Activity Patterns in Public Space: a tool for assessing city centres

Tracking Pedestrians in the Historic City Centre of Delft

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Abstract

Context

While urban design and planning focuses strongly on actor-oriented and user-oriented design and planning approaches, technologies that give insight into the behaviour of actors and users are rapidly evolving. Especially the use of tracking technologies – of which GPS is best known – is booming in urban research. Most research focuses on the technological possibilities and problems of using tracking devices. Little attention is paid to the questions to what extend and in which manner knowledge developed through the use of new tracking technologies might influence spatial design and planning decisions (Hoeven, 2008).

Aim and Methodology

Using GPS technology to observe walking patterns in city centres replaces old techniques and offers new abilities collecting a broad scale of data: a tool for evaluation and for discovering new insights. With GPS tracking it is possible to gather *individual and collective* data on *routing*, whole *trip* (including access transportation), *access points spent time*, *visited streets* (network), *visited locations* (activities), *intensities of use of space*. In the Spatial Metro project GPS tracking was used to **evaluate the actual impact of investments** and also to **analyse pedestrian movement** in the cities: measuring, valuing and predicting the demand for investment in pedestrian facilities (Van der Spek, 2008).

Results and Main conclusion

While collecting data using GPS tracking it is possible to get more insight in pedestrian behaviour and pedestrian movement in cities. It is possible to discover e.g. neglected places, qualitative places, gaps in the pedestrian network and main pedestrian routes. This insight should offer new abilities for Pedestrian Oriented Design for the city.

Tracking Delft

In this paper the Tracking Delft Pilot will be described. Here, tracking has been used to come to new insights and to define interventions in public space to improve the walkability of the city centre. In November 2009 ten students carried out research in the city centre of Delft: from two parking garages *pedestrians were tracked and interviewed during four days*. The research consisted of three parts:

1. General evaluation of the tracks ie by layering and making sub groups based trip or personal characteristics; leading to Design Interventions based on the routing and destinations of individuals as well as on collective behaviour.
2. Evaluation of the experience of pedestrians (Preferences research by Ohyoon Kwon)
3. Evaluation of space based on the methodology of Gehl (by Tine van Langelaar)

The research lead to two other papers: Tracking Delft from the perspective of preferences of people (Kwon) and comparison of use and influence of design based on behaviour of inhabitants and visitors (Van Langelaar). *This paper will focus on the design interventions based on the actual pattern of use of visitors.*

Biography

Stefan van der Spek is lecturer and researcher at TU Delft in the field of *Urban Design*. His central subject is *Pedestrians, Activity Patterns and Public Space*. His main areas of interest are transit oriented development (stations) and vital city centres. He initiated '*Urbanism on Track*'. More information: http://tudelft.nl

Acknowledgement

'Urbanism on Track' was initiated as an event in January 2007, bringing together experts on tracking technologies. Focus of this group is application of tracking technologies in *Urban Design and Planning*. Today, '*Urbanism on Track'* represents a networking group on linkedin (http://linkedin.com). More information: http://bk.tudelft.nl/uot

'Tracking Delft' are experimental pilot projects with GPS-tracking which are carried out by TU Delft students within the elective courses 'Urban Design' (1) People, Pedestrians & Public Space', (2) 'Mobility and Networks', and (3) 'New Metropolis'. In these design oriented courses the research on 'Activity Patterns in Public Space' is integrated. More information: http://bk.tudelft.nl/trackingdelft (Dutch only).

'Tracking Delft I' was carried out in Fall 2009 (TD1). This research focussed on visitors of the city centre of Delft. People were interviewed after being tracked using GPS devices throughout their whole walking tour. In total 325 pedestrians have been tracked in four days. Participating students were: *Michiel Baltus, Hidde Dirks, Steffen Esselink, Ohyoon Kwon, Tine van Langelaar, Maarten Rozemuller, Stephan Saarloos, Simon Scheepens, Lu Yu, Sianan Yuan*

