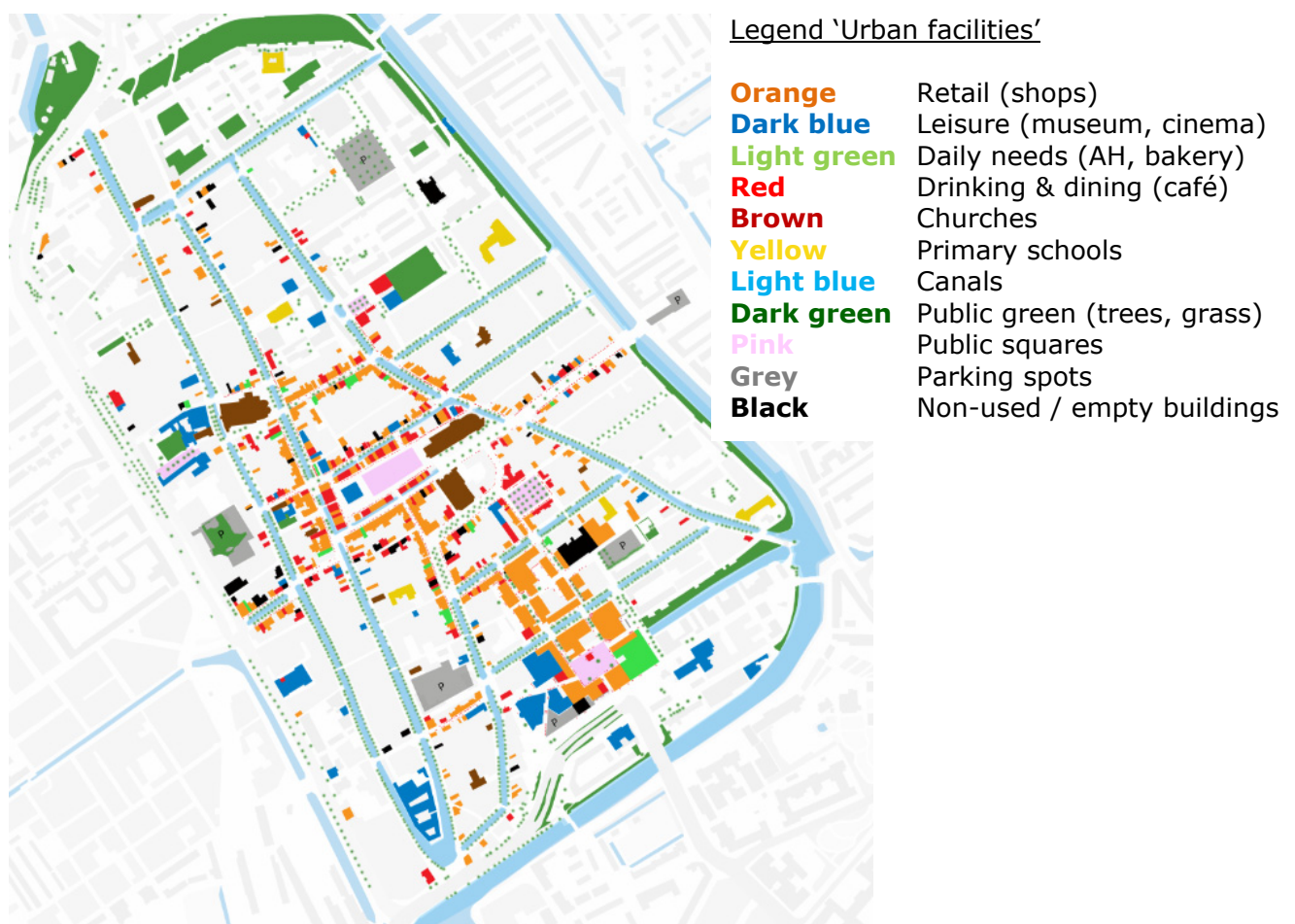


Figure 11.1: Urban facilities

Typical retail (orange), leisure (dark blue), daily needs (light green) and drinking & dining (red) streets can primarily with high density be found in the middle of the city centre. These are streets and areas that connect the Bastiaansplein, Beestenmarkt, Grote Markt, Doelenplein (all pink) and the Oude Kerk (brown) with each other. Also streets like the Brabantse

Turfmarkt, Choorstraat, Binnenwatersloot, Peperstraat, Nieuwe Langendijk and Breestraat contain these accommodations. Other functions like schools (yellow), public spaces (pink), public green (dark green), canals (light blue) and parking spots (grey) are mapped as well.

The black lines in the middle of *figures 11.2 and 11.3* show where the central shopping area can be found. In these streets the urban facilities are closely and densely situated next to each other. Not all facilities are connected to the central shopping area; some lines are disconnected from this area as the picture shows. These shops are not visited or not visited that much compared to the facilities in the middle of the centre as *figure 11.3* shows.

In *figure 11.2* the living areas, as pointed out in the land use plan, are mapped. It is striking that a real hard separation can be seen between the shopping streets and the living areas. The urban facilities cover the middle of the city centre whereas the residential areas are situated alongside the edges. In reality, an even larger area consists of mixed functions; sometimes ground floors are dwellings and sometimes small businesses can be found. The Oude Delft, for example, contains a lot of buildings with this interpretation.



Figure 11.2: Shopping streets vs. living areas *Figure 11.3: Pedestrians mostly visit urban facilities*

Looking at the combination of used and non-used streets of all three target groups (*figure 10.16, left image*), the map with urban facilities (*figure 11.1*) and mono-functional residential areas (*figure 11.2*) it immediately becomes clear that pedestrian movement and visited streets directly relate to the presence of (a high concentration of) urban facilities.

Consequently, streets which lack facilities, especially a linked chain with different programs, are not or much less visited by pedestrians as can be seen on *figure 11.3*. As previous research shows (Gehl et al., 2006; Van Santen, 2008; Van der Spek, 2008-b; Louter and Van Eikeren, 2008), reasons to visit a city centre are mostly limited to shopping and leisure activities. Therefore, most pedestrians have no reason to visit the edges of the city centre. It must be noted that the Paardenmarkt is used; however pedestrians only go over there on Queensday. On normal days, there is no program offered yet on Queensday some local events take place which apparently attract residents. No visitors/tourists went over there, probably due to the fact that during these research days no festivities took place at the Paardenmarkt.

11.3 Three-Step analysis

The second analysis focuses on network connectivity: the embedding (anchoring) of important public places to their surroundings. The anchoring of a place determines the range of the place and thus whether it is part of the cognitive map of the inhabitants. When a place is part of the

daily movement pattern, it will also take the functions and facilities of this place in the offer for the resident into account.

The Three-Step analysis shows how individual elements are anchored in their environment by demonstrating all connections to a depth of three directional changes from the start point. The method provides insight into the scope and the physical range of a programmatic element, as well as in the cohesion of the urban structure as a whole. Serious asymmetry in the range and/or lack of depth functioning show deficits in the structure of the public space and a possible inefficient or little sustainable situation.

The Three-Step analysis is based on the rule that we can orient ourselves to a range of three directional changes. It turns out that the scope in these three steps seen from an element is actually the territory of the occupant. Conversely, from a public space as a square or a park the scope and anchoring of that spot can be mapped. In this way the range with potential users of a place can be demonstrated.

Historic squares often show a large range because they originally arose at a crossing of long country roads. This explains why old town squares in the current city are still successful and repeatedly are adapted and redecorated to the requirements of the current time. In contrast, some newly designed squares are dramatically bad connected in the urban fabric. As a result they form no part of ordinary, everyday movement routes of the inhabitants and they will have to contain special functions in order to attract public (Josselin de Jong et al., 2007).

First, for the visitor group, a Three-Step analysis is made of the Phoenix and Zuidpoort garage. Second, more interesting for city residents, different anchor points like the Grote Markt and other public spaces are looked at.

11.3.1 Garages as anchorpoint

The Three-Step analysis of the Phoenix (*figure 11.4*) and Zuidpoort (*figure 11.5*) garage is mapped below. Reachable streets are coloured; black lines represent the first step, anthracite is the second step and light grey are third step lines.



Figure 11.4: Three-Step Phoenix garage



Figure 11.5: Three-Step Zuidpoort garage

Clear gaps in the Phoenix garage network connectivity, see *figure 11.4*, can be found at the northern living area where streets like Geerboogerd, Paardenmarkt, Schuttersveld, Doelentuin, Burgwal, Beestenmarkt, Molslaan and Zuidpoort area are not reached. Urban facilities in these areas are therefore not well connected to the Phoenix garage. However, as *figure 10.6, left*

image shows, pedestrians leaving the Phoenix garage do find the Burgwal, Beestenmarkt, Molslaan and Zuidpoort area. This is probably due to the presence of the central shopping area. People are attracted to visit these streets due to the offered program. They have a reason to be there.

Figure 11.5 shows the Three-Step analysis of the Zuidpoort garage. There are no big gaps in the network connectivity; the main roads can be reached in two or three steps. Only the small local streets that can function as short cuts for main streets cannot be reached. Subsequently, urban facilities in the city centre are well connected to the Zuidpoort garage. However, as *figure 10.6, right image* shows, pedestrians leaving the Zuidpoort garage do not visit the entire northern and eastern part of the city centre.

11.3.2 Public spaces and landmarks as anchorpoints



Figure 11.6: Three-Step analysis Grote Markt



Figure 11.7: Three-Step analysis Beestenmarkt



Figure 11.8: Three-Step analysis Oude Kerk



Figure 11.9: Three-Step Brab. Turfmarkt / Burgwal

The previous Three-Step analysis was based on one starting point for visitors and tourists. However, these two parking garages were not used by city centre and neighbourhood inhabitants who travelled on foot. In order to find out how (historic) public squares and other places lie in the urban network, a few more Three-Step analyses are made.

Public spaces that are frequently used by pedestrians are: the Grote Markt (*figure 11.6*), Beestenmarkt (*figure 11.7*), Oude Kerk (*figure 11.8*) and Brabantse Turfmarkt / Burgwal (*figure 11.9*). Public spaces that are barely used by pedestrians are: de Paardenmarkt (*figure 11.10*), Oostpoort (*figure 11.11*), Doelenplein (*figure 11.12*) and Doelentuin (*figure 11.13*).

The images below show their network connectivity. The first and second step is most important, especially when routes are longer. People begin to hesitate and wonder if they are still walking in the right direction and will, most likely, have to orientate themselves again by looking on a map or asking for information.



Figure 11.10: Three-Step analysis Paardenmarkt



Figure 11.11: Three-Step analysis Oostpoort



Figure 11.12: Three-Step analysis Doelenplein



Figure 11.13: Three-Step analysis Doelentuin

As assumed correctly, the most frequent visited places and destinations are situated very well in the urban network. A lot of small veins can be detected between the main roads. All four starting points have first step lines towards neighbourhood areas, which is definitely not the case compared to the less used public spaces and landmarks. Here, first lines only occur within the city centre itself. It is striking that all four locations (*figures 11.6 – 11.9*) are not linked to the Paardenmarkt (*figure 11.10*) and Doelentuin (*figure 11.13*).

The Paardenmarkt (*figure 11.10*) and the Doelentuin (*figure 11.13*) are the worst connected locations. Although they have nice first steps, there are limited second steps to be found. Only the third step reaches the city centre well. However, almost the entire west part is neglected. On the other hand, Oostpoort and especially the Doelenplein are connected better and quite well. Oostpoort is well connected to the southern part of the city centre whereas the Doelenplein is best integrated in the entire inner-city area.

A reason that pedestrians only rarely visit Oostpoort probably can be found in the fact that there is no other program offered at the location. The tower is the only attraction. Unlike the first four successful public spaces which offer a broad range of different programs.

11.4 Walking distances: 400-800m from garages

A third analysis concerns the walking distance with regard to pedestrians who leave the Phoenix or Zuidpoort garage. As the grey areas in *figures 11.14 and 11.15* show, there is a limited amount of city centre facilities that can be reached by walking 400 meter from the Phoenix and Zuidpoort garage. Most accommodations can be arrived by walking 800 meter. As previous research shows (Van der Spek, 2008-b), pedestrian movement is often limited to 400 – 800 meter walking space.



Figure 11.14: Walking 400m & reached facilities



Figure 11.15: Walking 800m & reached facilities

Normal walking speeds measure 5 km/h. This means that you can walk 400 meter in approximately 5 minutes and 800 meter in 10 minutes. However, when pedestrians go shopping the velocity is reduced to, say, 2.5 km/h. So, 400 meter is accomplished in circa 10 minutes and 800 meter in 20 minutes. Moreover, pedestrians who go shopping or have a drink remain on a destination quite a long time whereby the travelled distance plays a subordinate part.

As *figures 11.16 and 11.17* show, most city centre visitors use streets and destinations who are located within 400 – 500 meter of the garages. Only a few roads between the 500 – 800 meter are visited. Subsequently, other destinations are too far away and just not attractive

enough to walk towards to. Thus another explanation why people do not visit the northern and eastern part of the city centre can be found in the accessibility and distance of certain urban facilities.

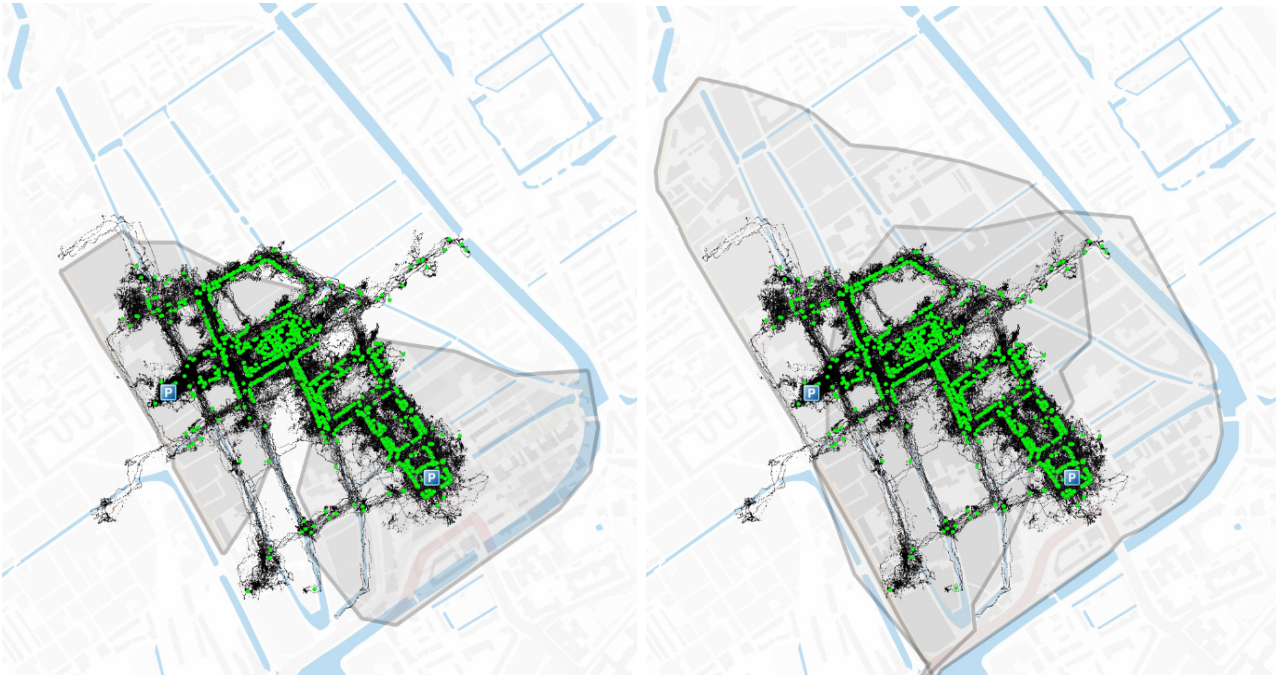


Figure 11.16: Walking 400m/trips & destinations Figure 11.17: Walking 800m/trips & destinations

11.5 Visibility graph analysis

The images below represent a visibility graph analysis. They measure the visual integration and how it correlates with pedestrian movement, zoomed in on local scale. A grid structure was laid over the road network of the city centre. Different colours represent different values of visual integration. Red indicates high values which means a good visibility whereas blue lines show the lowest, and therefore least visible, values. The images are made by Sinan Yuan. They, unfortunately, are not 100% reliable: some streets are forgotten or drawn wrongly.

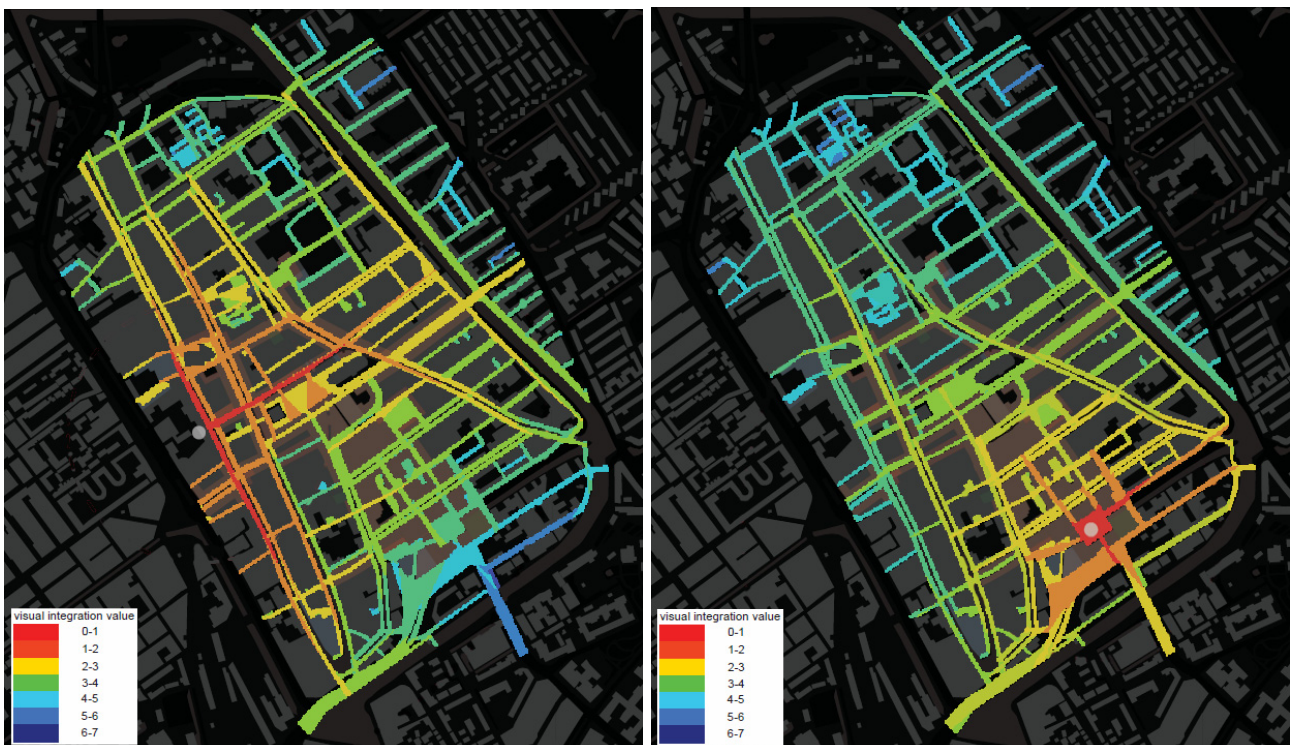


Figure 11.18: Visibility graph analysis city centre of Delft; Phoenix (left) and Zuidpoort (right) garage

Figure 11.18 shows the step depth analysis from the Phoenix and Zuidpoort garage. "Step depth" means the number of turns a person has to take to get from the departing point to any other location within the plan. One could say a sort of visual computer version of the Three-Step analysis. Every street that is directly visible from the starting point is at depth one shown by a red colour. Streets which are visible from that point are at depth two, and so on.

When one starts at the Phoenix garage (view already projected from the Oude Delft canal) areas with good visibility can be found on the Oude Delft, Nieuwstraat, Voldersgracht, Vrouwjutteland en Vrouwenregt. Bad visibility can be found in the northern living area around the Geerboogerd street, the Paardenmarkt, Vijverstraat, Zuidwal, Sint Sebastiaanbrug, Ezelsveldlaan and Nieuwelaan.

You could make the assumption that streets that are blue will be least visited. Compared with the GPS data it can be concluded that visitors leaving the Phoenix garage use most of the street(part)s that are coloured red and orange. However, a few alleys and normal streets (Vlamingstraat, Oosteinde and northern part of the Oude Delft) are not used. Moreover, streets in the eastern part of the city centre with the yellow, green and blue colour (Oosteinde and Oranje Plantage and the streets that lie in between them) are not used at all which is not suggested by the visibility graph analysis. Meanwhile, green and blue coloured areas like Bastiaansplein and Beestenmarkt are visited best which is not implied by the analysis. Blue areas like the northern living area and Paardenmarkt indeed are not visited.

Starting from the Zuidpoort garage good visibility can be found on the Bastiaansplein and the streets surrounding it; Zuidwal, Ezelsveldlaan, Zuidergracht, Kruisstraat, Vesteplein, Bastiaanpoort and Paradijspoort. Bad visibility occurs around the Geerboogerd street, the Paardenmarkt, Doelentuin, De Vlouw, Dirklangenstraat, Bagijnhof, Sint Agathaplein and some alleys.

You could make the assumption that streets that are blue will be least visited. Compared with the GPS data it can be concluded that visitors leaving the Zuidpoort garage use most of the street(part)s that are coloured red and orange. However, a few normal streets (Ezelsveldlaan, Zuiderstraat and a part of the Kruisstraat) are not used. Moreover, streets in the southern and eastern part of the city centre with the yellow, green and blue colour (Achterom, Zuidwal, Nieuwelaan, Oosteinde, right part of the Molslaan and Sint Sebastiaanbrug) are not used at all which is not suggested by the visibility graph analysis. Meanwhile, green and blue coloured areas like the Grote Markt and Beestenmarkt are visited best which is not implied by the analysis. Blue areas like the northern living area and Paardenmarkt indeed are not visited.

Consequently, the visibility graph analysis has considerable deviations when compared to the actual trips made by pedestrians as measured by the GPS devices.

11.6 History of Delft: morphology analysis

Urban morphology focuses on the question of the cultural significance of the spatial realities of the city. Central to this type of research is the cultural function of the shape of the city. This cultural function is, among other functions such as the spatial program, important for urban development. The cultural tradition of shaping the city can provide inspiration for designers to interpret a design task. This paragraph focuses on the consistency and quality of public spaces that make up the urban landscape. It tries to define the quality of urban spaces which are important for everyday use of the city. It is not just about residing qualities but also the meaning of the spaces for the ability to orientate in the city (Geurtsen, 1988).

Delft is situated in the delta coast and the mouth of the rivers Maas and Rijn. This is where two landscapes come together. The so-called inversion landscape southwest of Delft, where the influence of the sea with its tides has been dominant and the landscape of peat mining and reclaimed land east of Delft. The area behind the dunes and north of the mouth of the Maas was originally a tidal area. Via a creek system sand (on ridges along creeks itself) and clay (in the tidal flats) was deposited. Later a thick peat package grew over this.

The first settlement occurred around Delft in the creek ridges and they have mined from these ridges with peat overgrown tidal areas. The city of Delft was founded at the place where the (finger-shaped) creek ridge was at its highest and widest as *figures 11.19 and 11.21* show. Canals and ditches were dug to drain the lower parts, including the Schie canal and Gaag as can be seen on *figures 11.20 and 11.22* (Municipality of Delft, 2009-a).