'Tracking Delft II' was carried out in Spring 2010 (TD2). This research focussed on the activity patterns of inhabitants in Delft. People living in the city centre and surrounding neighbourhoods were tracked for one week. In total 40 households have been tracked during their outdoor activities. Relevant data from this project are the pedestrian tracks in the city centre by visitors and inhabitants. Students participating were: *Antal Bos, Marcel Bos, Robin Boelsums, Manuel Félix Cárdenas, Thomas Galesloot, MinHong Khor, Remco de Koning, Hoiman Lam, Tine van Langelaar, Michael van Pelt, Soudabeh Rajaei, Richard de Ruiter, Tom Schilder, Laura Smits, Ido Sokolov, Remco Sommer, Sander Trentelman, Evert Willeumier*

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Introduction

Between 2005 and 2008 a method to evaluate the effectiveness of investments in public spaces in city centres was developed within the Spatial Metro project by TU Delft. The method was based on mapping and analysing pedestrian movement. This method using 'tracking technologies' was applied in the city centres of Norwich, Rouen and Koblenz. The development and application of this method is described in 'Street-Level Desires' (Hoeven, 2008) and 'Urbanism on Track' (Spek, 2008).
Meanwhile, the method has been developed further within the U-Lab research project 'Activity Patterns in Public Space' (Spek, 2009). This paper will focus on the application of the method in the city centre of Delft. Here two tracking experiments have been carried out: As part of an Urban Design course, students mapped pedestrian movement and interviewed the participants in Fall 2009. Starting point were two garages: Zuidpoort (South) and Phoenix (West). A second experiment in Spring 2010 consisted of households in the city centre and adjacent districts. For this research, the selected data was limited to the pedestrian movement in the city centre.

Method

GPS-tracking uses GPS-devices to collect and map outdoor activity of animals and humans. Examples are travel behaviour and walking. Every few seconds the location of the device in space and time is logged. This enables to collect accurate and valid spatio-temporal information of subjects. The method is based on GPS-tracking in combination with street-interviews and urban analysis method. The method is in detail described in Sensors (Spek, 2009).
On itself, GPS-tracking delivers a point cloud. Each point has the attributes coordinates (X, Y and Z), timestamp (t), speed (v), direction ($\propto$) and the series it is part of (s). By reconstructing the sequence of the points, it is possible to show trips on a map and get insight in the behaviour of individuals or groups. The combination with (a) *background information* of the trip and participant (based on interviews or observations) and (b) *context information* (the frame: static and dynamic condition, such as space, traffic, weather, events, etc.) is essential to understand the behaviour.
The method consists of 5 steps:

1. Preparation of the research project
2. Data collection: field research - collecting spatial temporal data
3. Data processing: cleaning, filtering and classifying the information
4. Data analysis: frame and results
5. Conclusion: interpretation of phenomena and design interventions

This paper will focus on the last part: introducing analysis and conclusions based on spatio-temporal data.

Results

Pilots / field study (spatio-temporal data collection)

The pedestrian study counted 325 participants who arrived by car and visited the city centre on foot. This represents trips from two locations: Zuidpoort (ZP) and Phoenix (PH). A second set of pedestrian behaviour was retrieved from the activity patterns research. Here pedestrian movement in the city centre by (i) inhabitants, but also visitors arriving (ii/a) by car, (ii/b) by public transport, (ii/c) bike and (iii) walking were isolated.
The studies show a distinct walking pattern from each location (see Figure 2 and Figure 3).

During 'regular' days the patterns from Zuidpoort is limited to the 'new shopping district' area. But on Market days, a clear shift covering the central market can be seen. Unfortunately, most movement is focussed on the direct street to the market. Some extra circuits are made including the Choorstraat area as well.

The general conclusions can be divided in several themes, based on origin and familiarity of the participant(s), and purpose and duration of the trip. These isolated maps give good insight in the behaviour of different groups with diverse backgrounds or distinct objectives. The results will be discussed during the presentation.

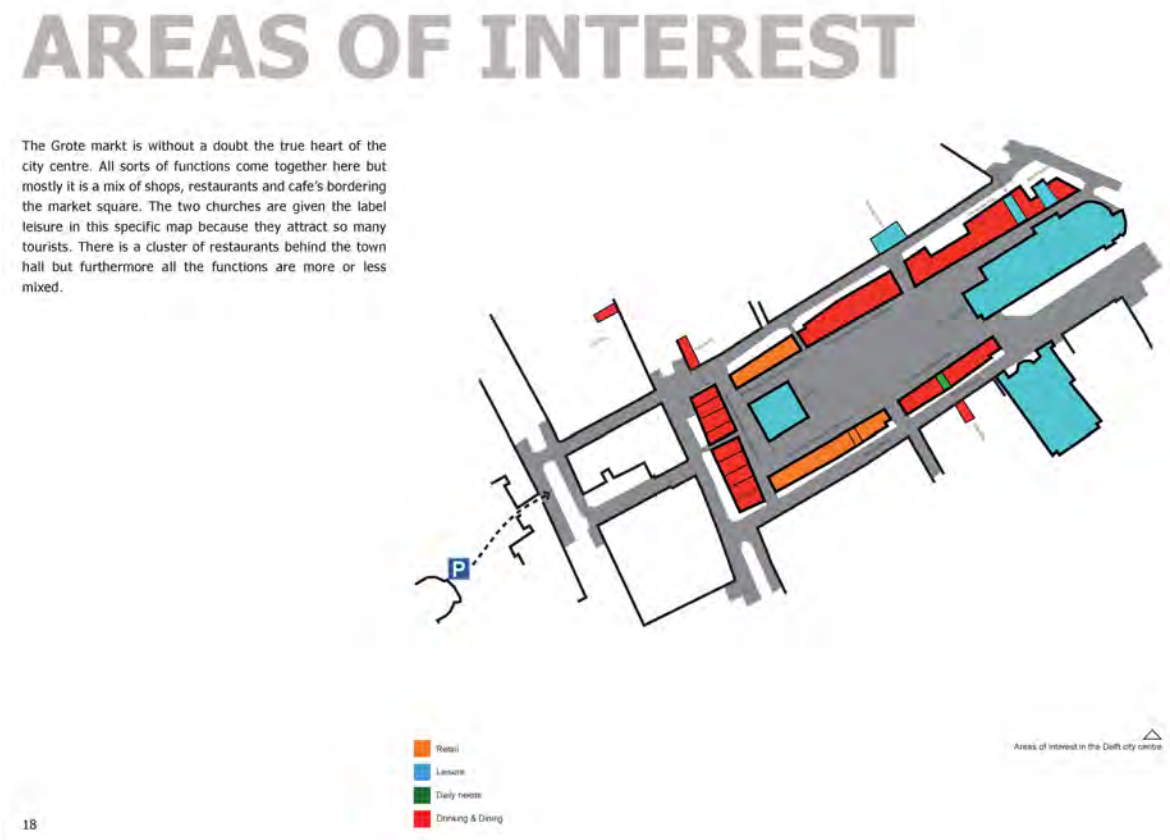
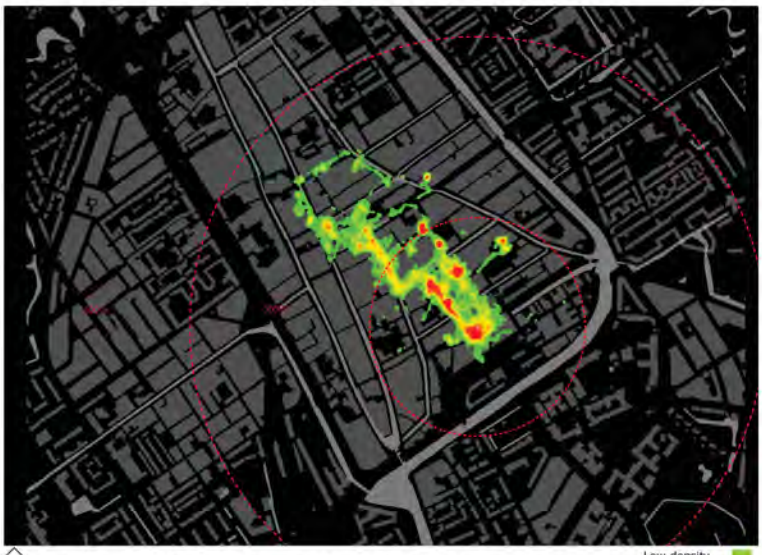


Figure 1: land use analysis

DAY

Wednesday November 18th



The pattern and intensity on Wednesday of people that enter the city centre through Phoenix (36 out of 177 tracks)

Wednesday clearly shows the main walking routes of the people who parked their car in the Zuidpoort garage. We can clearly distinguish the Vestpoort and the Bastiaanspoort are both used to exit the Bastiaansplein. In general, people walks in general in line with these streets. However, when the majority of the tracks from people who walks on the Bastiaanspoort/Kruisstraat stops at the intersection with the Molslaan. Some people continue towards the Beestenmarkt or turned left into the Molslaan heading towards the Brabantse Turfmarkt. Therefore the Burgwal is barely used. Almost all the people from the Vestepoort/Paradijspoort turn left on the Molslaan towards the Brabantse Turfmarkt.