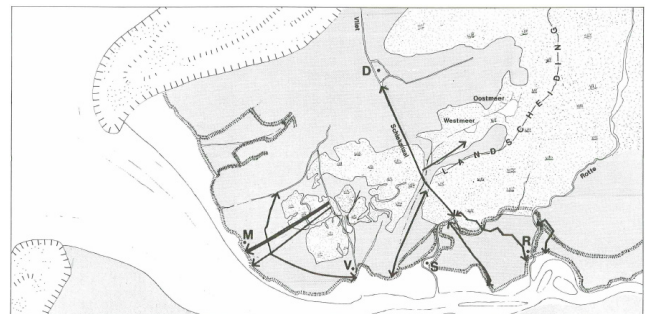
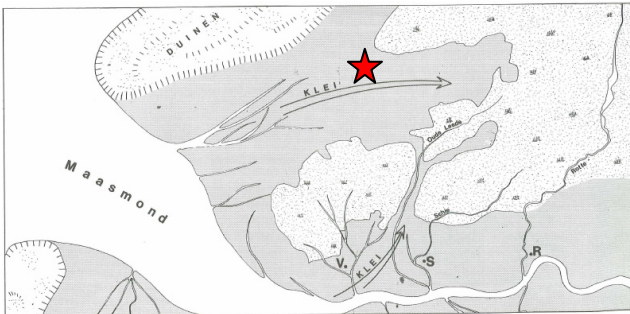


Figure 11.19 and figure 11.20: Delft (red star) 12th and 13th century (Palmboom, 1990, pp. 12, 13)

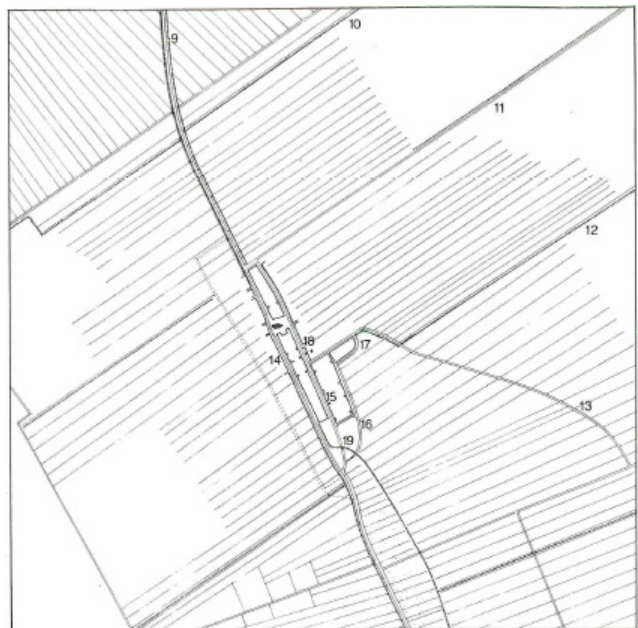
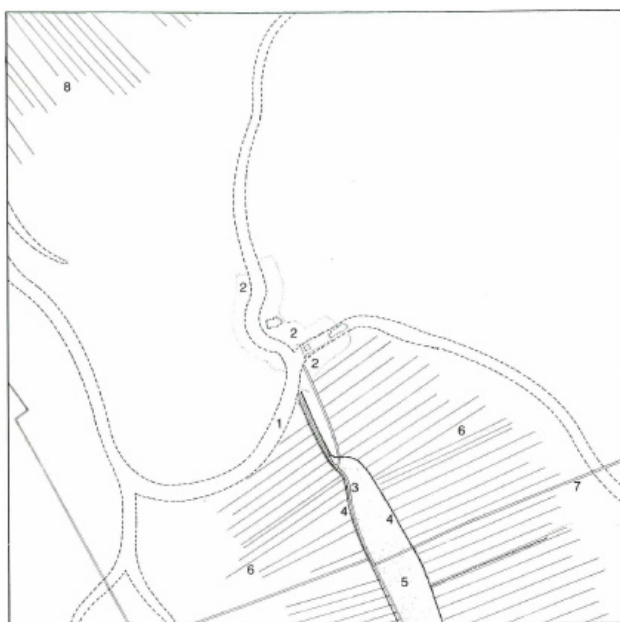


Figure 11.21: Delft - 12th century

Figure 11.22: Delft - 14th century (Geurtsen, 1988, p. 14)



Figure 11.23: Delft - end of Middle Ages

Figure 11.24: Delft before 1567 (Geurtsen, 1988, p. 15)

The secondary east-west connections in the city centre form traditionally the compounds of the hearts in the countryside. Especially the water connections were important between (marketplace) Delft and the agricultural centres like the Buitenwatersloot. The city map on figures 11.23 – 11.26 clearly shows that the east-west connections in the road structure are of secondary importance. They have a less continuous character than the north-south links (Municipality of Delft, 2009-a).

The internal space form of Delft is determined by a special mixture of regularity and exception and by a number of striking contrasts. Examples include (Geurtsen, 1988, pp. 11, 12):

- Linear elements (canals) and polar elements (markets, courts); in few Dutch cities this contrast is cut so sharply
- Linear stretched elements (Koornmarkt, Verwersdijk) contrasting with linear curved elements (Oude Delft, Achterom, Burgwal)
- In the North-South direction the space profiles of the canals are more or less constant, perpendicular to that is an extensive repertoire of special spaces: narrow alleys, wide courts (Bagijnhof, St. Agathaplein, Heilige Geestkerkhof), markets, water squares (de Kolk and the water around the Armamentarium-Ammunition building) and a tunnelled lateral canal (Botermarkt)
- The dominant linear spaces are North-South directed; the most dominant polar space, the Market, is east-west oriented
- This Market is a good example of regularity and exception. In main lines, it is determined by three lots of the regular pattern of the underlying agricultural allotments. Along the edges two dewatering locks were channelled and transformed into asymmetric profiled canals. The middle ditch was filled up. Therefore arose an exceptional large square (120 x 50 metres), for Dutch concepts.

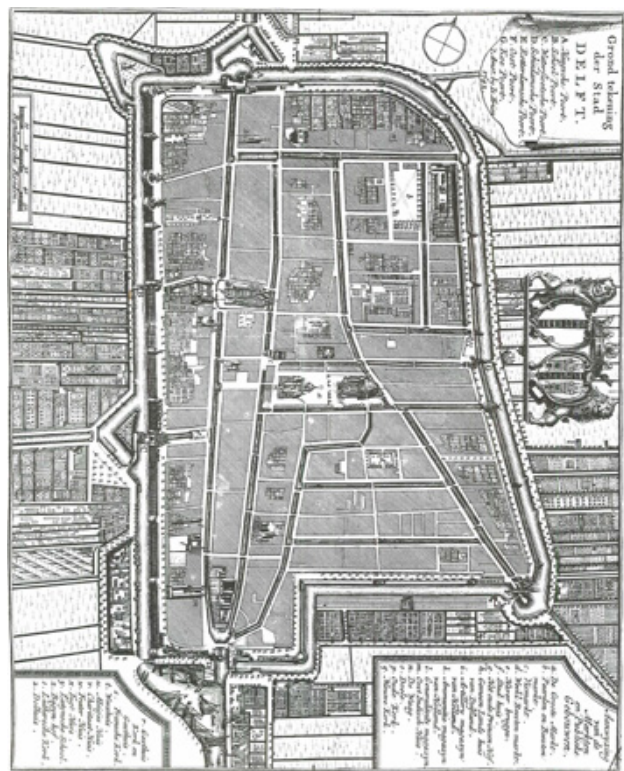


Figure 11.25: Delft – 1560 (Map Room TU Delft) Figure 11.26: Delft – 1742 (Geurtsen, 1988, pp. 16)

The rational organizing of spaces of the Renaissance period can be recovered in a few examples. The Market, the Choorstraat, the Nieuwstraat, the Doelenstraat (until the middle of the 17th century the monumental access to the Lakenmarkt) and the Beestenmarkt form the elements of a diagonal square series. After the powder house explosion of 1654 the then Lakenramen was newly planned as Paardenmarkt. Previously, this area was used for the textile industry (Geurtsen, 1988).

Historically interesting is also the development of the industry. While in the 12th and 13th century farming, ranching and trade were the sources of existence, in the 14th and 15th century the brewery came to fruition. From the 15th to the 17th century cloth weaving arose. From the 17th century new branches of industry are in emergence: carpet industry and pottery manufacture. Many street names refer to these activities (Steffen and Van der Voordt, 1979, p. 108).



Figure 11.27: Delft - 1913



Figure 11.28: Delft - 1958 (Map Room TU Delft)

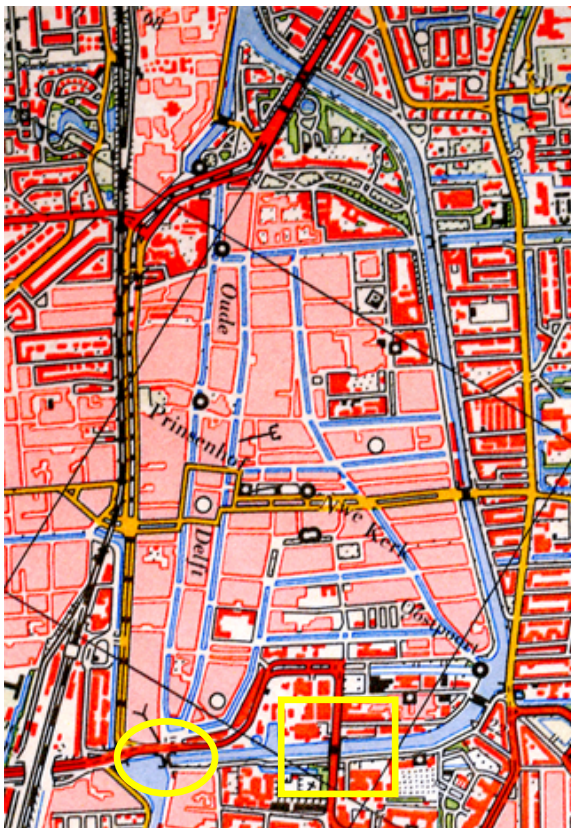


Figure 11.29: Delft - 1974

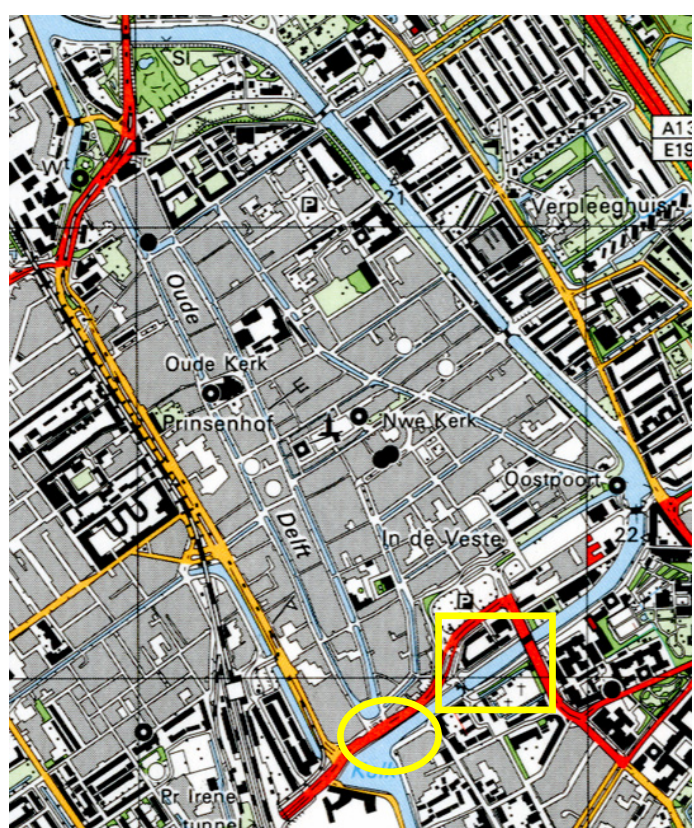


Figure 11.30: Delft - 1995 (Map Room TU Delft)

Around 1837 there are five markets: Paardenmarkt, Grote Markt, Beestenmarkt, Vismarkt en Brabantse Turfmarkt / Burgwal. Public buildings are: Stadhuis, Prinsenhof, Gemeentehuis, Oost-Indisch Huis, de Waag, Dole, Oude Kerk, Nieuwe Kerk en Bagijnhof.

Delft has developed from a 12th century settlement of land pioneers to the knowledge city of today. The historic centre is a typical Dutch canal city that is characterized by an elongated shape and a regular, bright distinctive spatial structure. *Figures 11.27 – 11.30* show the morphological developments of the last 100 years. The historical lines consist of old lanes and water links between the city centre of Delft and nearby towns and agricultural centres in the countryside (Municipality of Delft, 2009-a).

Consequently, looking at the different historical maps in this chapter, it can be concluded that the road and water network structure has not changed much through the years. In the year 1560 the main structure was already shaped. Three differences can be noted. The urban layout around the Paardenmarkt area did change due to the powder house explosion in 1654. The old shape counted three building blocks; the new area is divided into four blocks. Moreover, the function changed from textile industry into a market place for horses and other animals. The northern left part of the city centre first had a right angle, yet it changed into a curved one.

Open water of the Phoenixstraat, Wateringsevest, Nieuwe Plantage and canals on the Brabantse Turfmarkt, Burgwal, Oude Langendijk and Nieuwe Langendijk disappeared from the plan between 1742 and 2002 and turned into roads. First developments of the Zuidpoort area can be seen between 1750 and 1850. The terrain was initially situated outside the city gates and walls due to the water structure that separated the territory from the rest of the city. Between 1958 and 1995 the bridge that connected the Oude Delft with the Hertog Govertkade disappeared and was replaced by the current Hambridge and Sint Sebastiaansbridge.

The GPS-tracks show that current visitors actually visit streets and destinations that go back to the year 1742; the Grote Markt, Beestenmarkt, Vismarkt, Nieuwstraat, Voldersgracht, Brabantse Turfmarkt, Burgwal, Oude Delft, Choorstraat, Paardenmarkt, Doelenplein, Oude Kerk, Nieuwe Kerk, Bagijnhof, de Waag, Stadhuis and the Prinsenhof. Consequently, after almost 300 years, people are still looking for the same buildings and public spaces in the city centre of Delft. However, the functions have changed; churches are not only visited for services, people just like looking around inside. And at de Waag goods are no longer weighted; it is a restaurant nowadays. Yet the landmarks and picturesque canals, were now only boats with visitors sail, still function as attractors. Therefore, the city centre of Delft contains a lot of timeless historical qualities.

11.7 Quality analysis perception city centre

This chapter zooms in to qualities with regard to environmental psychology. How are spatial qualities experienced by pedestrians? The perception survey indicates visible and inner experiences such as perceptions, thoughts, knowledge, feelings, desires and inclinations as is described in *paragraph 1.4 and 1.5*.

This analysis builds on previous research done by Steffen & Van der Voordt (1979), Korthals Altes & Steffen (1988) and the Municipality of Delft (2009-b) in order to experience, map and improve the image of the city centre. Many pedestrians walk around and "make decisions that are closely related to what they see (visual access) and whether it would be easy to move through the area (locomotion). If that quick evaluation signals obstacles, the desire to go farther is reduced" (Kaplan et al., 1998, p. 31). To conclude: "Feeling safe is prerequisite to the use of urban open spaces." (id., p. 32)

The used method of the author's contribution consists of questionnaires which were filled in by visitors and inhabitants and contain their opinion about the city centre. What are attractive streets? Which areas are unattractive? And why? Second, a visual analysis of the city centre is made by the author to see and understand what it looks like on the streets currently. The focus looks first at the exit of both garages and second on jointly used and non-used streets by walking around in the area and take pictures.

11.7.1 Questionnaires

After the tracking days, participants were asked to indicate which streets and areas they found attractive and unattractive. In addition, they were asked why they had that opinion. The opinion of the visitors of the city centre is mapped in *figure 11.31* and the results of the inhabitants can be found in *figure 11.32*. It must be noted that these results are made quickly; people's verbal answers (registered in an Excel file) are processed in the images. However, the 165 detailed handmade maps of both researches (visitor research: 84 maps and inhabitants research: 80 maps) are not studied closely due to the limited timeframe. Consequently, more detailed and accurate research is recommended.

People's preferences have to do with impressions, experiences and memories. On both images some streets (Binnenwatersloot, Kromstraat and Bastiaanpoort) colour green as well as red. Subsequently, it is clear that different people have different feelings about the same place. *Figure 11.31* and its analysis are based upon the information that Ohyoon Kwon gathered for the visitor/tourist research.

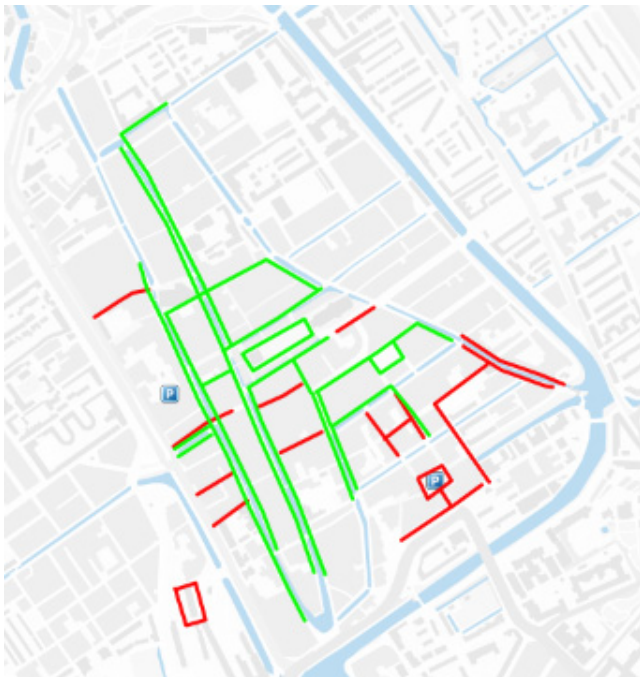


Figure 11.31: Visitors – (un)attractive streets

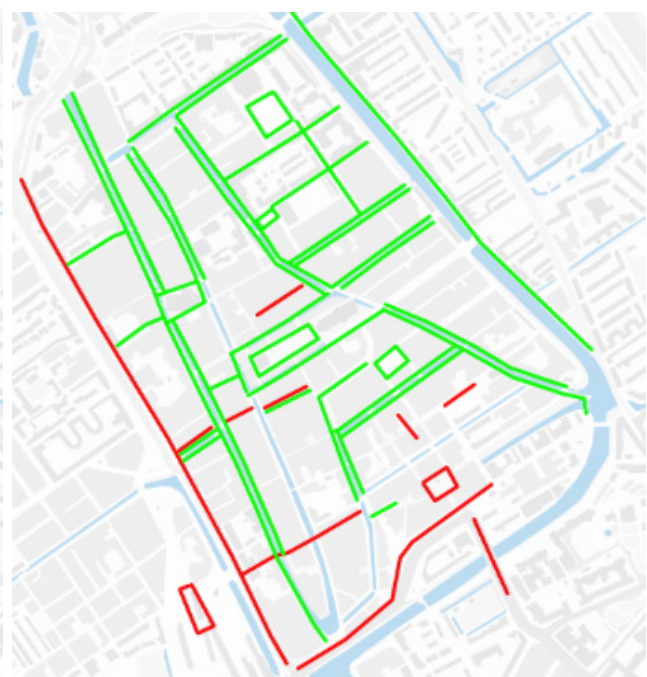


Figure 11.32: Inhabitants – (un)attractive streets

So, why are some streets and areas found attractive? Visitors respond: Nieuwe Kerk is very characteristic for the centre, beautiful centre with nice buildings and restaurants, shopping area is easy to access, parking garages have good quality and Zuidpoort is attractive for shopping.

Inhabitants describe positive factors as follows: old good atmospheric historic centre, cosy, cafes, shops, terraces, cosy streets and houses, canals, entire inner-city, good lightning, good place to go out, nice laid, nice buildings, city centre has a human scale, small scale, lovely canals, trees, cosy crowd, nice shops, good living-work city, good balance, variety, charming, nice green, special housing, cute little shops.

So, why are some streets and areas found unattractive? Visitors respond: city needs more interesting shops, Zuidpoort has boring and unattractive shops, the new district has a too modern style that does not match the historical character of the centre, shopping area is too far from parking garage, difficult to know locations of shops, parking garage needs more places and toilets, some streets are dark and narrow, Zuidpoort area had many teenagers that hang around and do nothing and there are many cyclists riding in the pedestrian area.

Inhabitants describe negative factors as follows: dirty streets with lots of graffiti, groups of teenagers hanging around is scary, lots of cars, messy, narrow, cheerless, dead, looking at

backsides of buildings, many streets are dirty and too narrow to walk with a baby car, presence of garages/companies. Residents have specific critique towards some locations:

- Spoorzone (temporarily due to redevelopments): the entire station site is empty with lots of asphalt, problem area, it is a mess, Phoenixstraat is a disaster to use, underneath the railroad it is very messy and confusing.
- Zuidpoort: too open, empty, less attractive, bleak ('sfeerloos'), without character, massive, new buildings.
- Bastiaansplein: big and boring shops, no nice shops, hard wind, horribly ugly, disgusting square, just too big with too tight high buildings around it.
- Kromstraat: lot of noise and nuisance caused by drunken people in the evening and at night, unsympathetic, the alley is getting narrower, empty, poorly designed, bad atmosphere.
- Barbarasteeg: empty, poorly designed, bad atmosphere.

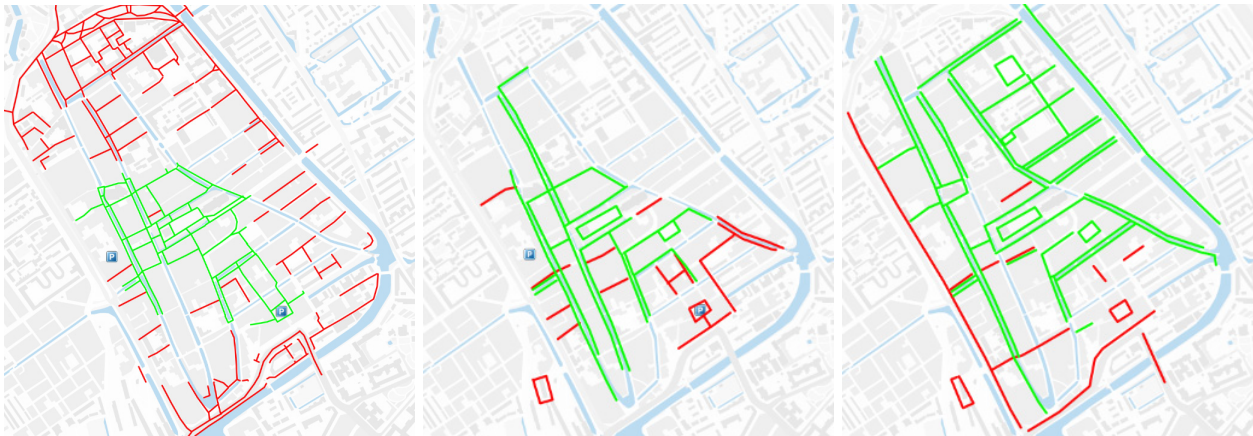


Figure 11.33: Use and non-use... versus experiences visitors... and experiences inhabitants

Subsequently, when the use and non-use of the centre is compared with the experiences of the visitors/tourists, see *figure 11.33*, it can be concluded that a clear similarity can be found between used streets and positive feelings that pedestrians have with certain areas.

Further, when the use and non-use of the centre is compared with the experiences of the inhabitants as shown in *figure 11.33* it is striking that a lot of non-used streets actually are experienced quite positive. One explanation can be found in the fact that no pedestrian used the streets however most bike trips did. So, people do know and use the streets and are obviously quite fond of them yet they do not walk there. On the other hand there are similarities: some non-used streets colour red as well on the cognitive map. It must be marked that Bastiaansplein is used by both target groups yet people do not like the atmosphere and design.

Consequently, in order to attract people, the physical environment needs to (change in order to) facilitate interaction for the social environment to increase human welfare and use of the city centre.

11.7.2 Visual analysis city centre

The visual analysis of the city centre deals with the route a pedestrian experiences when (i) leaving the Phoenix and Zuidpoort garage and (ii) while walking through the city centre; looking at the joint used and non-used streets. *Figure 11.34* shows an overview map where the pictures are taken.

11.7.3 Exit parking garages

The next part concerns the parking garages Phoenix and Zuidpoort. How attractive are the routes pedestrians have to take when leaving the garage towards the city centre? *Figure 11.35* shows three possible ways (red arrows) to leave the Phoenix garage.