After we compared the days with the origin of the people we can conclude that on a normal day approximately 60% of the people who parked their car in the Phoenix garage are regional visitors. 36% are people from the region Delft. If we compare these statistics with the statistics of the Phoenix garage (61% and 23%) we can conclude that more people from the region Delft parks their car in the Zuidpoort garage. This is probably caused by the fact that more large retail brands and a large grocery store are established near the Zuidpoort garage.

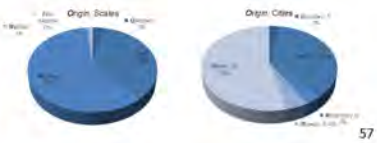
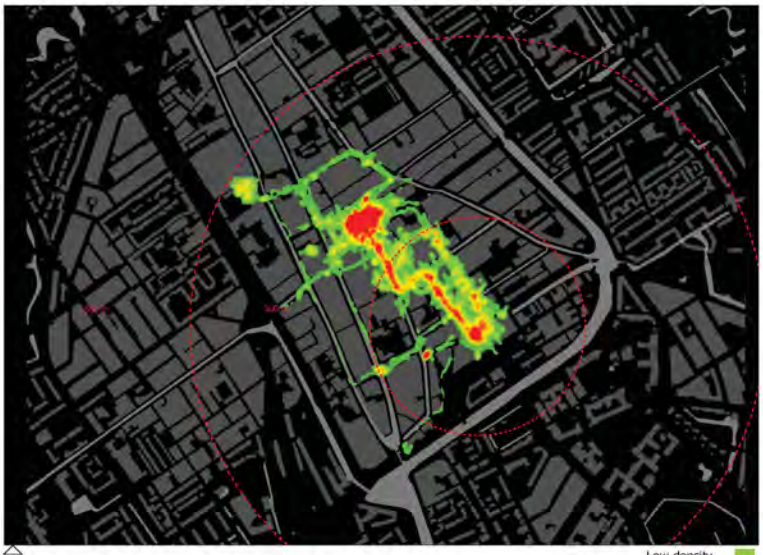


Figure 2: tracks on a regular day

DAY

Thursday November 19th



The pattern and intensity on Thursday of people that enter the city centre through Phoenix (57 out of 177 tracks)

The pedestrian movement pattern on Thursday clearly altered from the usual pedestrian movement pattern. On Thursday the Grote Markt is more frequent and intensely used, because of the market on the Grote Markt and the Brabantse Turfmarkt. Because of the Grote Markt participants from the Zuidpoort are drawn further to the north.

In general people don't get any further than the Choorstraat. The pedestrian movement pattern from the Zuidpoort is oriented on the north – south direction. Therefore the east and west are not used to their full potential, for example the Nieuwe Langendijk and the Binnenwatersloot.

If we take a look to the statistics, the majority of the persons who visits the city centre ones or twice a month come on Thursday. Probably most of them are attracked to the market.

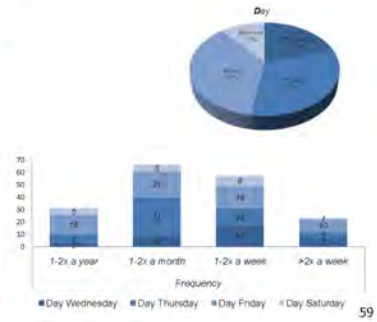


Figure 3: tracks on a market day

Urban Analysis (context: static conditions)
Next to GPS-tracking research including interviews the static conditions or so-called frame was analysed. Four main urban analysis methods were used to estimate and evaluate the walking patterns: (1) *Land use*, (2) *Space syntax*, (3) *Visibility* and (4) *3-step analysis* (Figures 1 and 4-6). Further, the research was extended with two focus points: (1) *visual quality* (Langelaar, 2010) investigating the quality of facades in Delft based on the theory of Jan Gehl and (2) *appraisal of the participants* (Kwon, 2010) mapping the experience of visitors. These projects are elaborated in two separate papers.