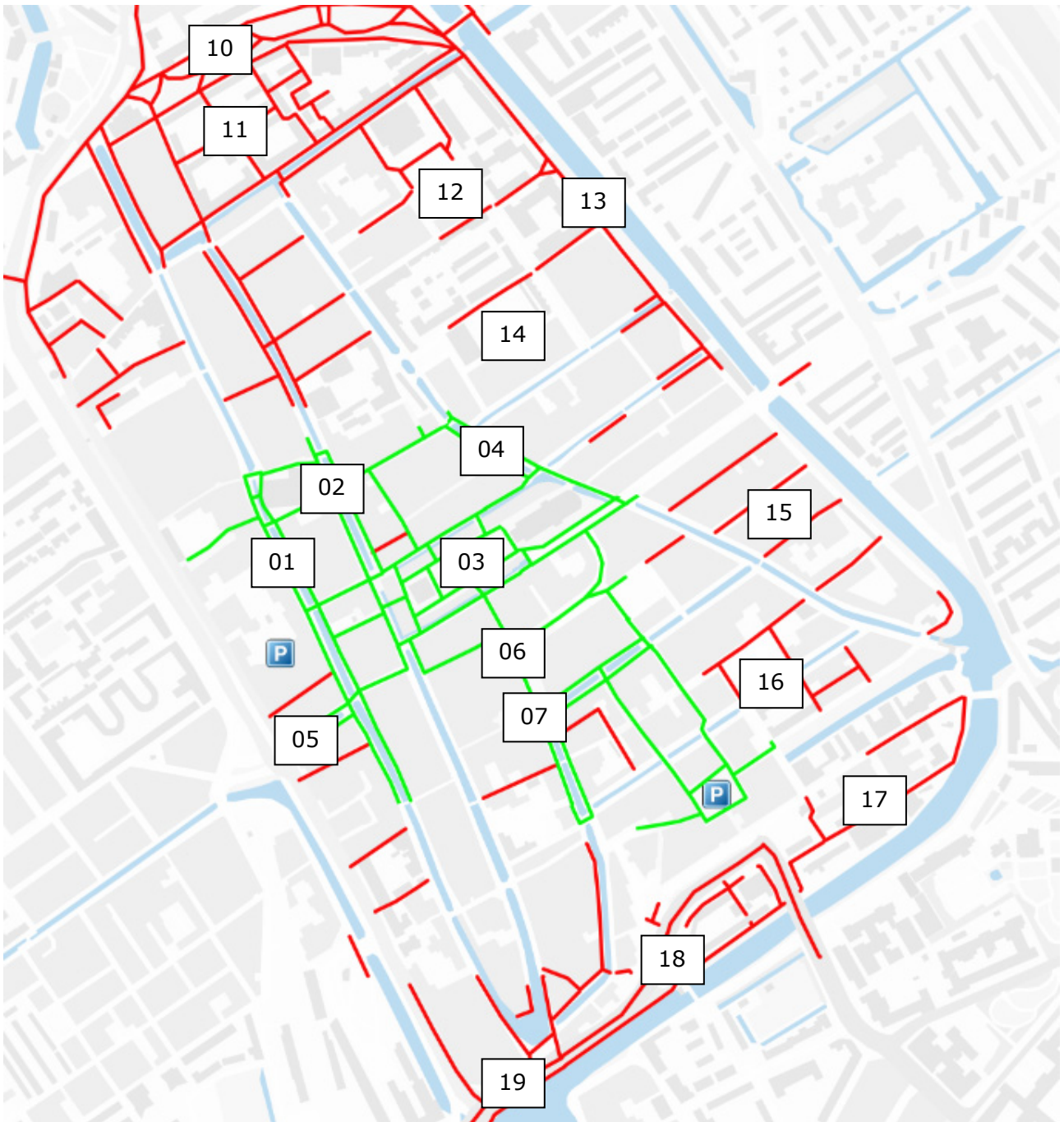


Figure 11.34: Overview map - Visual analysis used and non-used streets in the city centre of Delft

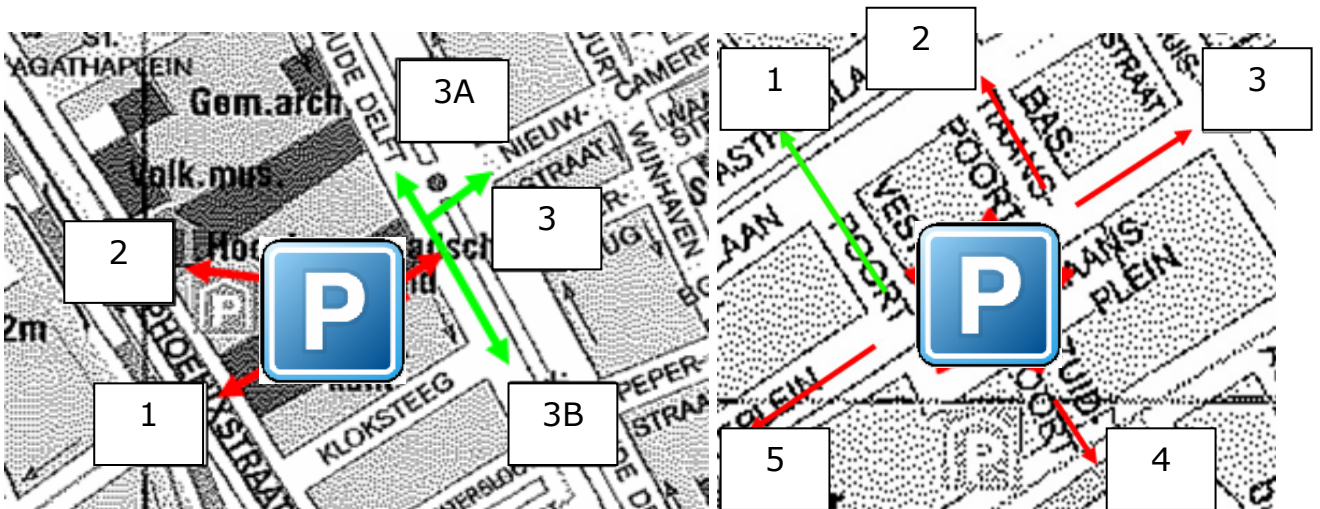


Figure 11.35: Leaving Phoenix garage – 5 ways

Figure 11.36: Leaving Zuidpoort garage – 5 ways

On *figure 11.37 (exit 1)* can be seen that the exit is not well designed: (i) If one does not know that you can walk through the Town Hall building to reach the Phoenixstraat, you will not enter the building (ii) The Town Hall has limited opening hours (iii) The entrance of the building is not clearly visible (iv) The route towards to entrance of the Town Hall is only partly visible. There's a fake wall on the ground floor in front of the real façade.



Figure 11.37: Leaving the Phoenix garage – exit 1 (through Town Hall) and exit 2 (through park)

The second route, demonstrated in *figure 11.37 (exit 2)* to leave the garage is attractive, yet unclear: (i) A pedestrian walks alongside the park easily. If someone wants to enter, he has to make an angle of 180 degrees (ii) The park is only accessible during daytime. When arriving later you have to walk all the way around the buildings (iii) If you are not aware that you can walk through the park to reach the Phoenixstraat, you do not enter the park. The route can not be seen until you stand in the park (iv) The fence looks like a closed wall when you stand in front of it, therefore it is not attractive to walk inside. It feels like it is locking you in.



Figure 11.38: Leaving the Phoenix garage – exit 3

Exit number 3 is photographed in *figure 11.38*. The exit is not well designed: (i) It is not clear where to walk towards; the closed horizontal wall suggests a direction. However, the yellow columns grab your attention so people first look in that direction (which will lead you to residential houses) (ii) When you see the light from the streets, there is a dark and out dated designed tunnel in front of you which pedestrians have to walk through first (iii) At last the exit is reached. However, it is not possible to walk straight ahead; a canal is blocking the route.

Once a pedestrian reaches the Oude Delft canal a decision has to be made whether to go left or right as *figure 11.39* demonstrates. If someone does not know the city: (i) And the plans are to go shopping on the market, you will choose road 3A, because here the icon of the Old Church will guide you towards the market (churches and markets used to go hand in hand in the old days) (ii) And you're here for a business lunch, you will choose road 3B because there is a restaurant only a few meters away (iii) And you just want to walk around, you will most likely choose route 3A because there is a really cosy café on the corner (not in picture).

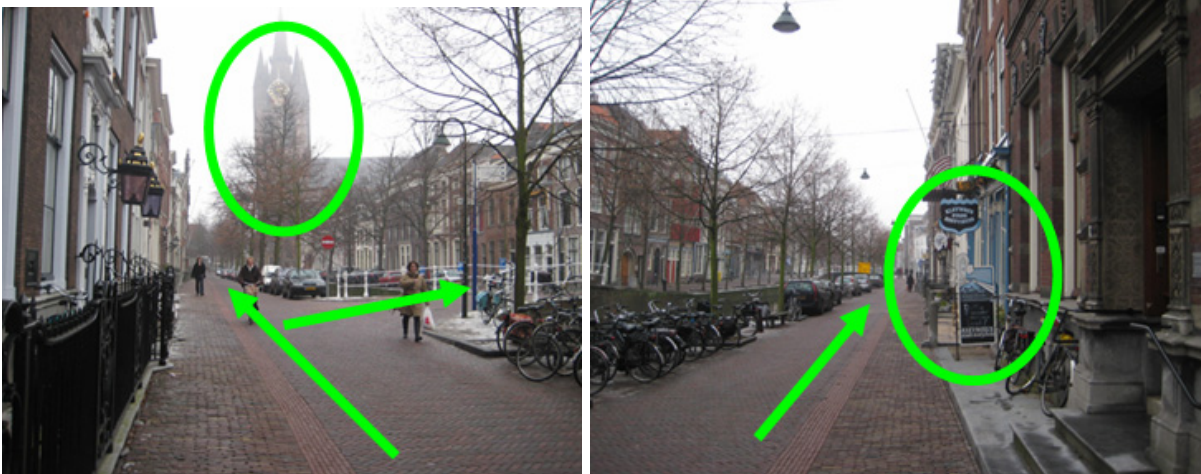


Figure 11.39: Leaving the Phoenix garage – choosing 3A (left) or 3B (right)

Figure 11.36 shows five possible ways to leave the Zuidpoort garage. The next pictures are taken from the Zuidpoort garage / Bastiaansquare. On figure 11.40 can be seen that exit street 1 is very well designed: (i) The New Church is clearly visible (orientation; know where you are and where to walk towards) (ii) Good visual contact with the next 'follow up' street (iii) The shops have open and interactive facades with a vertical rhythm and a good texture. The other streets are less attractive or even bad.



Figure 11.40: Leaving the Zuidpoort garage – exit 1 Vestepoort and exit 2 Bastiaanpoort

The second exit street shown in figure 11.40 is less attractive: (i) There is no icon to walk towards (ii) The street looks blocked while it actually does continue on the right (iii) The facades of the few stores are closed, passive and lack transparency (Gehl et al., 2006). Pedestrians are not tempted to enter this street; it is not showing anything.



Figure 11.41: Leaving the Zuidpoort garage – exit 3 Zuiderstraat and exit 4 Zuidpoort

The third exit street is badly designed as can be seen in *figure 11.41 (left)*: (i) There is no icon to walk towards (ii) The left façade is totally closed, passive, boring and uniform (Gehl et al., 2006). You just look at bricks (iii) The right façade is the same with the slight difference that here is a window display (iv) The street has a cheap view looking at the temporarily mobile egg rolled store.

Exit street number four is less attractive as is demonstrated in *figure 11.41 (right)*: (i) This street is used heavily by cyclists as a short cut (ii) There is only one door opening in the entire façade (iii) The facades are open but passive and uniform. However, people do use this street but not for shopping purposes. This street connects the city centre with the southern Delft area by the Sebastiaanbridge and the bus station is just around the corner. Furthermore, you could see the bridge as an orientation icon to walk towards.



Figure 11.42: Leaving the Zuidpoort garage – exit 5 Vestplein and façade Bastiaansquare

Figure 11.42 (left) shows the fifth exit street and it is moderately designed: (i) The hang over roof of the theatre can be seen as an orientation point (ii) The facades are transparent and rich in sensory experience but uniform and passive at the same time (iii) There are few open doors to enter (iv) At the end of the street, there is no continuing programme for pedestrians; the canal blocks the way towards the Clarenstraat and Breestraat.

The two right pictures in *figure 11.42* of the Bastiaansquare are less attractive: (i) This 'street' is the area in front of the Fortis Bank, but this can be hardly seen from the square because there are a couple of objects in front of it. If you do not know the Bank is located here, you pass it by clueless (ii) There are only two door openings in the entire façade (iii) The facades are open but passive and uniform. There is a lot of glass in the windows but the sight looking inside is blocked.

11.7.4 Used streets

Second, a visual analysis is made of the used streets which are mapped in green lines on the ground plan in *figure 11.34*. Images [01 – 07] of frequent visited areas clearly demonstrate seductive spatial qualities combined with attractive mixed programs on a nearby location.



[01] Oude Delft / Oude Kerk



[02] Choorstraat



[03] Grote Markt



[04] Vrouwjuttenland



[05] Binnenwatersloot



[06] Jacob Gerritstraat



[06] Burgwal



[07] Molslaan



[07] Brabantse Turfmarkt

11.7.5 Non-used streets

Third, a visual analysis is made of the non-used streets which are mapped in red lines on the ground plan in *figure 11.34*. Images [10 – 19] of non-visited areas clearly demonstrate public spaces with good and bad qualities.



[10] Nieuwe Plantage with walking and sitting possibilities



[11] Anna Boogerd (houses)



[12] Paardenmarkt = cars...



... and Hofje van Pauw



[13] Oostplantsoen (canal)

Attractive places are, for example, the several green recreational areas (Nieuwe Plantage, Hofje van Pauw, Oostplantsoen, Doelentuin and Zuidwal) where one can walk, enjoy the environment and take a rest by sitting down on one of the benches.



[14] Doelentuin = invisible / wall... inside is a beautiful park



[15] Harmenkokslaan (houses)



[16] Klooster (houses) and...



Yperstraat = cars



[17] Nieuwelaan



[18] Zusterlaan and...



... Zuidwal



[19] Westvest / CS

Unattractive streets can primarily be found in monofunctional residential areas (Anna Boogerd, Harmenkokslaan, Klooster, Nieuwenlaan, Zusterlaan and Westvest). Moreover, large parking places can be found on the Paardenmarkt and Yperstraat where cars occupy the streets, chasing people away. No one wants to reside in a car dominating environment with no stay-quality. The residential neighbourhoods as well as the parking lots are characterized by unattractive public space (closed walls, nothing to look at, nothing to do), with no program located far away from the starting points.

It is an opportunity to use the current quality of the beautiful greenery and transform the repulsive parking lots into attractive pedestrian-loving environments and programs.

11.7.6 Alleys

The city centre of Delft is characterized by a lot of (small) alleys. This part discusses them. The first and biggest problem of most alleys is when you stand at the beginning of the street, you cannot see the end. So, you do not know where you walk towards and what will happen halfway through. It is unclear from the curved alley's edges what is going on inside; there is not enough visual contact with the programme and the end of the street. Not every visitor is waiting for a surprise and do feel unsafe entering such streets.



Figure 11.43: Alleys – Kromstraat (entrance Jacob Gerritstraat, halfway and entrance Koornmarkt)

The Kromstraat (figure 11.43) is a fine example of an alley that partly shows bad quality (graffiti, neglected space and empty buildings) as well as good quality (an art gallery, a children's shop, new pavement). When the street is entered from the Jacob Gerritstraat there is no programme other than buildings that are for rent and a coffee shop. A sudden change is made when the art gallery and shop are approached; the environment becomes more lively. Unexpectedly, the street gets tighter and graffiti can be seen. The feeling of being unsafe returns. Looking at the entrance on the Koornmarkt it looks entirely different than the one on the Jacob Gerritstraat; the width profile narrows down from 4m to 2m.



Figure 11.44: Alleys – Poppesteeg (Poppesteeg / Oude Delft and Poppesteeg / Westvest)

A more extreme example can be found in the Poppesteeg, figure 11.44. The left picture is taken from the Oude Delft canal that shows clear vision through the alley towards the station (you can see the train passing by). However, halfway through the "eyes" (windows and doors) disappear and graffiti and neglected buildings appear. The entrance from Westvest does not attract pedestrians to enter the alley.



Figure 11.45: Alleys – Schoolstraat (entrance Oude Delft, halfway and entrance Phoenixstraat)

Fortunately, there are more alleys in the city centre like the Poppesteeg / Oude Delft example. These are the straight streets, well lit, good visual contact and no litter on the floor or graffiti on the walls. Not all curved alleys are dark and creepy. Two other types of alleys deserve to be mentioned as well. The first is the Schoolstraat, figure 11.45, as a good example of an alley

with several programmes. It has well-kept entrances on both sides, the street and walls are clean, the profile is wide enough for pedestrians and cyclists, the street is well lit, good visual quality (many doors and windows) and there are multiple unexpected functions halfway through: a hotel, an office, a grocery store, a museum, et cetera. At last, the small scale of the built environment is human friendly.



Figure 11.46: Alleys – Barbarasteeg (entrance Oude Delft, halfway through and entrance Westvest)

The second type is the Barbarasteeg as is shown in *figure 11.46*, with bad visual contact when entered from the Oude Delft. It feels like entering a funnel and it is unknown where and how it ends. In the midway the profile is the smallest (it measures 34 cm for a two way sidewalk and 2 m for a two way bicycle path) and even during daytime dark due to the hang over greenery.

The entrance from the Westvest is normal but the pedestrian road on the left ends when it meets the old building (Virgiel). The pavement on the right is cut in half when the wall of the garden (Fokkema Architects) is reached. Therefore, pedestrians are obliged to walk on the cycle path which leads to big frustrations among cyclists. Especially during rush hour or city events, there is no room to cycle or walk at all. Despite of the not well functioning of the alley, the Barbarasteeg is heavily used. At this moment it is the most popular entrance to enter the inner city. Consequently, it depends on the strategic situation of a street how often it is used as well.

Alleys only have development potential if they (Miles, 2010);

- Have a unique selling point such as their geography, history, anchor development or a unique feature that attracts activity; or
- Are able to offer a short cut that more efficiently connects two other significant areas of activity.

If neither of these two conditions can be met, there's absolutely no point in getting excited about the potential of the space and I believe there is a high risk of creating a white elephant.

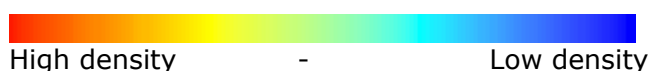
11.7.7 Conclusions visual analysis

Consequently, three main conclusions can be drawn from the visual analysis:

1. There are too much barriers (mostly canals, buildings and wide car roads) blocking the natural walking routes pedestrians could and would use
2. Bad visibility, poor maintenance buildings and unsafety feelings in narrow / curved alleys
3. Poor quality of the ground floor facades in the shopping area.

11.8 Density analysis

A density analysis made in ArcGIS shows concentrations of pedestrians who stay in the public space and destinations like shops. A high density is coloured red and a low density is coloured blue as can be seen in *figures 11.47 – 11.49*. Images could not be cleaned for 100% so some individual tracks are still shown. Every image represents another day.



The density analysis is made in order to answer the next research question: "Does a high density mean that public space contains good quality for accommodation?" High as well as low density streets are compared with the previously named quality analysis of the city centre.



Figure 11.47: Density analysis Phoenix & Zuidpoort garage; Wednesday, Thursday, Friday and Saturday

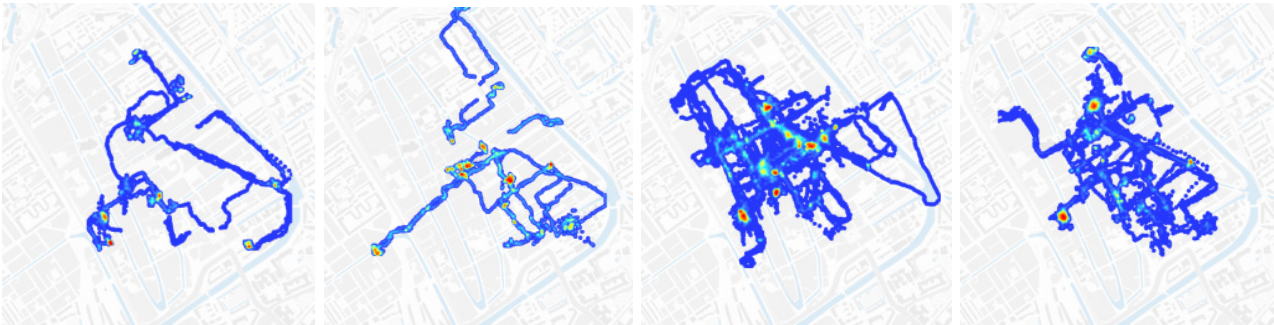


Figure 11.48: Density analysis city centre inhabitants; Wednesday, Thursday, Friday and Saturday

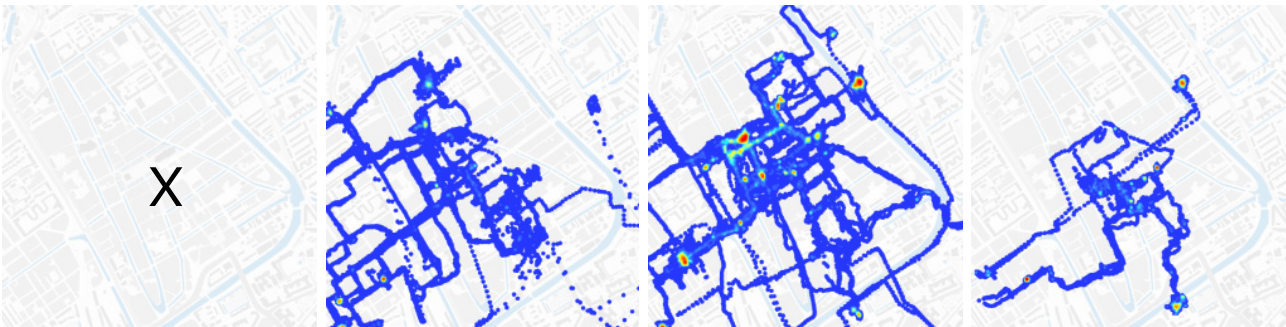


Figure 11.49: Density analysis neighbourhood residents; Wednesday, Thursday, Friday and Saturday

Figure 11.47 shows the density analysis of pedestrians leaving the Phoenix or Zuidpoort garage. All four images have in common that the most people stay the longest in the lightning-shaped axis Bastiaansplein – Vestpoort – Paradijspoort – Molslaan – Brabantse Turfmarkt – Jacob Gerritstraat – Grote Markt. It immediately becomes clear that Thursday is a market day by witnessing the highest density on the Grote Markt. Other public spaces that turn up red are the Kruisstraat (shopping part), the axis Prinsenhof – Oude Kerk – Choorstraat, Beestenmarkt, Burgwal and streets around Het Meisjeshuis on the Oude Delft / Boterbrug / Nieuwstraat.

Figure 11.48 shows the density analysis of pedestrian trips made by city centre inhabitants. It is clearly visible that Wednesday and Thursday were normal days and that Friday (Queensday) and Saturday were free days: much more streets and areas were used. However, pedestrians do not stay longer at a destination or street.

Figure 11.49 shows the density analysis of pedestrian trips made by neighbourhood residents. The map of Wednesday is empty due to the fact that no participants went into the city centre by foot. Compared to the city centre inhabitants a much greater use of the urban network can be detected. However, looking at the density analysis a preliminary conclusion can be that streets are predominantly used for transportation and not for staying. The image of Saturday demonstrates this best: in order to reach a destination, a neighbourhood resident has to use more streets as an approach lane than a city centre inhabitant.

Looking at *figures 11.47 – 11.49* a big difference in colours can be seen between visitors and inhabitants; *figure 11.47* has more red areas than *figure 11.48 and 11.49*. This is because of the different number of participants; an amount of 285 pedestrians results in more red areas than 72 tracks from city centre inhabitants or 55 tracks from neighbourhood residents spread over 4 days.

Except the amount of participants, another explanation of different densities can be found in the fact that inhabitants have much more varied destinations than visitors. Inhabitants also bring their children to school or day-care, go to work, shop at grocery stores, visit pharmacies, neighbours, family and friends, et cetera. Therefore, destinations are much more spread, geographically seen. Visitors' destinations are much more concentrated in and around the central shopping district. Moreover, on Queensday a lot of participating inhabitants joined one of the many flea markets in the city centre. Frequent used locations can be found around the Oude and Nieuwe Kerk, Doelenplein, Paardenmarkt and Binnenwatersloot.

Consequently, to answer the research question: compared to the street quality analysis pedestrians do stay longer in streets with high spatial quality. Streets with low(er) spatial qualities are mostly used as a route and not as a place to stay. Exceptions are made when attractive programs tempt people to come on over, such as Zuidpoort / Bastiaansplein, Kromstraat and Paardenmarkt. The Barbarasteeg for example is only used as transportation road and only used by neighbourhood inhabitants.

12 Recommendations and interventions

This chapter gives an answer to the main research question: "Which strategic spatial design interventions can improve public space for the slow traffic network in order to retain city visitors in the city centre of Delft?"

Strategic planning connects space, program and strategy. The strategic plan offers an attractive and well-thought spatial and programmatic vision. It becomes concrete in a combination of actions. This can be key projects, which can start tomorrow. The strategic plan is also flexible so that the demands of tomorrow can be integrated without loss of quality. The interventions are tempting in vision, image and text. The scenarios show opportunities, potentials and their relationship.

12.1 City centre scale

12.1.1 Future vision for the city centre of Delft

In 2030 the city centre of Delft will be a sustainable, environmentally-friendly town consisting of mainly pedestrians. Cars are, except in the residential areas, not welcome. They are collected in 4 parking garages on the 4 wind directions. Local traffic such as delivery vehicles (and emergency services) can, of course, enter the city during specific times by using pollers. The pedestrian zone has been extended so that the town is even more tempting to visit. Children play carefree on the street again, where no or little motorized traffic drives around. The waterways are more intensive used and by more different target groups: movements are no longer restricted to roads. As a visitor to the city centre you can hire a small water taxi or pleasure boat with your public transport card to move around. Various human and environmentally friendly modes of transport are now integrated in the townscape: bikes, tandems, steppes and electric plateaus make you can move further without getting tired. In this way also more remote areas are reached within minutes.

Good and short run-up routes to urban amenities are realized. Intensification of the existing core shopping area has taken place. Unoccupied shops are filled with specific commercial or retail chains. For visitors who do not like mass public activities, there are enough city tours available which show special spots of Delft. The average tourist does not come here and these locations are known for their intimate local qualities, both spatial and programmatic. A number of inhabitants has opened up its homes and finds it pleasant to get tourists to visit. The doors are always open for visit: coffee and cake are ready. While visitors enjoy a snack and drink, residents tell about their neighbourhood and the city. Inhabitants function as private guides who show visitors unknown and beautiful places.



Figure 12.1: Artisan & organic products, Rotterdamse Oogst, Schouwburgplein Rotterdam (Geest, 2010)

The area around the Zuidwal has been addressed, and is transformed from a busy thoroughfare road into an attractive residing environment. Thanks to the *Spoorzone* project the Phoenixstraat has been able to put its historical qualities back on the map. The Binnenwatersloot has become the new entrance for the city when arriving at the new Central Station. Thanks to the new bike trails the Barbarasteeg has become a new pedestrian street. People can now quietly pass because there is enough space. This alley is the beginning of a walking route that continues in the direction of the Breestraat; a shopping street for pedestrians with quirky shops and good restaurants.

Also in the Northern part of the city centre something changed. A new facilities area is put on the map. New life has been breathing into the historical and cultural value of the Paardenmarkt. Historical and cultural objects serve as carrier for new future developments. Monuments receive a contemporary feature making it a combined and timeless program, where many visitors are attracted to since people come to enjoy the city's history. The Paardenmarkt has its own identity so that it does not compete with the shopping areas.

The new city farm receives a lot of attention: for tourists as well as residents with their children it is a whole experience to spend a day here. Herein lies of course an educational component ("milk does not come from a factory") combined with leisure. Older children help with the care of the animals and inform young children about the animals. Old crafts such as wool spinning and knitting are here transferred to younger generations as *figure 12.2* shows. Thus, new features find their way to the Old Town. And indeed, historically seen there were animals and crafts on the Paardenmarkt as well.



Figure 12.2: Learning, Rotterdamse Oogst, Schouwburgplein Rotterdam (Ernst, 2010)

The spatial and programmatic unattractive parking places on the Gasthuisplaats and Yperstraat disappeared. Fruit and vegetable production is situated at these places now. Due to its good accessibility, tourists and residents both buy locally grown fruits and vegetables so the local economy is stimulated well. *Figure 12.1* shows an example of artisan and organic products. At the same time the environment is relieved by offering a restricted amount of products that needs transportation from the other side of the world.

The coordinate theme of urban agriculture and fruit and vegetable production refers to children. In 2006 the author conducted research for a Housing Corporation on how non-Dutch speaking tenants could be more involved in the activities of the Corporation. The final conclusion was: Organize activities where children are involved. In this way, both Dutch and non-Dutch mothers and fathers show up. This creates a good reflection of society. Or, as Hajer and Reijndorp define: the most beautiful spots consist of different population groups who encounter each other spontaneously (2001). *Figure 12.2* demonstrates learning by watching, touching and sharing information with each other.

The centre is an interactive historic core that shows her history on the streets. Knights and maidens perform live plays and then move through the public for questions, additional information and discussions as *figure 12.3* shows. Museums put their exhibits in public spaces which can be discovered and visited by digital treasure hunting. Connecting the past to the future.

Passers-by who find these objects can indicate digitally or virtually whether the object is still beautiful, user friendly and functional. If not, they are invited to be creative and are asked what they would change. The object changes then in such a way that it is up to date for contemporary use. These objects are linked in a walking route that shows tourist as well as inhabitants unknown public places.



Figure 12.3: Bring the history of Delft to life by theatre and games on the streets

An art route leads along a number of notable art objects in the centre. In addition, several new art galleries and initiatives are visited which relate to a contemporary and appropriate manner to the transformative city and the city public, sometimes in cooperation with private parties. Consequently, people wander and stroll through the urban fabric without getting lost.

12.1.2 Mission, vision and strategy

Based on the future vision, guidelines to realize this image are formulated below.

Mission for the city centre of Delft

An optimal functioning spatial, programmatic and socially sustainable city.

Vision for the city centre of Delft

A city which is happily and frequently visited by visitors, tourists, neighbourhood and city centre inhabitants who stay long, because the area is a spatial and programmatic attractive residing environment where you can wander and stroll without getting lost.

Strategy for the city centre of Delft

Work on an attractive visit and residential city. Strong elements are made stronger and bigger. What is weak(er) leans to the strong. On this basis a sustainable spatial policy will be formulated. The unique selling point of the city centre of Delft is its favourable location along different sorts of water and canals beside the historical character.

Because a city is infinitely complex and therefore can never be adjusted with a comprehensive plan, priority is given to four strategic key decisions:

- Guarantee the accessibility in a sustainable manner (established restricted-traffic centre, improve inner-city network of clear and mysterious walking routes)
- Embed cultural heritage and architecture as a developing force (better use and redevelopment)
- Use of leisure time (shopping & leisure) as stepping stone for 1) long-term staying in public space with good quality 2) urban economy
- Priority for entrepreneurs (attractive climate, increase density, fill holes in network, good accessibility, care for people flows)

12.2 District and street scale

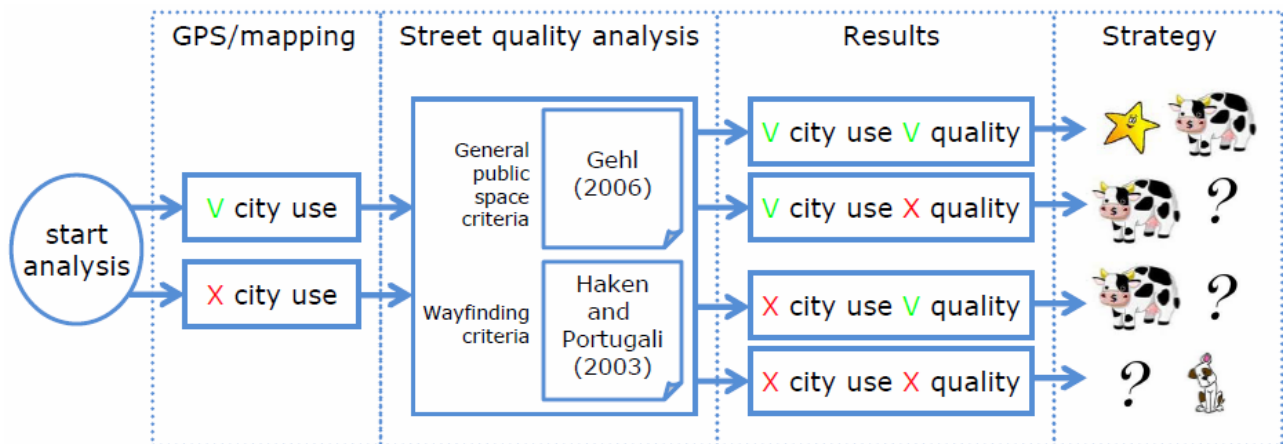


Figure 12.4: GPS-flowchart to develop strategies and interventions

In order to transform the above mentioned policy into strategic spatial design interventions, the GPS flowchart is used, see figure 12.4. Based on the results, an appropriate strategy is formulated. Figure 12.5 demonstrates the intervention map where the four colours represent the four segments. Thereafter, some images are added to visualize what it will look like on the streets.

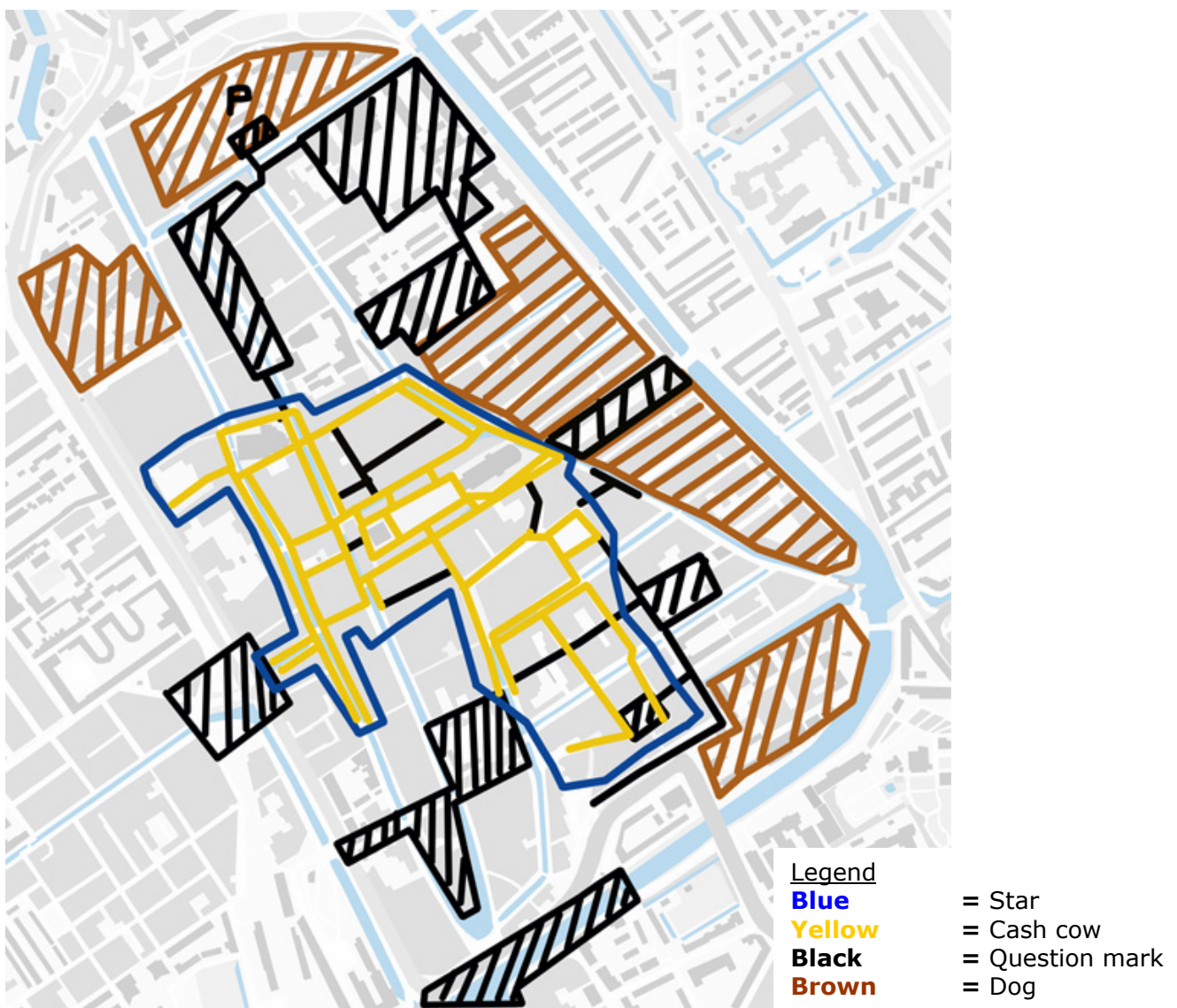


Figure 12.5: Intervention map

12.2.1 Star

The **blue area** in figure 12.5 can be considered as a "**star**". This realm consists mainly of the central shopping area that offers many mixed urban functions for each visitor to the city centre. However, in this scope there are a number of streets that are frequently visited by all types of visitors but none of the streets contain a good visual spatial quality. Streets which are marked by "**black lines**" deserve some extra attention. The interventions will consist of removing graffiti, garbage and make sure there are not too much empty buildings situated next to each other.

12.2.2 Cash cow

The **yellow streets** of the core shopping area in figure 12.5 need not be addressed; they can be considered a "**cash cow**". Both visitors, city centre inhabitants as neighbourhood residents use these roads and destinations. These streets provide a good spatial quality (pedestrians stay here the longest, looking at the density analysis) and sufficiently mixed program, so they attract all kinds of pedestrians. These streets are also within walking distance (400-500 meters) of the starting points Phoenix and Zuidpoort garage.

12.2.3 Question mark

The **black areas** or "**question marks**" in figure 12.5 are the intervention regions. Based on two types of scenarios, a continuation between a conservative (short term) and an ambitious (long term) transformation is made as figure 12.6 shows.

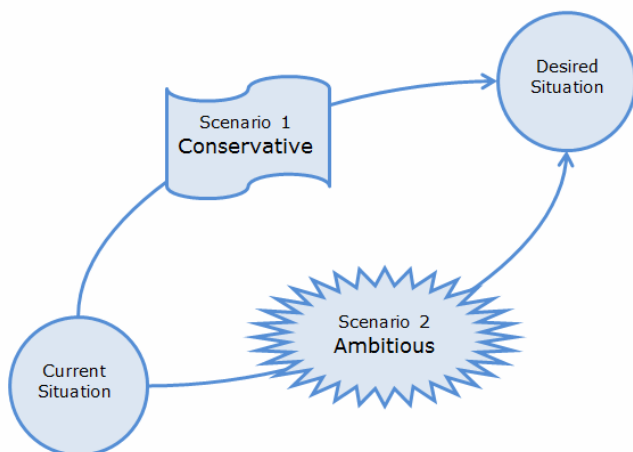


Figure 12.6: Two scenarios - conservative and ambitious interventions (Nieuwenhuis, 2008)

The conservative, short term interventions are as following:

1. The central shopping centre area (Zuidpoort, Beestenmarkt)

Although many participants visit the Zuidpoort area there still are some disadvantages that can be found. Many people complain that they find the Bastiaansplein too big. Therefore, the square is divided into a few smaller pieces that are more intimate, protected against wind and rain and each have their own atmosphere. A small children's playground can be added for example.

Second, pedestrians as well as cyclists use the Vestpoort and Bastiaanspoort. Especially during busy times these two transportation modes do not go well together. Cyclists just go faster and many (shopping) pedestrians do not look around. Many almost-accidents occur. Since the old library on the Kruisstraat is demolished, there is a big opportunity to lengthen the Kruisstraat towards the Beestenmarkt. By breaking down 2 or 3 houses, there is a new route for the slow network to go directly to the Beestenmarkt. Moreover, currently, only the left part of the Beestenmarkt is used. The right part is ignored by all pedestrians. This opportunity would provide cyclists a fast route towards the north and the Beestenmarkt would be fully used.

Third, streets like Kruisstraat, Gasthuislaan and Zuidwal are characterised by closed facades. Pedestrians have nothing to look at and nothing to do here. It is strongly recommended that closed walls are opened somehow. One could make a real opening, that would be best. Yet very expensive. Suggestions would be to do something that makes people feel safe there. Windows with art for example or children playing inside. Or peep holes that make pedestrians curious to see what is inside. The new spring collection? Discuss this problem with artists and they will come up with something creative.

The Kromstraat is used by every target group yet the spatial quality for visitors is not that good. The facades need maintenance, just some paint. A lot of buildings are empty and not taken care of. They could (temporarily) be rented to artists or students when waiting for a real tenant. The Kromstraat has a good (new, clean) street profile and functions like a children's shop, a gallery and a restaurant can be found. Due to the coffee shop and many empty buildings it does not feel safe here at night, not for anyone passing by. It is recommended that also more attractive program is offered for this street for it has the potential to be an interesting shopping and leisure street. *Figure 12.7* demonstrates improvements by adding spatial quality and more programs. This street has a potential to become safe and attractive.



Figure 12.7: What does it look like on the street? Before & after spatial interventions: Kromstraat

2. Zuidwal

Zuidwal transformed from a living area surrounded by canals to a modern shopping area with modern architecture and a fast road for motorized traffic. There is not much space left for the big numbers of pedestrians and cyclists that travel daily from Central Station towards, for example, the University area. *Figure 12.8* shows the pedestrian route towards Central Station.



Figure 12.8: Zuidwal – space for cars...

... and space for pedestrians.

To improve this situation the new *Spoorzone* route for the slow network is used, as can be seen in *figure 12.11* (new route from CS towards the south in yellow dots). The waterfront contains lots of spatial qualities but now it is just a route for ships. It is recommended to

transform this functional area into a spatial attractive environment where people can relax and enjoy themselves alongside the waterline. This could be realised by making the waterfront active and reachable; the quay should be lower and stairs should be added. In this way there is more interaction. Examples can be found in *figure 12.9* and *figure 12.10*. People attract people so it will be only a matter of time before programs will be added to the scenery. This could be anything from shipping treasures, storytellers, small exhibitions and building your own boat (from a piece of paper). The location of the Hertog Govertkade shows potential to transform this road in a staying place with good spatial quality and (temporarily) program. People can come over here to rest and look at boats or they can participate actively.



Figure 12.9: Zuidwal – a better route for the slow network and example accessibility waterfront (Utrecht)

The author also recommends that the *Hambrug* should be moved towards Central Station in order to provide a faster and better route from the centre towards the southern area. On-going traffic then no longer has to storm through the city centre. The Hambrug now ends nowhere; you have to go right or left on the Kanaalweg in order to continue your trip. There is no destination or orientation point to see here. When the Hambrug is situated on top of the Rotterdamseweg, a clear route is directly visible from a large distant. *Figure 12.9* illustrates the new location of the bridge. The route itself is also more clear and logic due to the fact that the Rotterdamseweg is one straight road. You only have to turn left somewhere along that line in order to arrive at your Faculty. Anyone can remember that.



Figure 12.10: Zuidwal – interactive and accessibility waterfront with leisure program

3. Spoorzone - Bolwerk

Due to the fact that a new Central Station of Delft is waiting around the corner, the author studied the new land use plan with regard to connectivity. Visitors and city centre inhabitants do not use streets and alleys that connect the city centre to the west part of Delft, however neighbourhood inhabitants do. Uncleaned GPS-tracks from neighbourhood inhabitants are

compared to future connections between city centre and neighbourhood *Hof van Delft* of the *Spoorzone* project (Municipality of Delft, 2006) as can be seen in *figure 12.11*.

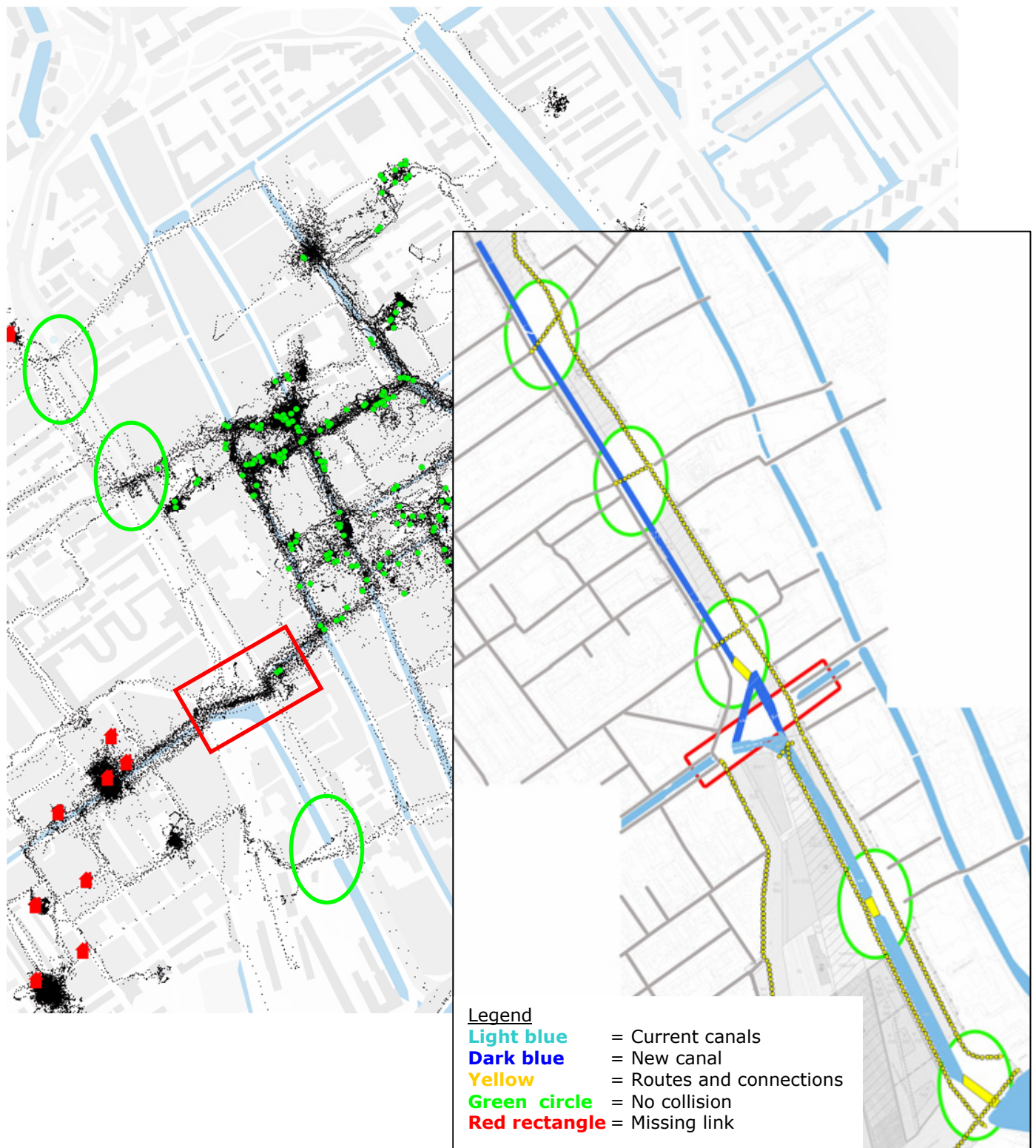
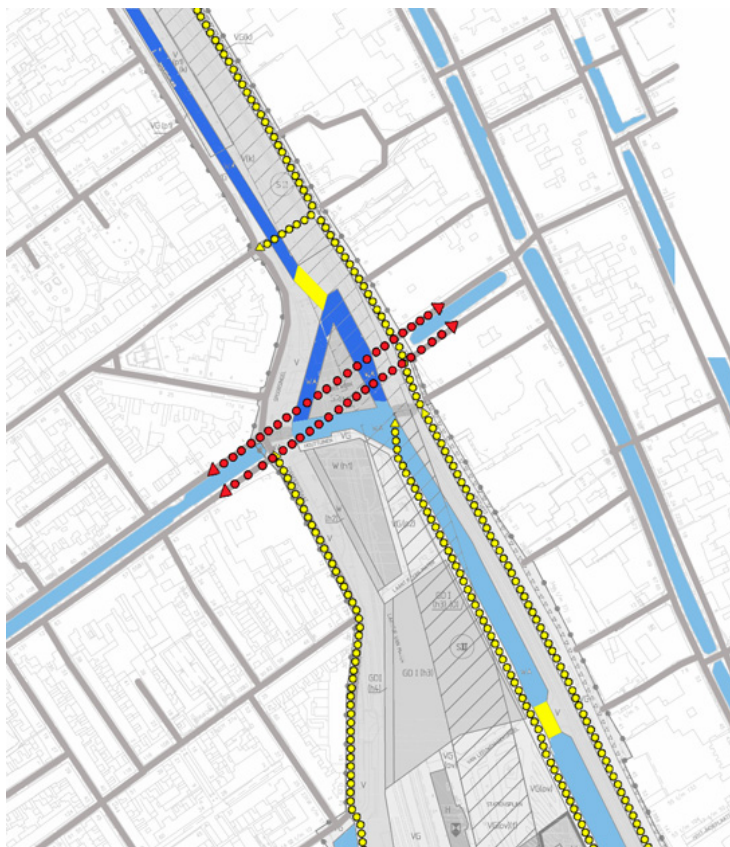


Figure 12.11: City use of neighbourhood inhabitants (left), future connections by Spoorzone Delft (right)

Green circles represent no collision between pedestrian's city use and new connections. However, the red rectangle represents a conflict between city use and a missing link between neighbourhood and city centre. The streets Buitenwatersloot and Binnenwatersloot are now used frequently and are well connected, yet the land use plan disrupts this connection. The author proposes a slow network bridge that guides pedestrians directly into the city centre, as *figure 12.12* shows, in order to avoid an illogical route and complicated detours.