Dynamic conditions (weather, temporary events)
A city is in constant motion. No day is the same. Season, weather, holidays, but also events and other (unexpected) activities influence route choices and behaviour of humans. Especially in the city of Delft this is the case: redevelopment of the waterfront, station area, tramline to the university district and a new parking garage and hotel on the east side of the centre. Further, the city is recognised by its canals with small streets, but these streets also cause traffic jams, influencing slow-traffic movement.
For the research it is essential to be aware of these temporary circumstances to draw the right conclusion or see the results in the right perspective.

Design
Based on the actual movement and spatial conditions, several interventions have been suggested by the students following the course. The interventions vary from limiting traffic to replacing building blocks and adding bridges (Figure 7). The main issue discovered by the students is the fragmentation of the centre due to the lacking identity of the connecting routes and broken links due to discontinuity in streets. Especially going south too north, there are no direct connections. Only with several turns, it is possible to reach the other side of the city centres. Sometimes people have to walk in the wrong direction to walk around a block. This affects the navigation and limits the orientation.
To increase orientation, the main nodes in the city should be improved to guide people easier through the city, resulting in circuits instead of serial routes. Examples of these projects and interventions are shown in Langelaar (2010).

Conclusion
The research and pilots show, that GPS tracking is not an instrument on its own, but is effective to add insight in walking/pedestrian behaviour. Firstly GPS tracking contributes to other methods, such as urban analysis, space syntax, 3-step analysis, interviews and counting. Secondly, GPS-tracking fills a gap: data on actual behaviour in space and time is lacking. This information is essential for developing and maintaining a vital city. Finally, the method can be used on different scales and in different settings. Although the focus of this research was the city centre, the method could work well in other districts. Further, the method performs as a tool to distinguish different user types with diverse spatio-temporal characteristics. Finally, the results of GPS-tracking can be used for (a) focus on where to invest in public space to improve quality for pedestrians and (b) to evaluate the efficiency of investments. This is underpinned by the design projects, which are initiated from the spatio-temporal data in relation to the context.