Legend

Light blue	= Current canals
Dark blue	= New canal
Yellow	= Routes and connections
Red	= Proposed link

Figure 12.12: New land use plan with connectivity proposal slow network

The ambitious, long term interventions are as following:

1. Barbarasteeg / Breestraat / Gasthuisplaats / Army Museum

Due to the fact that the Central Station area is changing, we already noticed a new bike route from the station towards the University domain. As *figure 12.12* clearly demonstrates, bikes are given an alternative way to continue their trip. This means that the Barbarasteeg which is currently too small to deal with the huge amount of cyclists and pedestrians can become a pedestrian zone with no bikes allowed. It now measures 34 centimetres for pedestrians and 2 meters for (two way) cyclists at its narrowest part. A walking person needs about 60 centimetres of space. However, if two pedestrians (for instance one with luggage and one with a baby buggy) are passing each other a width of say 2 meters paved surface is necessary as sidewalks (De Jong, 2008, p. 263). So, turning this important entrance of the city centre into a secure passage would prevent a lot of annoying and dangerous situations.



Figure 12.13: What does it look like on the street? Before & after a spatial intervention: Barbarasteeg

Subsequently, if it turns out that even with the measure of being a pedestrian area there still is not enough room to walk normally, there always is the possibility to remove the wall on the right side. *Figure 12.13* gives an example what the alley could look like with more light and space to move around.

The Barbarasteeg will remain the most important entrance street to the city centre when one arrives at the Central Station. The Breestraat follows the Barbarasteeg when walking straight forward. Although many pedestrians use this street, almost no one stops here. As the author carefully observed this street the past months it became clear that there is simply too much car traffic driving around. A lot of unwary pedestrians regularly have to jump for their life in order to prevent getting hit by a bike or car. The author would recommend making both the Barbarasteeg as the Breestraat pedestrian zones. Cars can drive at the Oude Delft; they do not have to be in the Breestraat. Then, Delft could really give visitors a safe and cosy welcome.

When walking over the Breestraat the high and dirty walls of the parking lots of the Gasthuisplaats can be seen. Also when you leave the Breestraat you are confronted with a messy backstreet area. This location will be transformed into a very attractive public space with good spatial quality and an interesting program that is not situated in the city centre yet. The second point "Paardenmarkt" will explain this further.



Figure 12.14: Redevelopment of the Army Museum: cannons as play yard or good acoustics for music?

Due to the fact that the Army Museum will close in 2012 and leave Delft in 2013 a new program must be found in order to put this extraordinary landmark back on the map. Not many participants visited the Museum so it is time for a change. By the way, cannons can also be used as a chair as sometimes can be seen. Another option is using the space as rehearsal space for choirs. Both examples can be found in *figure 12.14*. Other options for the building are, for example: (student) dwellings, concert rooms, party centre, indoor skate park, housing a theatre group, a prison, cultural centre, another museum, (temporarily) ateliers, child care, a shelter or a business centre.

It would be best if the program would fit in to the atmosphere of the Barbarasteeg and Breestraat in order for the area to become one integral concept. So, a combination of artists, freshly starting up one man companies, creative industry and adding a little leisure (drinking and dining) would be a great concept. There could be exposition spaces and meetings rooms for rent. Or silent spaces for reading or playing music. Thus, a multifunctional flexible building that could be used 24/7. Make room for young talent. During daytime people work and in the evening exhibitions can be shown. Examples can be found in Rotterdam: the Schieblock (CS), the old meat hall (Van Helmontstraat, Marconiplein) and the Schiecentrale (Lloydstraat).

2. Paardenmarkt / Gasthuisplaats / Ypenstraat

As described in the first paragraph the biggest transformations will occur at the Paardenmarkt, Gasthuisplaats and Ypenstraat. These areas are now characterised by a lot of parking spots. The Gasthuisplaats sees a lot of pedestrians passing by due to the fact that it is situated within 400 meters of the Zuidpoort garage and it is surrounded with spatial and programmatic

attractive streets. By the way, both the Gasthuisplaats and the Ypenstraat are located within 400 meters of the Zuidpoort garage so these parking spots are superfluous. Currently, for visitors, the Paardenmarkt is situated too far from the city centre to walk towards to. To use the historic and spatial qualities of that location a new underground parking garage is constructed at the crossing Geerweg and Geerboogerd. Some houses have to be demolished but they have no cultural meaning since they were newly built around the 1970s / 1980s.

Constructing a garage at that point means that pedestrians immediately know where they are when they are above the ground: the tower from the Nieuwe Kerk can be seen. If you start walking towards it and you take the first street to your left you already see the Paardenmarkt. Due to this short distance and well-designed route this place could be really successful.



Figure 12.15: Example of a (con)temporarily urban farm in Delft

The Paardenmarkt, Gasthuisplaats and Ypenstraat will be transformed into an urban farm and locations where vegetables and fruit are home grown. *Figures 12.1, 12.2 and 12.15* demonstrate what these functions can look like. The Paardenmarkt is a big location so if there is still room other functions like a gym, culture school or a youth club can be situated here. The theme is “children” and “learning by doing”. Activities are focused on children since they have yet to learn everything in life. Especially city children do not always know how to deal with large animals and how to take care of them. And why humans need them in the first place. They can learn this, first with mom and dad and later on young adults can participate as volunteers passing on their knowledge to youngsters. Of course products from animals as well as vegetables and fruits are sold and in this way children learn about the value of money and how to handle that.

3 . Doelentuin / Voorstraat / Nieuwe Langendijk

None of the participating pedestrians visited the Doelentuin as destination. During the city evaluation it turned out that this park actually contains good spatial quality. Green contributes to neighbourhood and city orientation and improves safety, sporting activities and meeting opportunities (Linger et al., 2010). So, it would be a shame not to use this beautiful facility. After the Paardenmarkt garage is constructed, the Doelentuin can be promoted to pedestrians because it is within walking distance now. First, the high walls have to go in order to increase visibility. Also a small suitable program can be added, this could be free jazz concerts on lazy Sunday afternoons, for example, see *figure 12.16*.

Streets who are not much visited are the Voorstraat and Nieuwe Langendijk, yet they do have good spatial quality and contain a modest program. The Voorstraat will profit from the Paardenmarkt garage; if people go for a walk around the block it is most likely that they will use the Voorstraat or when they walk towards the Oude Kerk this is the best legible route.

Due to the recently opened Koepoort garage at the boundary of the eastern part of the city centre, pedestrians now have the chance to go shopping on the Nieuwe Langendijk because it

is nearby. With a parking garage this close, most parking lots can be removed from the streets. Especially the places in the middle under the trees, as *figure 12.17 shows*.



Figure 12.16: Lazy Sunday afternoon jazz



Figure 12.17: Nieuwe Langendijk with cars

Because the cars are disappearing from the street, the Nieuwe Langendijk can be transformed back into a canal. The historical ambience of the street is thus restored and visitors and residents like to stay here to enjoy the stunning new canal by relaxing on one of the many terraces. Due to the low shores one can enjoy the waterline. There are also opportunities for movement and migration over water. Since a lot of features come together, the social space is always in full use. During daytime by tourists and at night by residents. In the winter you can come on over with the whole family and go skating on natural ice.

12.2.3 Dog

The **brown areas** in *figure 12.5* do not need to be addressed with large investments and interventions: The monofunctional residential areas or “**dogs**” in the north, east and south are fine the way they are. They do not need to attract visitors because it has no purpose. Wandering and strolling pedestrians can enjoy the surroundings (canals, greenery) because most of the areas contain good spatial quality. Residents want to live here quietly. Moreover, there are also a number of alleys where huge pedestrian flows are not wishful. These alleys form, for example, short cuts for local residents who just want to travel from A to B fast.

13 Follow-up research

This study looked at two data sets with three different groups. Given the limited period of time (one year) and the fact that only one person has worked on the huge amount of available data, there are still many questions to be answered. This chapter provides a summary of subjects which can be used for future studies by other researchers. These new studies can be related to the following themes:

1. Target group. For this research summarized visualizations of three different target groups are made. However, examination of available literature revealed that there is more than enough information per target group to zoom in on one specific target group and conduct a detailed depth research. For example, the first research contains information on both first-time visitors and frequent visitors. Now only the spatial differences are mapped, but, as is described in the next section, there is the possibility to zoom in on the detailed data of one group. Besides, it is also possible to examine differences in pedestrian behaviour looking at foreign tourists and Dutch tourists. This can be visualized.
2. Time - space activities and walking patterns. This research project looked at how long pedestrians reside in the city. The time-data is not linked to (types of) activities. In addition, the following questions which have already been mentioned in the research questions, are not yet answered:
 - How much time do first time visitors spend in the city centre?
 - How much time do familiar visitors spend in the city centre?
 - Do pedestrians reside in the public space or do they only use the street(s) for transportation? (Staying gives an indication for good quality of a place)
 - Which routes do people take in order to reach their destinations? *see figure 13.1
 - Do pedestrians use the same streets for departure and returning? *see figure 13.1Different patterns are called simultaneous, sequential or hierarchical choice (Bovy and Stern, 1990, pp. 18, 19)
 - Why do people use these, and not other, routes?
 - What is the influence of market days; Do different groups of pedestrians visit these locations (visitors/tourists) or are they trying to avoid them and therefore take detours (inhabitants)?

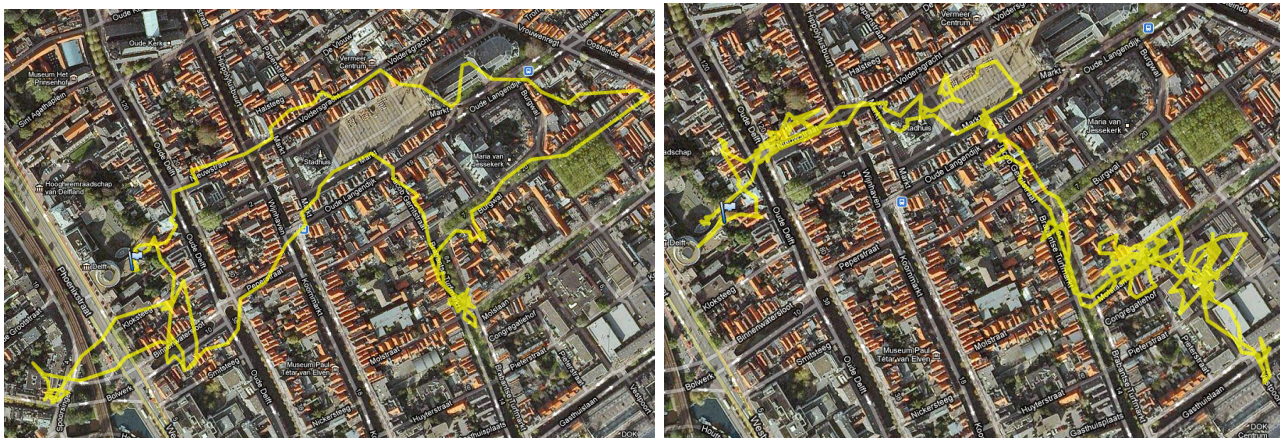


Figure 13.1: Example of a route shape "circle"... ... and "line" (different vs. same street use)

3. Mobility. For the graduation project only the pedestrian flows are analyzed. However, the data from the second study also gives information of journeys by bicycle (figure 13.2), train and car (figure 13.3). It should be researched how these mobility flows use the city of Delft (and beyond). What is the relationship of the town and its neighbourhoods? Where do people go for shopping, school, et cetera? For which facilities and activities (destinations) do people leave Delft and turn to other cities? And why?



Figure 13.2: A participant who did all trips by bike Figure 13.3: A participant who did all trips by car

4. Scale. This research project has only focused on movements and destinations in the city of Delft. However, the second study also includes movements on a much larger scale. It can be investigated what the relationship is with:
 - the inner city of Delft and its neighbourhoods. It has been observed that people from postcode areas 2612 and 2628 sometimes completely avoid the city and do everything in their own neighbourhood and beyond it. The same is true for a part of postcode area 2613 (figure 13.3). What are people, especially those who live further away from the centre, do and do not undertake in their district and in the city? What does the city centre mean for these neighbourhood residents?
 - the city of Delft and the Province of South-Holland. What kind of relationship does Delft have with surrounding cities such as The Hague, Rotterdam, Rijswijk, et cetera? Where do people live and where do they work? From the inhabitants of the second investigation, 49% holds a university degree and 32% a bachelor degree. Of all participated residents, 54% works outside Delft, 7% in the centre of Delft and 28% somewhere else in Delft.
 - the city of Delft and the Randstad (Rotterdam, Amsterdam, Utrecht), for example visits to Amsterdam on Queensday.
 - the city of Delft and the rest of the Netherlands (national level) as a bike trip to Coevorden and a train trip to Leeuwarden.
 - the city of Delft and abroad (international). For example, car trips to Belgium can be seen. Delft residents are not city-bound but move in a large geographical area.
5. Strategies at national level. The same study should be performed in other Dutch cities, such as Amersfoort and Hilversum, to see if similar types of strategies emerge, looking at behaviour and assignments arising from there. Dutch cities have a similar history and culture, so they have the same spatial patterns. Compared with other countries, the Netherlands was always about 50 years behind so a different pattern of urban development emerged which cannot be compared with, for example Belgium or Germany.
6. Designing. This research project has finished formulating strategic interventions at multiple levels (city center - street). Design tasks are defined, but these are not elaborated. The proposals can therefore be given to an urban designer, who can work out several locations visually.

7. This project used minimal information of demographic data, looking at the possibilities of SPSS. Demographic information can be linked to weather and events in the city for example. Frequency tables and cross tabulations provided more insight in the behaviour of people as can be seen in *figure 13.4* and *figure 13.5*.

		06 GENDER		Total
		Male	Female	
DAY	Wednesday	6	12	18
	Thursday	17	29	46
	Friday	13	21	34
	Saturday	9	7	16
Total		45	69	114

Figure 13.4: Example of a cross tabulation: day and gender

		TIME_DURATION					Total
		< 30 minutes	30 minutes - 1 hour	1 - 2 hour	2 - 4 hour	4 > hour	
DAY	Wednesday	3	2	7	6	0	18
	Thursday	5	12	15	11	3	46
	Friday	2	7	11	12	2	34
	Saturday	1	4	7	4	0	16
Total		11	25	40	33	5	114

Figure 13.5: Example of a cross tabulation: day and trip duration

8. Perception analysis. The perception of city centre visitors (first research) is elaborated on a map. However, for the second research a look is only taken at the Excel file with the verbal comments about the perception by the city centre and neighbourhood inhabitants. But there is more. There are about 164 hand coloured maps to be evaluated which makes this research part more accurate, detailed and complete.
9. As Millonig and Gardner (2009) show, different tracking-clusters can be made from the data. People can be subdivided in man, woman, age, walking speed, number of stops, average duration of stops, visited destinations, et cetera, as *figure 4.6* shows.



PART III: REFERENCES AND APPENDICES

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Appendices

A Literature review: City centre scale (strategies)

According to Gehl there are "three requirements of public spaces" (1971, p. 51):

- Desirable conditions for the necessary outdoor activities
- Desirable conditions for the optional, recreational activities
- Desirable conditions for the social activities

Moreover, one has to make the right choices when designing a city or neighbourhood (Gehl, 1971):

- Assemble instead of disperse
- Integrate instead of segregate
- Invite instead of repel
- Open up instead of close in

It is argued that it is not the 'encounter' function that forms the most important role of public space. Only when information is actually *exchanged* one can speak of urban quality. Public space is then upgraded to public *domain*; there were places represent multiple and incompatible meanings on a certain moment. The public domain operates best when there is a well thought cultural program as well as urban concepts which cause spontaneous developments. Those can be provocative and there should be friction. So, urbanism should accomplish a spatial, social and cultural overlap and interference at the same time (Hajer and Reijndorp, 2001).

Previous experience shows that districts which enclose Lynch's nodes (1960) promote meetings between all sorts of people and traffic movements. Therefore, these neighbourhoods function better than districts where people do not need to encounter (Wolthuis, 2008).

According to Hajer and Reijndorp (2001) a striking trend can be described as 'avoidance mobility'; people with different backgrounds increasingly develop effective spatial strategies to only meet the people they like and avoid those they do not wish to encounter. Unpopular areas or *non-places* are shunned; only safe, comfortable and social homogeneous places are visited. No exchange takes place here. Causes can be found in fear of the unknown 'other', insecurity and prejudices. This can be turned by introducing a strict division of different moods or zones were urban places again will be appealing to a wide variety of visitors. "A combination of chic and shabby", say Hajer and Reijndorp (2001, p. 113).

One should especially pay attention to the relation between social safety and design aspects (Van der Voordt and Van Wegen, 1996, p. 108):

- Allotment type
- Location of facilities
- Transport connections
- Scale of the buildings
- Scale of the undeveloped space
- Design of public space
- Indoor / outdoor relationship
- (Housing) type
- Internal layout of (residential) complexes
- Materials and detailing

In order to develop a manageable programme, an analysis of the existing stock should be made (Jeffrey and Pounder, 2000):

- the 'office product' currently being offered:
 - i) available space
 - ii) amount of quality space
 - iii) flexibility / functionality of space
 - iv) age of buildings
 - v) occupancy levels



- urban design and urban environments:
 - i) building design
 - ii) character of conservation area(s) and listed buildings
 - iii) function of the area
 - iv) identification of weaknesses
- transport infrastructure and services
 - i) road network and external access
 - ii) traffic flows
 - iii) public transport capacity
 - iv) parking provision

Previous European research shows that “good practice aspects” with regard to revitalisation of historic city centres are (Drewe, 2000, p. 291):

- High-quality renewal standards specified for the restoration of areas and buildings of historic and cultural significance
- Restoration work to adapt a building to new demands
- Traffic improvements to increase public use and improve business opportunities
- Reintegration of historic centres into mainstream city activity involves the clear definition of functional requirements
- Improved environmental standards to increase confidence in locality
- Tourism and cultural opportunities aimed at the attraction of business

Fresh approach for the role of designers, “three conditions need to be satisfied” (Tan, 2008-b, pp. 119, 120):

- Designing is a social intervention as well; create diversity in the programme so that there is room for different ideas and lifestyles.
- Identity is embedded in a place; use this to strengthen local current qualities. The natural landscape, for example, shaped the form of the city (also Bosselmann, 2008).

Stimulate bottom-up processes; start and support local initiatives. They can have major effects on neighbourhoods and city scale.

B Literature review: Neighbourhood and city scale (discussing Jacob's ideas)

To achieve abundant diversity in neighbourhoods and streets of a city "four conditions" are indispensable according to Jacobs (1961, p. 204):

- Mixtures of primary functions (also Whyte, 1988; Edgar and Taylor, 2000; Hajer and Reijndorp, 2001; Wolthuis, 2008; de Bois, 2010)
- Most of the residential blocks need to be short; there must be many streets and possibilities to turn corners (also Whyte, 1988).
- Mixtures of buildings which vary in age and state; a large percentage of old buildings (looking at economic efficiency)
- High densities and concentration of people (also Whyte, 1988; Edgar and Taylor, 2000)

With regard to Jacob's old buildings "there is a need for an integrated approach to conservation which is not simply limited to safeguarding the architectural and historic fabric, but also ensures the integrated revitalisation of historic city centres or areas. Such a strategy should include opportunities for new economic and social development" states Drewe (2000, p. 283). Four strategies can be identified:

- Revitalisation of run-down historic centres
- Historic centre improvement
- Revitalisation of old industrial and commercial areas of historic interest
- Conservation in small and medium towns

Franke and Hospers (2009) argue that it is not desirable for every (city) inhabitant to live in a densely populated and diverse area. The fact that these settings often are accompanied by nuisance and insecurity as a result of social and cultural differences is a disadvantage that Jacobs does not mention at all. Another finding is that public life in districts, although not containing 24-hour diversity, can be active and lively as well. Furthermore, the demands are not feasible everywhere.

The desired diversity can not be planned anyway (Lengkeek, 2009). Jacob's idea was to give freedom to individuals in order to let them shape their own city. Urban designers should not plan *everything* in advance (Beunderman and Urhahn, 2009).

Effective spatial planning for urban area should pursue the following objectives (Jacobs, 1961, p. 177):

- Cultivating busy and interesting streets.
- Make this system a maximum continuous street network that completely crosses a district with potential suburban size and power.
- The use of parks, squares and public buildings as part of the street system in order to intensify and interweave complexity and multiple use of the system.
- Confirming the identity of the functional areas that are large enough to function as a district (also Lynch, 1960).

Successful streets have three main characteristics (Jacobs, 1961, p. 58):

- A clear demarcation between public and private space. They may not merge as is the case in housing projects and suburbs. It must be said that Jacobs is the only author I found in literature who does not want 'soft edges' (see *Appendix A.2, chapter 5.1 in the review paper*) in, say, commercial zones.
- Eyes (of the natural owners) on the street for safety (also Alexander et al: "A street without windows is blind and frightening", 1977, p. 770; Whyte, 1988). Van der Voordt and Van Wegen (1996) and Blokland (2009) add that it is actually the social *conditions* which determine whether there will be supervision or not. People have to want to guard their fellow man.
- A fairly constant use of the pavement to increase the number of effective eyes on the street.

C Literature review paper (AR3U022): Street scale

On the next page the literature review paper from *Theory of Urbanism* (AR3U022) is attached.



35 centimetres of literature study is a lot of pages...



Urban walking conditions

Formulating criteria to make streets in city centres more attractive for pedestrians.

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Abstract – The mornings are used to buy groceries, take the kids to school or go to work. In the afternoon there is time for lunch and when the weather is nice, people go outside for a walk or to sit down and take pleasure in the surroundings. The evenings create time to put the garbage outside, talk to the neighbours or people go for a walk around the block. Everyone starts and ends his journey on foot. If streets function well, city life will flourish. Cities need to develop successful and long-term goals with related dense programmes. In this way they prevent that pedestrian movements (and investments!) are pulled away from the city centres. Cities should strengthen street vitality and quality of their current centres. As Gehl said: “A good city is like a good party: people stay longer than they planned to because they are enjoying themselves” (Bliss, 2010).

The aim of this paper is to inventory and analyze, from different perspectives, what makes streets in cities most suitable for pedestrians. The paper provides a literature review varying from the starting points of social behaviour analysts (Gehl, 1971; Gehl and Gemzøe, 2000; Gehl et al., 2006-a; Gehl et al., 2006-b), an architectural point of view (Alexander, 1977; Harteveld and Scott Brown, 2007; Beunderman and Urhahn, 2009), city activists (Jacobs, 1961; Edgar and Taylor, 2000), people-watching urbanists (Whyte, 1988; Bosselmann, 2008) and psychologists (Gifford, 1987; Van der Voordt and Van Wegen, 1996).

The outcome of this paper contains primary theoretical elements which will form the base criteria of the checklist-tool for GPS-tracking projects. The author's graduation project deploys GPS-tracking as a tool to analyse where people go. Certain areas and streets are used heavily while others are ignored. The checklist will provide answers as to why this happens which provides insight to the cause of pedestrian behaviour. Consequently, street life can be improved by making strategic design interventions.

Key words – characteristics of human beings, pedestrians; physical requirements; urban street design criteria; street vitality and quality; urban physics; ground floor facades; environmental psychology

1 Introduction

Cities are becoming bigger and bigger. In Taipei and Dubai buildings as high as 500 – 800 meters are constructed. The Zócalo square in Mexico City has a size of 240 x 240 meters. The famous Tiananmen Square in Peking measures 880 x 500 meters. The bigger the better – seems to be the slogan. But we, humans, do not live on a height of 500 – 800 meters. And our living rooms have small proportions. We mostly move around at street level. And if we stand in huge public spaces, do we really feel comfortable?

Spatial qualities can be best witnessed and felt on a small scale. Decisions made behind a desk can be best checked by the harsh reality of streets. Is the environment made for pedestrians who can go for a walk and enjoy their senses? Are there things to see, touch, taste or hear? Is there occasion to sit? Or will people get into their car and drive off with a high speed? Urban designers and architects should check

preliminary designs carefully in order to clear out unsuccessful factors which prohibit street vitality and therefore quality. If streets function well, city life will flourish.

The aim of this paper is to survey and analyze theoretical writings on what makes streets in cities most suitable for pedestrians. The outcome of this paper will comprehend primary theoretical elements which will form the basis of the yet-to-be-made checklist-tool for GPS-tracking projects. The writer's graduation project deploys GPS-tracking as a tool to analyse pedestrian behaviour. Also areas and streets which are ignored will appear. The checklist will provide the *why*-answers.

The second chapter describes what human characteristics are. When do human senses function? (Gehl, 1971; Alexander, 1977; Whyte, 1988; Bosselmann, 2008) A continuation is found in the



third chapter that compares human senses with the built environment (Jacobs, 1961; Edgar and Taylor, 2000). Gehl and Gemzoe (2000) point out that there are four different sorts of cities in the next chapter. Chapter five deals with the physical requirements of the environment (Whyte, 1988; Beunderman and Urhahn, 2009). What roles do streets play? (Harteveld and Scott Brown, 2007) Paragraph two shows a couple of street design criteria (Gehl et al., 2006-a; Gehl et al., 2006-b; Bosselmann, 2008). Street measurements are discussed in chapter six (Alexander, 1977; Whyte, 1988). The most important aspects of urban physics are represented in chapter seven (Gehl, 1971; Alexander, 1977; Whyte, 1988; Bosselmann, 2008). Chapter eight deals with ground floor façade qualities (Gehl et al., 2006-b; Bosselmann, 2008). How environmental psychology works is explained in chapter nine; this includes a checklist for social security (Jacobs, 1961; Gifford, 1987; Van der Voordt and Van Wegen, 1996). Chapter ten brings together all statements in the conclusions.

2 Characteristics of human beings

Before we focus on the city and what kind of organism she is, let us go back to the basics. Who are we, humans? What are our characteristics? Persons move with a speed of approximately 5 kilometres per hour. Our sense organs such as eyes, nose and ears are adapted to this speed. In addition, human senses are frontally oriented as can be logically derived from the fact that our eyes are situated on the front of our head and not on the side like reptiles (Gehl, 1971). In big cities people walk faster; an average of 5.6 km/h is noted. In New York City, quick pedestrians move at 6.4 – 8.0 km/h (Whyte, 1988).

When friends or activities are visited a walk radius between 20 – 100 meters is held, although this depends on the kind of activity (Gehl, 1971). The majority of daily movements are quite short. The greatest density of pedestrians can be found within about 100 meters around typical pedestrian destinations, such as schools and stations. Therewith is the neighbourhood radius = 100 – 300 meters design the optimal scale for the urban promotion of pedestrian safety to daily destinations. Protection against cold and wet climates greatly increases the willingness to walk (Bach et al., 2006).

Most people have a walk radius of 400 – 500 meters when they plan trips (Gehl, 1971). In New York City people will walk up to 400 – 750 meters, depending on the block size. In other car-based cities this is more to 450 – 600 meters (Whyte, 1988). Recent research shows that people walk around 400 – 800 meters during their shopping trip. They arrive by car, put it in a garage and continue on foot (Van der Spek, 2008).

A couple of “pedestrian characteristics” can be summarized (Whyte, 1988, p.57):

- A large proportion of pedestrians are people in pairs and threesomes.
- People in groups / women / old people walk slower than people alone / men / young people.
- Pedestrians usually take the shortest route. Sometimes curving pathways can be seen along the outlined paving.

Our vision works best when it is horizontally orientated, covering almost 180 degrees. The vertical vision of humans is limited to the ground floor of buildings, the pavement and what happens on the street itself (Gehl, 1971). Consequently, human interactions mostly occur in the horizontal field unless our attention is drawn to a vertical field such as loud noises or yelling above or beyond. Previous research shows that the maximum distance to see happenings is 70 – 100 meters. Seeing facial expressions is set to the utmost of 20 – 25 meters (Gehl, 1971; Bosselmann, 2008).

We have to activate a lot of muscles in order to experience other places in space. When we look up to a building a maximum of five storeys (height about 15 meters with a sight line of approximately 13.5 meters) can be realised. There can not be any eye contact between the ground floor and the apartments on the sixth floor and higher (Gehl, 1971). Therefore, high-rise buildings and the human senses are not adapted to each other. Alexander (1977, p.115) states that: “There is abundant evidence to show that high buildings make people crazy”. He adds to this: “In any urban area, no matter how dense, keep the majority of buildings four stories high or less. It is possible that certain buildings should exceed this limit but they should never be buildings for human habitation” (1977, p.119).

As for the senses of our nose: “perfume and other strong odours can be smelled at 2-3 meters” (Gehl, 1971, p.64). Less strong fragrances need to be approached within 1 meter in order to be noticed. The greater the distance the stronger a scent needs to be.

In a silent environment people can hear and talk up to a length of 7 meters. We can hear without complications up to 35 meters in a quiet setting (id.). When surroundings contain 45 – 50 decibels of noise, people can hear birds singing. When the limitation of 60 decibels is reached, humans can only have conversations at distances of 5 – 15 centimetres (Gehl, 1971, p.167). Consequently, the amount of noise determines the public space vitality and quality.

3 Human beings and the built environment

Persons walking or running with an average speed of 5 – 15 km/h can observe details in the scenery. If the velocity is increased the amount of comprehensible information diminishes very fast. We need more time to experience what happens around us. Therefore, car based cities differ from pedestrian cities in scale and detail. The first consists of graceless big and simple signs while the second is carefully detailed. Consequently, in areas with narrow streets and much detail people positively describe them as “intimate, warm and personal” (Gehl, 1971, p.69). Large spaces, wide streets and tall buildings, however, are labelled as “cold and impersonal” (id.). Besides, 86% of children aged till 6 years have to hold hands with adults in areas where motorized traffic dominates. However, a percentage of 75% of these children can run around free if there is a pedestrian street (Gehl, 1971, p.173).

Human interactions like talking, eating and reading happen on the smallest scale. Previous research shows that if the right setting provides small scale events and low traffic volumes, the amount of human activity and the quality of the public space will rise at the same time (Jacobs, 1961; Gehl, 1971; Whyte, 1988; Bosselmann, 2008). Not the amount of people is relevant; the amount of minutes that people stay in an outdoor area count. Too much car traffic with high speed automatically destroys initiatives for activity. There is too much noise to talk, too much bad odour, there is nothing to do or to see other than honking cars flying by. There is no need for human life anymore.

On city scale it is important to concentrate all sorts of functions (houses, shops, city services, et cetera) in order to create attractive environments close to people their homes or work (Jacobs, 1961; Gehl, 1971; Whyte, 1988). In this way, they can walk or cycle for daily activities which increase the quality of street life. If different programmes are too far apart, people will step into their car again. Further, governments should invest more in the quality and quantity of public transport in order to compete successfully with the car in time and money. “The most successful places for living and working are those which are compact, bringing together homes and work” (Edgar and Taylor, 2000, p.160).

At the same time the arrangement of the central city should be watched carefully. Openings and entrances of buildings should be situated close to each other so that there is continuity in the urban structure (Gehl, 1971; Alexander, 1977; Whyte, 1988; Bosselmann, 2008). There should not be public spaces with megalomania, inhumanly large sizes. People do not know what to do with it;

activities will be split up instead of being more compact. You can not see what happens on the other side of the street or square if the dimensions are too large. The same happens when gaps occur in connected functions. Sometimes it is difficult to see what comes next or the following destination is too far away so people do not continue their walk (Gehl, 1971; Whyte, 1988).

4 Good public space

What is good public space for pedestrians? What are its conditions? What should it look like? First, city centres can be subdivided in order to analyse how well the environments already functions. Cities can be positioned in “four different types” (Gehl and Gemzøe, 2000, p.14):

- Traditional city; where the traditional functions meeting place, marketplace and traffic continue to coexist in balance.
- Invaded city; single use motorized traffic has absorbed all territory at the expense of other users and functions.
- Abandoned city; public life has disappeared. Characteristic elements are usually: drive and re-park at each destination, skywalks, underground private cities closed outside office hours.
- Re-conquered city; strong efforts are made to find a new balance between the three traditional functions.

If a city belongs to a category other than the first, in the chapters below you will find the reasons why the city is dysfunctional. Moreover, the information provides answers how to make a town healthy again.

5 Physical requirements

5.1 Moving moments

In order to make contact to other human beings or our surroundings there are some requirements in the “physical arrangement” of objects (Gehl, 1971, p.62):

- Promoting contact (visual and auditory): No walls, short distances, low speeds, one level and face-to-face orientation.
- Inhibiting contact (visual and auditory): Walls, long distances, high speeds, multiple levels and back-to-back orientation.

In every street there should be spaces where people can (Gehl, 1971):

- Walk; “A walking network with alternating street spaces and small squares often will have the psychological effect of making the walking distance shorter” (Gehl, 1971, p.141; also Jacobs, 1961; Bosselmann, 2008).



- Stand; “They demonstrate very clearly some important behavioural patterns characteristic of a large number of stationary activities in public spaces. (...) The keyword is *staying*” (Gehl, 1971, p.147).
- Sit; Sitting is the most essential quality function of a lively public space and it requires a safe situation, comfortable climate and space (Gehl, 1971; Alexander, 1977; Gifford, 1987; Whyte, 1988). Important criteria are: orientation, view play and type of seating. Primary seating contains benches and chairs. Secondary seating is stairways, pedestals, walls; basically any object a landscape has to offer. For old and less mobile people seats every 100 meters are necessary to recover from walking (Gehl, 1971).
- Use your senses: see, hear and talk. Public spaces should be designed according to the human senses as described in the second chapter. As previous research shows, there is a direct connection between street vitality and feelings of safety on streets. The more ‘street watching’ eyes there are the more secure people feel (Jacobs, 1961; Gehl, 1971; Alexander, 1977; Bosselmann, 2008).
- Enjoy soft edges; Transition zones between the front door and the sidewalks. Indoor activities can naturally reshuffle outdoors (also Alexander, 1977; Bosselmann, 2008). Their private and public duty functions best when the zones are measured between 3 – 4 meters. Shorter sizes can infringe privacy; larger proportions lose their street connectivity (Gehl, 1971). Beunderman and Urhahn (2009) call them ‘encroachment zones’. For individuals they provide privacy, expression and residential enjoyment while they give vivacity, identity, social cohesion and safety for the city.

Social successful “sensory streets” consist of (Whyte, 1988, p.79):

- Messiness; a mishmash of activities
- Merchandise
- Movement (also Jacobs, 1961; “Something happens because something happens”, Gehl, 1971, p.75; “The sight of action is an incentive for action”, Alexander, 1977, p.774; the “multiplier” effect, Bach et al., 2006, p.239)
- Blinded windows with peepholes *
- Light
- Sound
- Food and eating
- Public drinking fountains

* Nota bene: Blinded windows and closed walls should be replaced by open, interactive structures. When shut, they destroy visual accessibility and promote isolation. Indeed, there is nothing to see or do. Street vitality and quality will decrease. By 1982 the New York City Planning Commission banned blank-wall frontages completely in commercial streets by prescribing retail with accessibility from the streets and transparent windows (Whyte, 1988).

In addition to ‘movement’, streets can play four roles (Harteveld and Scott Brown, 2007, p.67):

- They function as channels for the circulation of people, goods and vehicles.
- City builders; in that they give access to places for settlements.
- Rooms for activities; especially in mild climates and in developing areas where much of life takes place outdoors and on streets.
- Information givers; telling travellers where they are in the city, providing communication between individuals and provide messages, both commercial and common.

5.2 Urban street design criteria

All of the activities as mentioned above should be well organised in order to create an orderly and complete city. This paragraph displays several design criteria for urban planners. They can be seen as a checklist for good urban space. You can start by making a quick analysis of a public space.

The results can be summarized in “four types of city space” (Gehl et al., 2006-a, p.173):

- Good quality, many visitors and lengthy visits.
- Good quality, few visitors and lengthy stays.
- Few qualities, few visitors, few and short-term visits.
- Few qualities, many visitors and no lengthy stays.

Based on observations like safety, comfort and enjoyment city space should include “twelve key criteria” in order to ensure public quality (Gehl et al., 2006-a, p.107):

- Protection against:
 - i) traffic and accidents – feeling safe
 - ii) crime and violence – feelings secure
 - iii) unpleasant sensory experiences
- Comfort; opportunities to:
 - i) walk
 - ii) stand/stay
 - iii) sit
 - iv) see
 - v) talk and listen
 - vi) play and exercise

- Enjoyment;
 - i) scale
 - ii) opportunities to enjoy the positive aspects of climate
 - iii) positive sensory experience

Seen from a designer's perspective these experiences can be translated into factors to create living city streets (Gehl et al., 2006-b, p.45):

- Scale;
 - i) many units, vertical divisions
 - ii) rhythm
 - iii) space scale
- Design transparency
 - i) transparency
 - ii) light in darkness
 - iii) active facades
 - iv) unbroken facades
 - v) façade relief
 - vi) materials and details
- Function;
 - i) exchange
 - ii) function and content
 - iii) edge zones
- External condition;
 - i) climate
 - ii) lighting
 - iii) traffic

Seen from another angle, Bosselmann (2008) formulated different city street design principles:

- Topography of a city (use natural elements for orientation and way finding).
- Streets that connect (interlink minor with major streets).
- Streets as promenades alongside parks.
- Boulevard designs that protect residents from heavy traffic.
- Streets as green connectors (ecology).
- Streets and watersheds (based on topography).
- Streets and climate (waterfronts are cooler than paved centres; natural wind circulation can cool down the city).
- Streets that channel wind (see [chapter 7](#) "Urban physics").
- Streets that should stay sunny (provide sunbeams on the street during lunch hours in cold climates).
- Streets and traffic (accommodate well-balanced streets for all sorts of traffic).
- Streets as centres to be reached on foot (improve good public transport, remove barriers for pedestrians and connect the slow network).

6 Measurements

In some cities streets measure between 20 – 40 meters and squares have a width or length of 40 –

60 meters. Alexander (1977) argues that public squares should measure to the utmost 13.7 x 21.3 meter. If courts become bigger they lose their liveliness. He states that an area is lively when a person has 13.9 m² and it is almost dead when a person uses 46.5 m².

Public spaces which measure larger than 110 meters are rarely experienced as pleasant and are not much used (Gehl, 1971; Bosselmann, 2008).

Active streets will measure 2 - 3 meters. They are especially interesting when there are a lot of doors and small units (Gehl, 1971). Alexander (1977) argues that the most comfortable pedestrian streets are no wider than the height of its built environment.

Good measurements for walkway widths are between 4.5 meters for normal streets and 7.6 meters for major avenues (Whyte, 1988). It is confirmed that pavements should be minimal 5.1 meters and streets with retail should have a width of circa 20.5 meters (Bosselmann, 2008).

Car parks should be situated 100 – 200 meters away from houses (Gehl, 1971). In this way, the human senses can be optimally used and (spontaneous) activities in streets will increase.

As for car parking in centres, it is recommended not to do this on the streets which face door openings. Cars can easily be parked under the ground, in garages or above stores. They never should be placed along walkways (Whyte, 1988; Bosselmann, 2008). The pavement is for pedestrians and retail. Both should be seen from across the street in order to maintain visual connectivity. If the width is big enough retail owners can put products outside and a nice line of trees can be added near the kerb.

Physical "elements of a good street" are (Whyte, 1988, pp.101, 102):

- Buildings flush to the sidewalk.
- (Speciality) stores along the frontage (facades which measure 6.0 – 7.6 meters).
- Doors and windows on the street.
- Second-story activity with windows.
- A good sidewalk (4.5 – 7.6 meters).
- Trees. Big trees.
- Seating (6-10% of the total open space, benches minimal 2.4 meters long, movable chairs, grass) and simple amenities.

7 Urban physics

A special part of the physical surroundings concerns the urban physics. Traditionally built towns consist of low rise buildings up to 5 floors which are positioned against or close to each other. Roads are tight and courtyards are based on human scaled senses. Here, most wind passes over town, the 'hill' effect, creating a warm and comfortable



microclimate in outdoor places. But areas with high-rise buildings, wide open roads and big public spaces catch the wind. The 'downward vortex' is guided straight down to the ground creating cold, windswept environments where no one wants to be (Gehl, 1971; Whyte, 1988; Bosselmann, 2008).

In practice, this leads to the fact that the outdoor season in low rise sceneries lasts two months longer than high-rise environments. In total, people can spend twice as much time outdoor in densely low built areas. Emergency solutions can be found in placing "windbreaks, trees, hedges and covered areas where they are most needed" (Gehl, 1971, p.178).

The arrangement of the public space also depends on the kind of climate which is encountered in an area. In Northern European countries flowers, trees and bushes can be found in public places. Although in Southern European countries almost no natural elements are present; most spaces are covered with stones only. There also is a cultural difference. In the Northern regions people run into the sun if it finally appears and stay in there as long as possible. Meanwhile, in Southern countries people move into the shadow if the sun comes out (Gehl, 1971).

Alexander (1977) adds that buildings should be situated to the north in order to create enjoyable outdoor spaces on the south if one lives in a cold climate. If this is the other way around, people are most likely not to use the spot outside. Moreover, it should be precluded that unnecessary shadows of too high constructions take away the rare sunlight. This is another disadvantage of high-rise buildings. When planning and designing public places one must keep these factors in mind.

8 Ground floor facades

Extra attention must be paid to ground floor facades because they are located in the horizontal view of the human senses. Our focus is in this field. There are different sorts of facades. Shops in historic city centres with small vertical patterns draw a lot of positive attention. We mark this as façade A. Huge buildings with horizontal non-transparent walls are marked as façade E. Previous research shows that façade A makes 75% of the people turn their head. For façade E this is 21%. Façade A makes 25% of the people stop while at façade E this is only 1% (Gehl et al., 2006-b, p.38). Consequently, transparent, interactive facades stimulate public life.

So, "critical positive ground floor façade factors" are characterised by (Gehl et al., 2006-b, pp.35, 36):

- 5 km/h scale (versus 60 km/h scale)
- Open (versus closed) transparency
- Interactive (versus passive) appealing to many senses

- Rich (versus boring) in sensory experience
- Diversity of (versus uniform) functions
- Vertical (horizontal) façade rhythms
- 15 – 20 units and 20 – 25 doorways every 100 meter (with a minimum of 10 doorways per 100 meter)

Research in Madrid concerning "rhythm, irregularity and transparency" show additional numbers (Gehl et al., 2006-b, p.39):

- Doors every 7 – 9 meter.
- Glass surface on about 63% of façade length.
- Niches and openings that extend façade length by 30%.
- Edge zoning (for stopping and activities) between 0.7 and 2.0 meters wide to prevent standing people from obstructing other pedestrians.

If the presence of high-rise towers can not be prevented they should at least pay a lot of attention to the human beings that pass them in order to protect the 'quality of life' on the streets. The ground floor should be used as a 'medium' between people and tower. It should have functions such as stores, markets, restaurants and commercial features with lots of entries and events. There should be a direct connection between the pavement and the building.

However, in big city centres it probably is not likely and/or feasible to design every high-rise construction like this. Here it is important that trade functions are concentrated as much as possible in one or more streets. These streets should be used as strong connectors to guide people from important place A towards B. This could be from a city centre towards a lake or river (Bosselmann, 2008). In this way, multiple local qualities are linked.

9 Environmental psychology

Public spaces provide a need for contact, knowledge and stimulation. To recapitulate, these are mental needs. When a person goes shopping this is not only to buy new things in order to replace the old ones. It is also a matter of staying in contact with other humans. This tickles the human senses (Gehl, 1971).

When humans are observed how they use a public space certain patterns can be recognized. Primary, people prefer to stay along the frontage of buildings or along the edges of natural borders (Jacobs, 1961; Gehl, 1971; Alexander, 1977; Whyte, 1988). Open spaces on squares or natural areas will not be used as long as there is some place on the boundaries. "If the edge fails, then the space never becomes lively" (Alexander, 1977, p.600). This has everything to do with analysing, controlling and guarding the surroundings while your back is protected by the periphery. Moreover, there should be something

happening in the centre of a public space. A fountain, tree or statue gives people reason to walk to the middle of an area (Alexander, 1977). Otherwise, there is almost always more activity on the edge than in the middle of a place.

In addition, Gifford (1987) states that the organisation of certain places encourage or discourage social interaction. This depends on the placing of elements such as seats in a *sociopetal* or a *sociofugal* setting. The first consists of putting seats in a circle for interactive face to face contact. The second would turn the same seats with the backs towards each other; making contact requires some effort now (Gifford, 1987; Bosselmann, 2008).

Based on the variables of surroundings and personalities a person reacts either positive or negative on the area. "Emotion can be viewed as a mediator between the environment and personality (as pre-existing influences) and behaviour (as the outcome)" (Gifford, 1987, p.85). Sceneries should be experienced as attractive; this is summarized in a *circumplex*;

- Arousing + pleasant = exciting
- Arousing + unpleasant = frightening
- Not arousing + pleasant = peaceful
- Not arousing + unpleasant = boring

Consequently, the more pleasant, the more desire a person has to approach a setting (Gifford, 1987). Jacobs (1961) illustrates this literally by adding curved streets in the tight American grids so that visual breaks in the long views occur. Suddenly, it is unknown and therefore exciting to find out what is going on after the bow. Bosselmann (2008) compares a four minute walk in Copenhagen with a four minute walk in Washington DC as can be seen on illustration 1. Immediately, it is clear that oversized city scales encourage a boring environment where every distance feels far away. In addition, functions are located far apart so you *do* have to walk for miles to get anywhere.

Good public space depends on how safe a person feels in an environment. Dutch researchers developed a "social security design checklist" for assessing crime vulnerability of neighbourhoods (Gifford, 1987, p.302; Van der Voordt and Van Wegen, 1996, pp.116,117):

- Potential visibility of public areas (also Jacobs, 1961).
- Actual presence of residents "social eyes" (also Jacobs, 1961).
- Social involvement / responsibility.
- Access and escape routes.
- Attractiveness of i) the area ii) a potential target.
- (Physical) vulnerability of a potential target and/or materials.

Psychological guidelines can be applied in order to bring neighbourhoods to life (Gifford, 1987, p.315):

- Keep the street front alive.
- Give residents things to do and places to be.
- Reduce the speed and number of cars (also Jacobs, 1961).
- Residences should open to the street, not from some central courtyard.
- Make parks more attractive to adults.
- Distinguish between home-based recreation and park activities.



Illustration 1 Copenhagen (above) and Washington DC (below) mapped at the same scale. The red line represents the length of two four-minute walks (Bosselmann, 2008, p.105).

10 Conclusions

Everyone starts and ends his journey on foot. Having studied all the literature it can be concluded that streets in cities operate best when they are designed with a human scale. Small, intimate surveyable spaces are experienced as being most

pleasant for pedestrians. Scale and size can better be too small than too big. Compactness and good connections between various functions are key words. Well designed edges, sufficient walking and seating opportunities are also requirements for frequent and qualitative use of a space.

If you walk down a street, the main focus is given to what is happening on the ground floor; contact and interactions take place here. For a fully functioning street, facades should consist primarily of transparent glass with many doorways.

Subsequently, adequate attention should be given to the outdoor environment of an area. Buildings should not be too high, situated close together and focused on the north in order to shape exterior spaces on the warmer south. This creates a pleasant microclimate where one can enjoy good quality.

The right approaches from psychology are indispensable as well. If there is plenty to see and do on the small scale, people's presence and activities will attract other people and create an exciting and attractive environment. Empty areas encourage crime.

A bright assortment of design criteria can be used to generate public places, and streets in particular, which are very attractive for pedestrians. The studied authors do not hold vastly different views; their criteria vary because they are approached from other disciplines. In summary, they complement each other very well.

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D Why is walking important and less car use preferred?

Why should we walk and let the car at home more often? Moreover, walking is synonymous for walking, cycling, skating, running, hopping, rowing and everything else you can line among the slow traffic network.

D.1 Health

In some environments distances are so great that walking or cycling no longer is possible. The result is that people get into their car and generate health problems because their body does not move anymore. As a consequence, the amount of overweight or obese people with a bad physical condition increases dramatically (Gifford, 1987; Gehl and Gemzøe, 2000; Bosselmann, 2008).

TNO reports that in recent decades the number of people with (severe) obesity has grown rapidly. It involves both adults and children. About half of the adults are overweight, 11% serious (obese). A TNO study from 2002-2004 shows that 14.5% of boys and 17.5% of girls in the Netherlands is too fat. Approximately 3% has obesity. In Moroccan and Turkish communities the percentage of overweight children are even comparable to that among adults. The increase in obesity is a consequence of a social lifestyle change: we eat unhealthy and exercise less. The impact of obesity on health is significant. Also, overweight has social and emotional consequences. So, there is every reason to avoid development of overweight (Lörtzer, 2010).

Especially socio-economic disadvantaged children form a higher risk. However, recent PhD research shows that a half hour of walking or cycling four times a week is enough to take away important risks of overweight among young people. Even though they do not lose weight on the training, the risk of diabetes already significantly appears to reduce. The relatively light training is easy to maintain for young people with obesity. Another research showed that effects of weight training were not that effective (Rijksuniversiteit Groningen, 2010).

Automobile drivers research shows that 12% of the men and 18% of the women would happily kill other chauffeurs every once in a while. It might be no surprise that drivers suffer from chest pain and other stress symptoms. The further a person drives the higher his blood pressure will be (Gifford, 1987, p. 375).

D.2 Congestion, safety and parking problems

Being a fast growing city, Shanghai is now constructing new roads with a width of 4.5 meters (highways in the Netherlands are 3.5 meters) which make vehicles drive faster and faster. As a result, roads have become too dangerous for cyclists. For them a special network was designed that is situated right-angled on the fast driveways. Consequently, a great deal of the city is assimilated by traffic flows. Rapidly growing congestions are reported and they will only get worse by a growing amount of cars (Alexander et al., 1977; Bosselmann, 2008).

People think that a lot of problems will turn up if heavily used roads would be shut down. One would expect more traffic jams in other streets. Research in the 1970s, in Groningen, the Netherlands mapped where cars were parked using dots and small lines. This was done before and after the inner-city was made car-free. The number of cars did not change; their location did (Bach et al., 2006).

Other research shows that if there is less room for vehicles, there will be fewer vehicles. "As space for it diminishes, so does the traffic" (Whyte, 1988, p. 75; also Jacobs, 1961). Lastly, more and more people own a car. However, there is limited space in city centres so parking problems are an often heard complaint. Alexander et al. (1977) add 'eyesore' to this. Streets completely filled up with cars look awful; there is no visual quality.



D.3 Air pollution and noise: problem analysis

Cars are mostly used on short distances but it is then that they produce the most pollution because the engine is still cold. For local trips it is much better to use another way of transportation. The car is best used for long journeys (Alexander, 1977).

Statistics show that half of the routes in Malmö are less than five kilometres long. By bike it takes less than a quarter and yet people have a preference for the car. The most extreme example could be found with a man who drove 200 meters between his house and work. In addition, he drove tens of meters for lunch (Fiets.123, 2008). I discussed this point with my brother (a student who owns two cars) one day. He told me that once you own a car, you will use it. It is like a pleasant addiction that is always there for you. My father shows the same symptoms.

PhD research confirms this. Striking is the fact that car traffic in general is considered 'a (social) problem', while the own car use is regarded 'barely a problem' for society. This shows that there indeed is a major social dilemma. Car owners rarely travel by public transport, once one owns a car, they use it when and where it is possible. The results of this study show that the problems of the car use are difficult to manage. Many respondents are not willing or do not see opportunities to reduce their own car use. And none of the assessed think that so far introduced policies will have much effect. Given the great advantages of using the car that far outweighs the collective disadvantages it is unlikely that people will voluntarily reduce their own car use (Steg, 1996, pp. 178, 179).

Air pollution is one of the major health problems in the Netherlands. Probably 18,000 people die each year about ten years earlier by the present concentrations of air-borne solid particles in the Netherlands. Children in polluted areas are more likely to suffer from respiratory allergies and develop weak lungs faster. Emissions of particulate matter (PM) and nitrogen dioxide (NO₂) causes the most health damage from air pollution. In October 2004 the environmental satellite *Envisat* published images; see figure D.1.1 Over a period of 18 months the satellite measured nitrogen dioxide (NO₂) in the air above the earth. The images showed that in Europe most of NO₂ can be found above the Netherlands, Flanders, the Po-Plain and the Ruhr-area. Due to the emission of smaller particles (PM_{2.5}) the average Dutch person lives at least one year shorter now (Milieu Defensie, 2010).

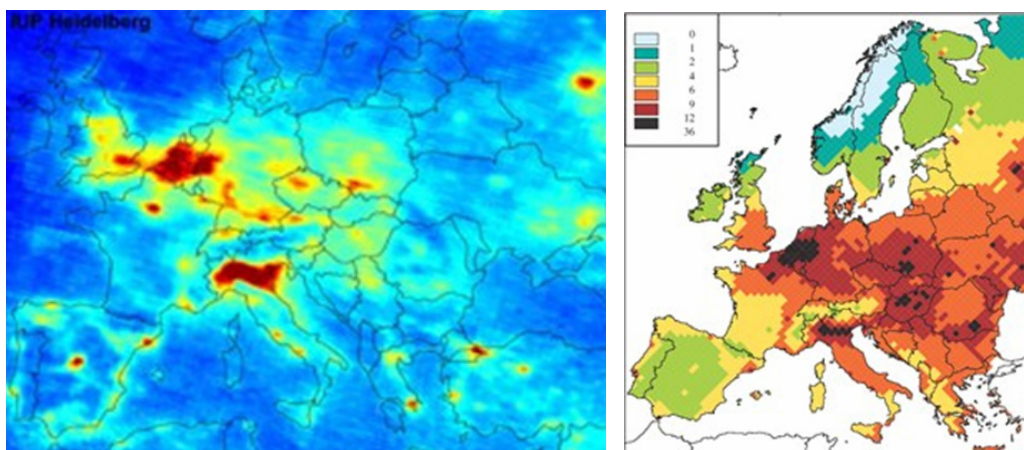


Figure D.1.1: Concentrations of nitrogen dioxide and emissions of particulate matter (Milieu Defensie, 2010)

The *Vrije Universiteit Amsterdam* and *CE Research* calculated which traffic is most polluting in 2004. Cars contribute the major part with an amount of 30%, trucks 23% and vans 22%. Motorcycles and mopeds produce 9% to the pollution and busses 5%. The dirtiest air can be found in the Randstad and North Brabant. Air pollution is the highest in the Rijnmond area. Within the European Union, it is the Netherlands that has the most (freight) traffic per square kilometre. The number of diesel kilometres in the Netherlands grew by 50% over the past decade (Milieu Defensie, 2010).

Apart from air pollution our country scores badly on noise. Hundreds of thousands of people are seriously affected by road noise. Road traffic also contributes greatly to climate change, approximately 16% of greenhouse gas emissions in the Netherlands. Contrary to popular belief, cars are not economical. An average diesel car still runs 1:16 and a gasoline car 1:13 (Milieu Defensie, 2010). Consequently, there is a demand for healthier environments and quality of life.

D.4 Possible solutions

Solutions can be found in expanding and improving public transport, both quantitative and qualitative. In Belgium this has even led to the fact that public transport is free of charge for an increasing amount of people (seniors, disabled, officials). Paris narrows wide city streets to reduce automobile traffic in order to give cyclists more room to manoeuvre. In London, Stockholm and several German cities there is a toll when you drive your car in the centre. The charging system aims at counteracting environmental damage from CO₂ emissions. In London this led to a bisected number of traffic jams and the harmful emissions fell by 12% (Milieu Defensie, 2010).

Furthermore, walking plays several important roles in “healthy, sustainable, lively and safe cities” as Gehl et al. state (2006-a, pp. 15-17):

- Transport; it is free, quiet, does not take much room, no heavy demands on infrastructure.
- Work; a lot of people work in public spaces. They have a right for quality.
- Sustainability; a combination of public transport, cycling and walking instead of vehicles.
- Health; integrating walking or cycling in everyday activities improves your physical condition without thinking (about or paying for) it.
- Recreation; people checking out other people and their business.
- Social interaction; modern techniques reduce personal contact. Encounters and events provide face to face reciprocity.
- Information and inspiration; seeing thing with your own eyes is still important.
- Democracy and diversity; face to face contact with people that have different backgrounds, stimulates a democratic, diverse and secure society.
- Friendliness and a feeling of security; an absence of people is often the cause of real or imagined insecurity.
- Room for the unexpected; as soon as you close the front door behind you an excited street life is entered where funny surprises will make you smile.

Last but not least, every person leaves his house per foot and arrives at his destination... also on foot. So, everybody becomes a pedestrian sooner or later (Bosselmann, 2008). The funny thing here is that for the past 2,000 years actually nothing has changed. Humans have always been walking and they still do, in almost the same way as ever before (Gehl, 1971; Whyte, 1988; Bosselmann, 2008). It does not look like this is going to change any time soon. We might as well create high quality walking environments then!

To summarize all the arguments above John Butcher, Founder of Walk21, said it best: “Walking is the first thing an infant wants to do and the last thing an old person wants to give up. Walking is the exercise that does not need a gym. It is the prescription without medicine, the weight control without diet and the cosmetic that can’t be found in a chemist. It is the tranquilliser without a pill, the therapy without a psychoanalyst and the holiday that does not cost a penny. What’s more, it does not pollute, consumes few natural resources and is highly efficient. Walking is convenient, it needs no special equipment, is self-regulating and inherently safe. Walking is as natural as breathing” (Walk21, 2006).



A4 flyer promotion: Interested people were given a flyer

GPS Research in Delft

From November 18th until November 21st a GPS tracking research by TU Delft department of Urbanism is taking place among the shopping people in the city centre of Delft. By tracking people we can analyze pedestrian movement in the city centre. Eventually this will lead to a better understanding of the potential problematic areas in the centre.

Way of working

When you agree to participate, we will ask you to sign an intake form. This form is only used in case you do not return the device (see Lost property). No private information will be kept after you have participated. After registration you will be handed a GPS device, please make sure the GPS device is blinking when you leave the garage. The device can be stored in a jacket or a bag. Please make sure you **don't lose it!** When returning, you have to fill in a short questionnaire. The answers will provide us more insight into walking behaviour.

Lost property

The GPS devices we are using are specially modified for this project and have no other use. In the unfortunate case of loss or robbery, please contact us. All missing devices will be reported to the police.

GPS Device

Please make sure that the switch of the GPS device is switched to log. If this is the case, the light above the red button is blinking when you leave the garage.

Information

The research teams will leave at 18:00, please make sure you will be back before 18:30. In the unfortunate case you are not in time back please contact us:

You contact person:
Name
Cellphone number

No private information will be kept. The intake form will be handed back to you when you return the device.

(c) 2009 TU Delft



Discovering Delft by foot

Tracking Delft is a research project by TU Delft department of Urbanism, focusing on pedestrian movement in the city centre of Delft. By observing movement with a GPS device we are able to find potential problems and ways to improve the city centre!



GPS intake form



U-LAB
laboratory for
cities and
urban landscapes



Device ID

Phoenix

Participant ID

PH

Intake Form

Thanks you for agreeing to participate in this research. This form is only meant to contact you in case the GPS device has NOT been returned. No private information will be kept.

date

time

name

cell phone number

estimated return time

1 hr / 2 hrs / 4 hrs / longer

signature (participant)

I received a GPS device and will return it to TU Delft/ Gemeente Delft

Return

signature for return

The devices are property of TU Delft. After returning of the device, this page will be handed to you.



Questionnaire

	 U-LAB laboratory for cities and urban landscapes	
Device ID	_____	Phoenix
Participant ID	_____	PH
Date	_____	
Time of departure	_____	
Time of return	_____	

Questionnaire

Thank you for participating in the research. This questionnaire is part of the tracking research and will give us better understanding of movement behavior.

Trip

What was the main purpose of your trip?

☐ shopping ☐ tourism ☐ leisure ☐ other

How often do you visit Delft city center?

☐ first visit (or) _____ times/month

Please specify the type of shopping

☐ daily needs ☐ fashion/luxury ☐ non-specific

Personal

Zip code

Gender

☐ male ☐ female

Age _____

Visiting Group

☐ alone ☐ with partner ☐ with children ☐ family ☐ Other

Occupation _____

Household Situation

☐ Single ☐ Partner no kids ☐ Family(with kids) ☐ Partner no kids(have left)

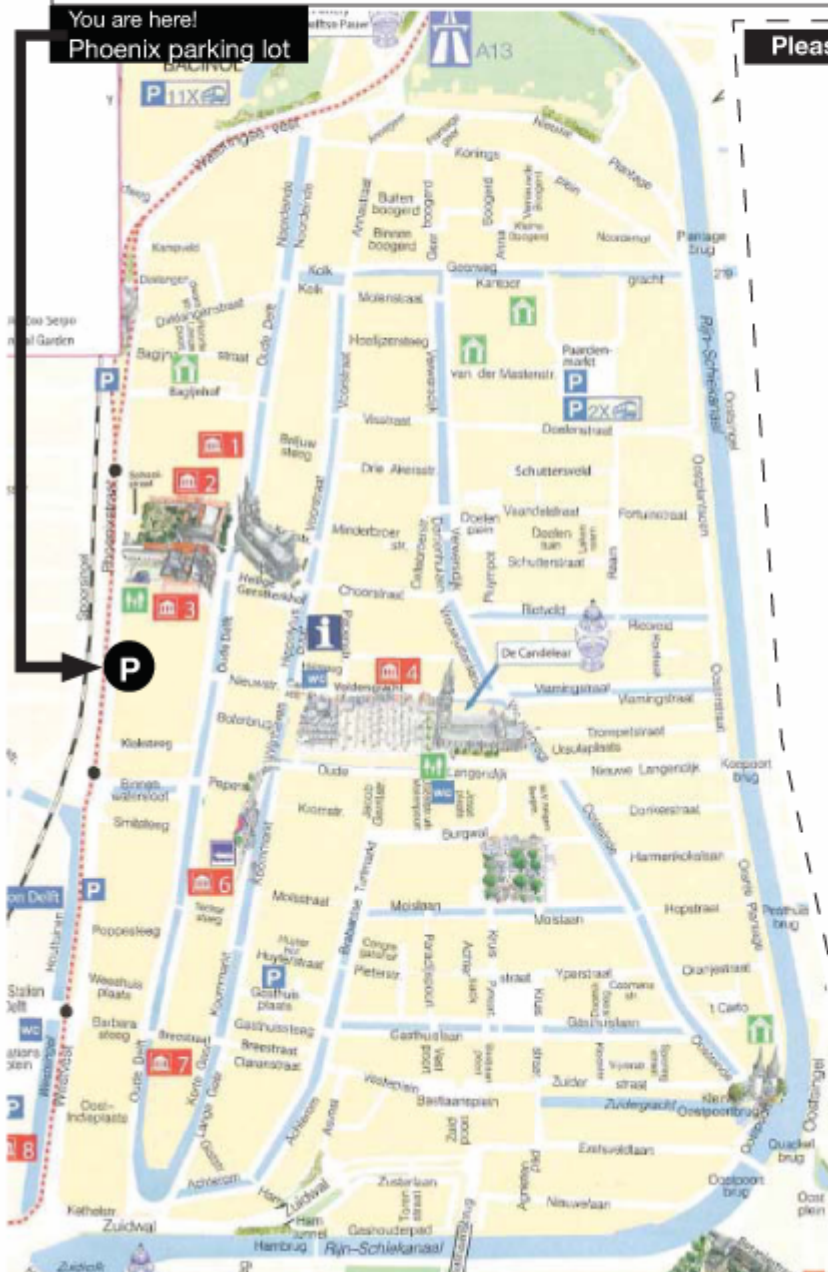
Below figure is the map of Delft where you visited today.

- Could you mark and explain good/ bad experiences in public spaces?
(easiness of wayfindings, quality of public spaces)
please use green pen for marking good experience,
use red pen for bad experience
- What do you think is the most important/ meaningful places and buildings?
Please mark on the map.

You are here!

Phoenix parking lot

Please explain here



F Used documents in research pilot Tracking Delft 2

Most of the following documents are in Dutch; the research concerned Dutch households. However, some documents are translated into English due to the fact that some international students participated in carrying out the field research.

Information DOK employees

Betreft: GPS-onderzoek in de binnenstad van Delft, samenwerking TU Delft en DOK

Contactgegevens

Master student Tine van Langelaar: 06 – 2127 5381 en c.m.vanlangelaar@student.tudelft.nl
Projectcoördinator Stefan van der Spek: 06 – 3925 0981 en s.c.vanderspek@tudelft.nl
Website project: <http://bk.tudelft.nl/trackingdelft>

Achtergrond informatie

De afdeling Stedenbouw van de TU Delft is sinds 2005, in samenwerking met andere steden in zowel binnenland (Almere) als buitenland (Norwich, Rouen, Koblenz) bezig met onderzoek naar het gebruik van de openbare ruimte.

Tracking Delft is een pilot met GPS tracking door master studenten van de TU Delft in de stad Delft. In november 2009 hebben studenten van het vak *Urban Design: People, Pedestrians & Public Space* het eerste experiment uitgevoerd. Van 18 t/m 21 november 2009 is het gedrag van bezoekers van de binnenstad vastgelegd en geobserveerd met behulp van GPS tracking vanaf de Phoenix en Zuidpoort garages.

Tracking Delft 2 is de tweede pilot. In de week van maandag 26 april 2010 zal het dagelijks leven buiten de deur -de activiteiten patronen- van bewoners van de binnenstad en omliggende wijken in kaart gebracht worden. Gedurende vier volle dagen (woensdag 28 april t/m zaterdag 1 mei 2010) zullen geselecteerde huishoudens in de wijken een GPS apparaat meenemen, om daarmee hun routes vast te leggen.

Het *doel van ons onderzoek* is om een antwoord op de vraag: "Hoe gebruiken inwoners de stad Delft?" te krijgen. We zijn benieuwd welke activiteiten binnen de stad ondernomen worden op het gebied van wonen, werken, winkelen, sporten en cultuur. De focus ligt op de binnenstad en omliggende wijken. De TU Delft geeft middels een rapport advies aan de gemeente Delft om de stad aantrekkelijker te maken.

Voor Tracking Delft 2 hebben we de beschikking over 80 GPS-apparaten. We hebben besloten dat we 40 huishoudens kunnen benaderen en dat er 2 GPS-apparaten per huishouden uitgedeeld worden. Een verdere verdeling is gemaakt in 20 huishoudens in de binnenstad en 20 huishoudens in de andere wijken, die om de binnenstad heen liggen.

De verdeling is als volgt:

- 5 huishoudens voor de wijken Westkwartier, Ministersbuurt, Olofsbuurt (postcode 2613)
- 5 huishoudens voor het Centrum (postcode 2611)
- 5 huishoudens voor Centrum Oost
- 5 huishoudens voor Centrum West
- 5 huishoudens voor Zuidpoort + In de Veste
- 5 huishoudens voor Koepoort (postcode 2612)
- 5 huishoudens voor Delftzicht (postcode 2624) + Koningsveldbuurt (postcode 2627, 2628)
- 5 huishoudens voor de Indische Buurt (postcode 2612)

40 huishoudens in totaal. Zorg voor een reservelijst van 50% per wijk! Er vallen last minute altijd wel mensen af. De te benaderen **doelgroep** is: tweeverdieners (ook huisvrouwen). Dit kunnen mensen met en mensen zonder kinderen zijn. Het GPS-apparaat wordt enkel aan de ouders meegegeven, niet aan de kinderen. Men dient tussen de 25-65 jaar te zijn en goed Nederlands te spreken.

Studenten dienen niet benaderd te worden. Daarnaast zoeken we mensen die we een duur apparaat kunnen toevertrouwen. We kwamen met het idee om mensen te beoordelen op het tijdig inleveren van geleend materiaal (boeken bv). Leden die zorgzaam met geleende spullen omgaan, zullen waarschijnlijk ook zorgzaam met de apparaten omgaan - is de gedachte.

Selectie proces



DOK selecteert in het adressenbestand een groep mensen, die aan eerdergenoemde criteria voldoen. Deze groep zou volgens Eppo telefonisch benaderd worden of zij interesse hebben aan het onderzoek deel te nemen.

Deelname aan het onderzoek is overigens anoniem. Er worden geen persoonsgegevens bewaard. Alle bijdragen worden geanonimiseerd door het toekennen van een random nummer.

Het GPS-apparaat is klein en dient voor een goede satelliet ontvangst in een jaszak of broekzak meegenomen te worden.

Het onderzoek zelf vindt plaats in week 17; maandag 26 april 2010. **De GPS-apparaten worden op maandag 26 of dinsdag 27 april bij mensen thuis afgegeven.** Van te voren zal een afspraak gemaakt worden door de bewoners en een student op een dag en tijdstip dat het beiden schikt. De bewoners ontvangen een mondelinge en beknopte schriftelijke instructie hoe het apparaat werkt. Daarnaast zal een oplader voor de GPS-batterij en een 'dagboekje' overhandigd worden. In het dagboekje kunnen bewoners per dagdeel in kernwoorden kort noteren waar ze naartoe zijn geweest.

Momenteel wordt onderzocht of het mogelijk is om mensen 's morgens een sms bericht te sturen ter herinnering aan het meenemen van het GPS-apparaat. Per huishouden zal besproken worden of mensen van deze sms service (kosteloos) gebruik willen maken.

Van woensdag 28 april tot en met zaterdag 1 mei (inclusief Koninginnedag) zal het tracken plaatsvinden. Bewoners (alleen de volwassenen, niet eventuele kinderen) nemen het apparaatje mee iedere keer als ze het huis verlaten. Er zal waarschijnlijk iedere avond even kort telefonisch contact zijn om te informeren of alles goed verloopt en of de apparaten het goed doen. Dit moment zal vastgesteld worden tussen student en bewoner. Tevens kan de bewoner dan aan het opladen van het apparaat herinnerd worden.

Misschien worden de apparaten tussendoor uitgelezen. Dit houdt in, dat een student of coördinator van het project op afspraak langskomt om de reeds verzamelde data op een laptop over te zetten. Enerzijds omdat het apparaat een beperkte opslagcapaciteit kent. Anderzijds is alle data waardevol voor ons, dus hoe eerder het op een computer staat, des te veiliger dat is. Als een apparaat bijvoorbeeld zoek raakt dan is ook alle data weg.

Op maandag 3 of dinsdag 4 mei worden, op afspraak, de apparaatjes weer opgehaald bij de mensen thuis. Hierna volgt een korte vragenlijst om het praktijk onderzoek af te sluiten. De kans dat we mensen later voor details contacteren, is aanwezig. Dit kunnen vragen in de trend zijn van: "Waarom bent u naar slager X geweest, terwijl slager Y dichterbij uw huis is?" We waarderen het daarom bijzonder als mensen telefonisch of per email beschikbaar blijven voor eventuele vragen.

"Ja, ik wil" ... en dan?

Als bewoners aangeven mee te willen werken, dan kunt u de aangeleverde welkomst brief met retourenveloppe aan hen verzenden. Ook bij geïnteresseerden die nog twijfelen, kunt u deze spullen toesturen. Zij kunnen dan alles rustig nalezen en bij vragen of participatie contact met ons opnemen.

Information letter for participating and/or interested DOK-members

Betreft: GPS-onderzoek in Delft

Delft, 31 maart 2010

Geachte heer/mevrouw,

U maakt deel uit van een selectie, die vanuit DOK benaderd is voor deelname aan een GPS-onderzoek. Wij zijn een enthousiast onderzoeksteam master studenten van de Technische Universiteit in Delft, faculteit Bouwkunde, afdeling Stedenbouw. Binnen onze afdeling zijn we sinds 2005, in samenwerking met andere steden in zowel binnenland (Almere) als buitenland (Norwich, Rouen, Koblenz) bezig met onderzoek naar het gebruik van de openbare ruimte.

Het doel van ons onderzoek is om een antwoord op de vraag: "Hoe gebruiken inwoners de stad Delft?" te krijgen. We zijn benieuwd welke activiteiten binnen de stad ondernomen worden op het gebied van wonen, werken, winkelen, sporten en cultuur. Daarnaast willen we graag weten welke routes genomen worden en welke vervoerswijze u gebruikt. De focus ligt op de binnenstad en omliggende wijken. De TU Delft geeft middels een rapport advies aan de gemeente Delft om de stad aantrekkelijker te maken.

De bibliotheek DOK, een samenwerkingspartner met grote interesse vanuit de technologische kant, heeft op basis van een door ons aangegeven gezinssamenstelling en woonbuurt, een aantal huishoudens geselecteerd. Zo komen we bij u terecht. Bij deelname worden uw gegevens geanonimiseerd. Het eindresultaat zal bestaan uit een kaart van Delft, waarop bewegende stipjes (verplaatsende mensen) te zien zijn. Persoonlijke informatie wordt alleen voor dit project gebruikt. Als het onderzoek is afgerond, worden uw gegevens vernietigd.

Wat gaan we doen? Op **maandag 26 of dinsdag 27 april** komt één van de deelnemende studenten thuis bij u langs voor afgifte en uitleg van het apparaat. Deze afspraak wordt in goed overleg met u en uw contactpersoon gemaakt op een moment dat het beide partijen schikt. U krijgt dan tevens een oplader en een handleiding van het GPS apparaat. Daarnaast vragen wij u bij te houden in kernwoorden waar u die dag bent heen geweest. U houdt dus een soort dagboekje bij. Hier kunt u tevens de weersomstandigheden noteren.

Tijdens het onderzoek geven wij u en uw partner gedurende 4 dagen een GPS-ontvanger mee. De 4 dagen zijn van **woensdag 28 april t/m zaterdag 1 mei 2010**. Iedere keer als u het huis verlaat, neemt u het apparaatje mee in uw broek- of jaszak. Welke routes gebruikt u, waar gaat u heen, hoe lang doet u hierover, hoe gaat u hierheen en hoe lang verblijft u op de plaats van bestemming zijn items die geregistreerd worden in het apparaat. Op deze manier wordt inzicht in het gebruik van de stad Delft verkregen.

Op **maandag 3 of dinsdag 4 mei** worden de apparaten weer bij u thuis opgehaald. Het ophaal moment wordt wederom door u en uw contactpersoon afgesproken. Tevens hebben we dan een korte vragenlijst hoe u het onderzoek ervaren heeft.

Bent u geïnteresseerd in het onderzoek en wilt u meedoen? Of wilt u eerst meer informatie? U kunt ons vrijblijvend middels onderstaande contactgegevens benaderen. Indien u, net als ons, erg enthousiast bent, dan kunt u direct de bijgevoegde antwoordkaart invullen en (zonder postzegel) naar ons retour sturen of de informatie naar ons mailen. Vult u alstublieft wel de gehele kaart in, want wij hebben geen enkele contactgegevens van u. Deze zijn en blijven eigendom van DOK.

We horen graag van u!

Met vriendelijke groet,

Master student Tine van Langelaar: 06 – 2127 5381
Projectcoördinator Stefan van der Spek: 06 – 3925 0981
Contact: trackingdelft-bk@tudelft.nl
Website: <http://bk.tudelft.nl/trackingdelft>



Return letter / envelope participating DOK-members

Ja, ik doe graag mee aan het GPS-tracking onderzoek in Delft!

Uw naam Geslacht: M / V
 Telefoonnummer Leeftijd:jaar
 E-mail adres

Naam partner Geslacht: M / V
 Telefoonnummer Leeftijd:jaar
 E-mail adres

Uw huisadres
 Postcode Delft

Hoe wilt u benaderd worden voor verder contact?
☐ Telefonisch ☐ Per e-mail
 Hoe wilt uw partner benaderd worden voor verder contact?
☐ Telefonisch ☐ Per e-mail

U bevindt zich in de huishoudens doelgroep:
☐ Met partner, geen kinderen leeftijd(en):
☐ Met partner, met kinderen leeftijd(en):
☐ Met partner, kinderen het huis uit leeftijd(en):

*Vouw het papier 2x op de stippellijn en plak het dicht met plakband.
 Zo kan niemand uw gegevens lezen.*

Uw beschikbaarheid voor het ontvangen van de GPS:
☐ Maandag 26 april 2010; ☐ Dinsdag 27 april 2010;
☐ ochtend 09.00 - 12.00 uur ☐ ochtend 09.00 - 12.00 uur
☐ middag 12.00 - 18.00 uur ☐ middag 12.00 - 18.00 uur
☐ avond 18.00 - 21.00 uur ☐ avond 18.00 - 21.00 uur

Uw beschikbaarheid voor het retourneren van de GPS:
☐ Maandag 3 mei 2010; ☐ Dinsdag 4 mei 2010;
☐ ochtend 09.00 - 12.00 uur ☐ ochtend 09.00 - 12.00 uur
☐ middag 12.00 - 18.00 uur ☐ middag 12.00 - 18.00 uur
☐ avond 18.00 - 21.00 uur ☐ avond 18.00 - 21.00 uur

Persoonlijke informatie wordt alleen voor dit onderzoek gebruikt. Als het onderzoek is afgerond, worden uw gegevens vernietigd. DOK heeft u benaderd, dus wij weten nu niet wie u bent. Wilt u dit formulier volledig invullen en naar ons toesturen?



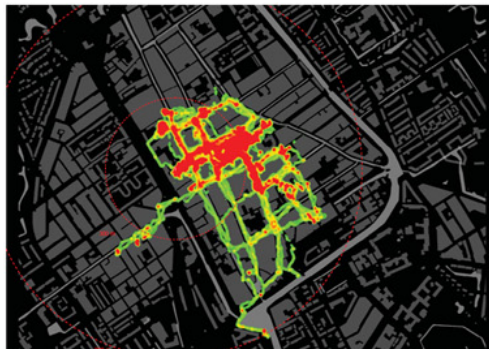
TU Delft, faculteit Bouwkunde
 Afdeling Stedenbouw / Urbanism
 t.a.v. dhr. Stefan van der Spek
 Antwoordnummer 10183
 2600 GA Delft

geen
postzegel
nodig



A1 poster promotion for DOK (Dutch only)

Het analyseren van menselijke bewegingen ter verbetering van de stad Delft.



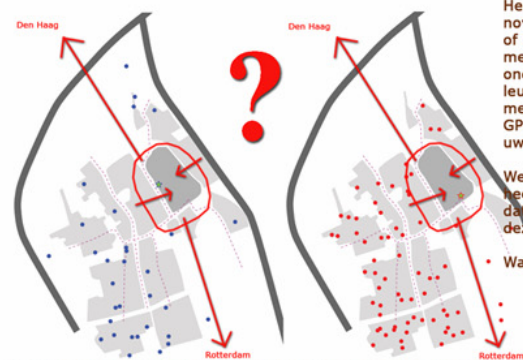
Een dichtheidsanalyse vanuit de Phoenix garage op donderdag Marktdag.



De gebruikte GPS apparatuur.



Een dichtheidsanalyse vanuit de Zuidpoort garage op donderdag Marktdag.



Herkomst bezoekers Phoenix garage (links) en Zuidpoort garage (rechts); Zoals u ziet, hebben we geen informatie over bewoners van de binnenstad en de omliggende wijken verkregen. Deze data willen we nu gaan verzamelen.

Herkent u ons?

Heeft u ons afgelopen november vanuit de Phoenix of Zuidpoort garage geholpen met het eerste GPS tracking onderzoek? Vond u het een leuke ervaring en wilt u graag meewerken aan het tweede GPS onderzoek? Dan is DIT uw kans!

Weet u nog waar u gisteren heen bent geweest, hoe laat dat was en hoe lang u op deze plaats bent verbleven?

• Waarschijnlijk niet...



Bij gecombineerde intensiteit kaarten wordt duidelijk welke gebieden veel worden gebruikt en welke gebieden niet zo aantrekkelijk zijn.



Hierboven de heatmaps; waar zijn bezoekers heen geweest?

Destination	Phoenix	Zuidpoort
Oude kerk v. plein	15	4
Choorstraat west	26	13
Choorstraat oost	15	10
Oude Delft	15	8
Hopeluststraat	16	20
Verdriessingel	23	6
Kaasmarkt	23	35
Bastiaansplein	26	6
Oude Delft oost	3	6
Grote Markt oost	56	48
Grote Markt west	42	49
Oude Langendijk	29	20
Jacob Gerrit straat	28	65
MO-ans	12	38
Cloot-ans	2	17
HBA-ans	4	17
Verdriessingel	3	25
Bastiaansplein	2	19
Verdriessingel	12	42
Hoofdwijk OMA	8	73
Hoofdwijk OMA	12	66
Pynepoort	6	41
Kraaiendijk	8	35
Huisman	18	35
Buizenhartstraat	38	56
Burgwal	25	29
Binnenmarkt	18	29
Pedestrian area	9	18

Wat doen we?

Mensen herinneren zich nooit precies hoe ze door een stad liepen en welke bestemmingen ze bezochten.

GPS tracking geeft gedetailleerde en nauwkeurige informatie in ruimte, tijd en duur.

Het apparaat registreert de werkelijk gebruikte route, snelheid en wijze van transport, de lengte van de reis, de bestemming(en) en (soort) activiteit(en).

Het doen van onderzoek geeft inzicht in individueel en collectief gedrag van mensen.

Wat moet u doen?

U neemt een klein GPS apparaatje in uw broek- of jaszak mee iedere keer als u het huis verlaat van woensdag 28 april t/m zaterdag 1 mei 2010. Als beloning krijgt u een prachtige originele pen van de TU Delft!

Van te voren maken wij een afspraak met u om uit te leggen hoe het GPS apparaat werkt. Na het onderzoek komen wij het apparaat ook weer bij u ophalen.

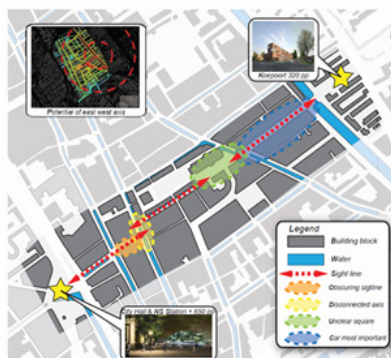
Deelname aan het onderzoek is anoniem. Er worden geen persoonsgegevens bewaard. Alle bijdragen worden geanonimiseerd door het toekennen van een willekeurig nummer. De data wordt alleen voor dit project gebruikt.

Nieuwsgierig geworden?

Neem de gratis A4 flyer mee, kijk of u aan de criteria voldoet en neem contact met ons op!



Het GPS apparaat op ware grootte.



Master studenten Stedenbouw van de TU Delft hebben op basis van de verzamelde gegevens verbeteringen voor de binnenstad bedacht.



A4 flyer promotion for DOK (Dutch only)

Interested people could pick up a flyer and contact us for participation



TRACKING DELFT, PILOT 2

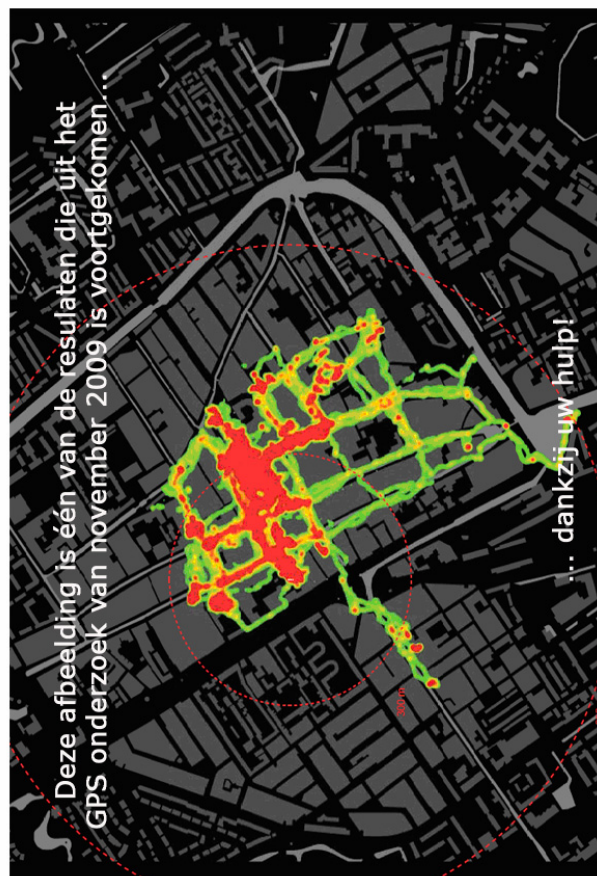
Heeft u ons afgelopen november vanuit de Phoenix of Zuidpoort garage geholpen met ons GPS tracking onderzoek? Vond u het een leuke ervaring en bent u nieuwsgierig naar meer? Dan is DIT uw kans!

Voor ons nieuwe GPS onderzoek zoeken wij:

- DOK-leden
- Tweeverdieners (ook huisvrouwen)
- Tussen 25 - 65 jaar oud
- Met of zonder (thuiswonende) kinderen
- U bent beschikbaar in de week van 26 april 2010
- U bent woonachtig in de wijken:
 - o Centrum, Centrum Oost, Centrum West, Zuidpoort, In de Veste (postcode 2611)
 - o Koepoort, Indische Buurt (postcode 2612)
 - o Westkwartier, Ministersbuurt, Olofsbuurt (postcode 2613)
 - o Delftzicht (postcode 2624)
 - o Koningsveldbuurt (postcode 2627, 2628)

Wat moet u doen? U neemt een GPS apparaatje in uw jaszak mee iedere keer als u het huis verlaat van woensdag 28 april t/m zaterdag 1 mei 2010. Deelname aan het onderzoek is anoniem. Er worden geen persoonsgegevens bewaard.

Voor meer (vrijblijvende) informatie of deelname:
 Master student mw. Tine van Langelaar: 06 – 2127 5381
 Projectcoördinator dhr. Stefan van der Spek: 06 – 3925 0981
 Of stuur een e-mail naar: trackingdelft-bk@tudelft.nl



GPS lending form residents downtown Delft (Delft Tracking 2)

GPS devices that we use for research are expensive to buy. To prevent that the equipment gets stolen or sold, this form has been prepared. If the device is lost, we do report this to the police. By signing this form you promise to take care of the device and return it at the end of the investigation at TU Delft. You get this form back if we pick up the GPS device.

GPS-device number

Date 2010

Name inhabitant

Signature inhabitant

I hereby promise to take good care of the GPS-device and I will return it to the TU Delft.

The resident has taken good care of the device and the GPS is brought back undamaged.

Date 2010

Name contact person TU Delft student

Signature contact person TU Delft student

Instructions on the use of GPS device, week 26 April 2010

Each time you leave the house, you must follow these steps:



Step 1: Pick up the device. If you're outside the building, move the button to "**LOG**".



Step 2: Wait outside the building until **the orange symbol** starts to blink. If the power light is flashing, the device is connected to the satellite. The data will be stored. You can now put the GPS in your jacket or pocket. Make sure that the device is not stuck. Incidentally: The device has no indoor (in the office, in a movie theatre, a restaurant, etc.) reception. The orange symbol then will light up permanently. As soon as you leave the building, the GPS will automatically find and reconnect with the satellite.



Step 3: If you are at home in the evenings and you don't go outside anymore, you can turn off the GPS. To do this, switch the button to "**OFF**". Remember to charge the battery at night. It is usually full in one hour. If you leave the house, start again from step 1.

Manual Qstarz BT-Q1000X Travel Recorder



The GPS device is small and makes a good satellite reception when carried in a pocket from jacket or pants.

If the GPS device is lost or destroyed, you must immediately contact coordinator Stefan van der Spek, phone number 06 – 3925 0981. This number is also listed on the GPS itself. If the device is lost, we do report this at the police.

For general questions, please contact your TU/Delft student ,
phone:



Red button = pressing indicates a "point of interest" (marked point) registration on the map. This function should preferably not be used. Make sure that the device is not stuck in your coat / bag / trousers; otherwise this button is continually pressed.



Orange light: blinking = device has satellite connection. If this light starts flashing **red**, the memory card of the device is full. Contact us directly!



Blue light = Bluetooth reception. The device does not record any data. Do not use this feature! Move the button from **NAV** to **LOG**.



Green light = status of the battery. If this light stains **red**, the battery of the device is empty. Charge the device directly until the green light goes out (=full battery). Preferably, charge the device every night, so that as much as possible data is collected during the day.



LOG = on = the device is registering your route.

NAV = the device can be used to navigate with hand held devices (laptop, smart phone) but the data log feature is disabled. Do not use this feature.

OFF = the device is off. Use this function when you get back home after a trip.



On the right side a small USB connector is inserted. 1) The GPS data from the travel recorder can in this way be transferred to a computer. The device is customized for the research. You can not elect the data at home. 2) With this connection you can charge the battery.

Diary: registration activities in keywords

Diary

GPS device number

Example scenarios	Morning 6.00 - 12.00h	Afternoon 12.00 - 18.00h	Evening 18.00 - 00.00h	Night 00.00 - 06.00h
Monday 26 April 2010	7.30 work in Rotterdam	12.30 lunch in Schiedam	21.00 Mustsee cinema	00.30 café De Waag
	9.00 groceries at AH	12.15 kids to school	19.00 children to music school	---
	10.00 coffee at neighbour	13.00 to the market	20.00 bingo centre	00.15 night shop

Activities	Morning 6.00 - 12.00h	Afternoon 12.00 - 18.00h	Evening 18.00 - 00.00h	Night 00.00 - 06.00h
Tuesday 27 April 2010				
Wednesday 28 April 2010				
Thursday 29 April 2010				
Friday 30 April 2010 Queensday				
Saturday 1 May 2010				
Sunday 2 May 2010				

Weather registration

Weather conditions

GPS device number

Example scenario		Morning 6.00 - 12.00h	Afternoon 12.00 - 18.00h	Evening 18.00 - 00.00h	Night 00.00 - 06.00h
Monday 26 April 2010		Sun and sheep clouds	Rain	Hail	Storm
Registration		Morning 6.00 - 12.00h	Afternoon 12.00 - 18.00h	Evening 18.00 - 00.00h	Night 00.00 - 06.00h
Tuesday 27 April 2010					
Wednesday 28 April 2010					
Thursday 29 April 2010					
Friday 30 April 2010 Queensday					
Saturday 1 May 2010					
Sunday 2 May 2010					



Questionnaire

Questionnaire inhabitants city of Delft - pilot "Tracking Delft II"

Inhabitant with GPS device number:

A. Contents

1. We provided a GPS manual. Did it lack information you needed?
☐ No
☐ Yes, I missed
.....
2. How did you experience having a GPS device with you all day?
☐ It was fun!
☐ A nice experience but I always had to think / be reminded about it
☐ It was a hassle.
3. How did you experience keeping a diary?
☐ It was fun!
☐ A nice experience but I always had to think / be reminded about it
☐ It was a hassle.
- Did it happen one or more times that you...
4. ... forgot to take the GPS outside the house and/or you didn't switch it on?
☐ No ☐ Yes, namely on (put it in diary!)
5. (if applicable) ... accidentally took the GPS of your partner?
☐ No ☐ Yes, namely on (put it in diary).....
6. Do you have pets?
☐ No ☐ Yes, dog/cat ☐ Yes, horse ☐ Other, namely:
7. No doubt you have seen the new central station project "Railway Zone". There are many road works and it is a mess around the station. Did you take different routes to reach your destinations because of the road works?
☐ No, that is not necessary.
☐ Yes, namely: old route:.....
New route:.....
8. For which activities do you use the city of Delft? Prioritise of 1-2-3.
..... ☐ Daily groceries, like the AH or C1000
..... ☐ Fun shopping (shopping)
..... ☐ Run shopping (purposeful purchases)
..... ☐ Visit tourist places like museums and churches (daytime)
..... ☐ Cultural activities, like cinema and theatre
..... ☐ Go out, like drinking & dining
..... ☐ Otherwise, namely:
9. If you want to go shopping, which city do you choose? Strike out as applicable:
☐ Delft, shopping centre: Zuidpoort / In de Hoven / Leeuwenstein /
☐ Rijswijk, shopping centre: In de Bogaard /
☐ Den Haag, shopping centre: Noordeinde / Leyweg / Frederik Hendriklaan / De Stede / Leidsenhage / Mariahoeve / Leyenburg /
☐ Rotterdam, shopping centre: Alexandrium / Koopgoot / Zuidplein / Keizerswaard / Plaza /
☐ Otherwise, namely:.....

10. If you don't choose for a shopping mall in Delft: Why do you choose another city? What is missing in Delft?
11. Looking at cultural activities and going out: Does the city of Delft satisfy all your needs and wishes?
☐ Yes
☐ No, I miss in the supply of Delft:.....
 Therefore I go to: Den Haag / Rotterdam / Rijswijk / otherwise:
12. How do you travel to your destinations in the city of Delft? Prioritise of 1-2-3.
 ☐ By foot
 ☐ By bike
 ☐ By car
 ☐ By taxi
 ☐ Public transport, like bus or tram
 ☐ Appliance, like a wheelchair, walker or scooter
 ☐ Otherwise, namely:.....
13. See picture: Are there streets or areas in the inner city of Delft that you find:
☐ Attractive (cosy, pleasant)? Draw a **green** circle around those places on the map.
 Why is this place attractive for you?
☐ Unattractive (scary, dirty, boring, empty, hard wind, street kids)? Draw a **red** circle around those places on the map.
 Why is this place unattractive for you?

B. Method

14. How did you experience the contact between you and your contact person / TU Delft student? For example: accessibility for questions, customer service and expertise.
☐ Excellent
☐ Good
☐ Not good, because:.....

C. Personal information

15. Where do you work?
☐ Delft inner city
☐ Delft other
☐ Outside Delft
16. What is your highest completed education?
☐ Secondary school
☐ Intermediate Vocational Training
☐ Higher Vocational Training / College
☐ University

D. Future

17. Do you have improvements that we can apply before, during and after the research?
☐ No, everything went perfect.
☐ Yes, namely:

18. It's likely that more GPS research will be done in the future. If you again are in the right target group, can we contact you for participation?
☐ Yes, please!
☐ No, preferably not.

(Question 13)