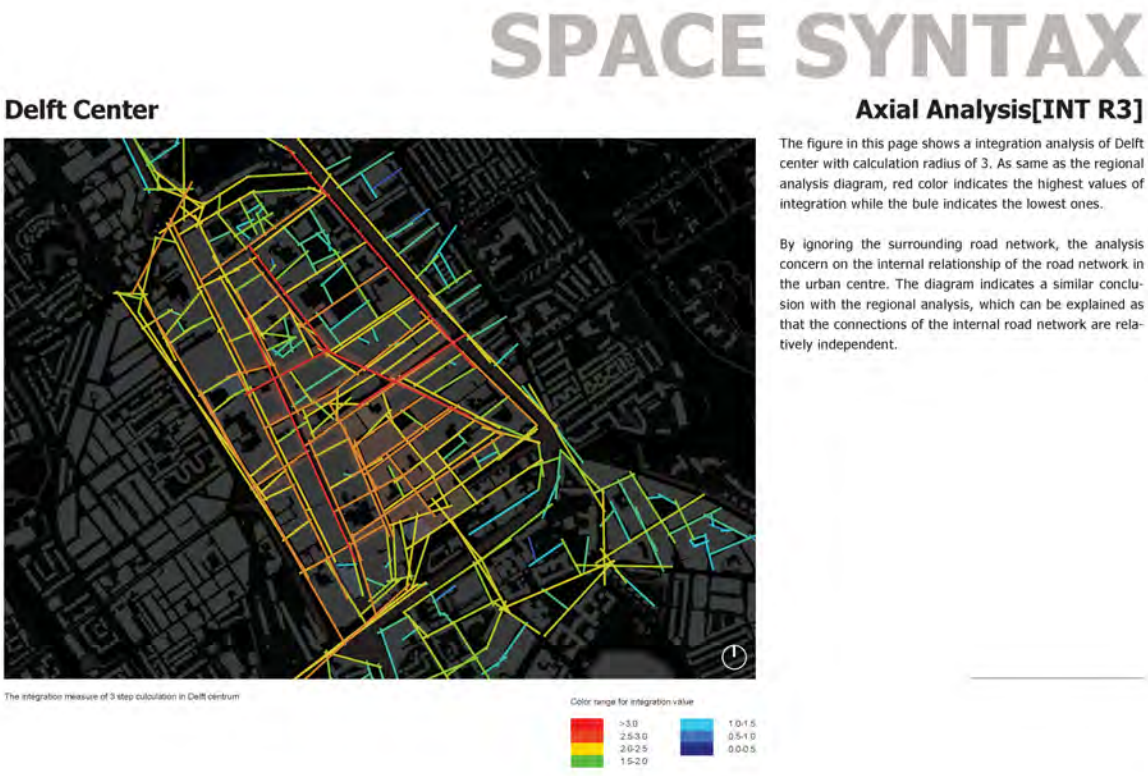


Figure 4: space syntax angular analysis

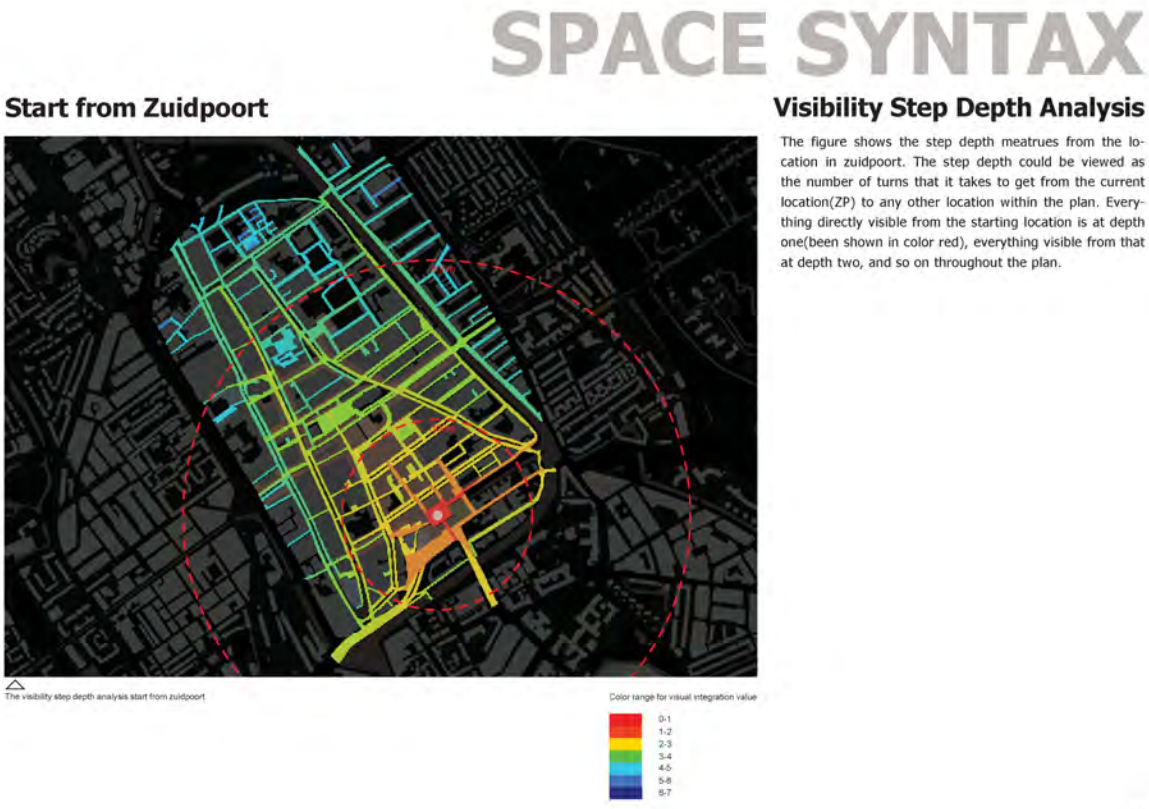


Figure 5: space syntax visibility analysis

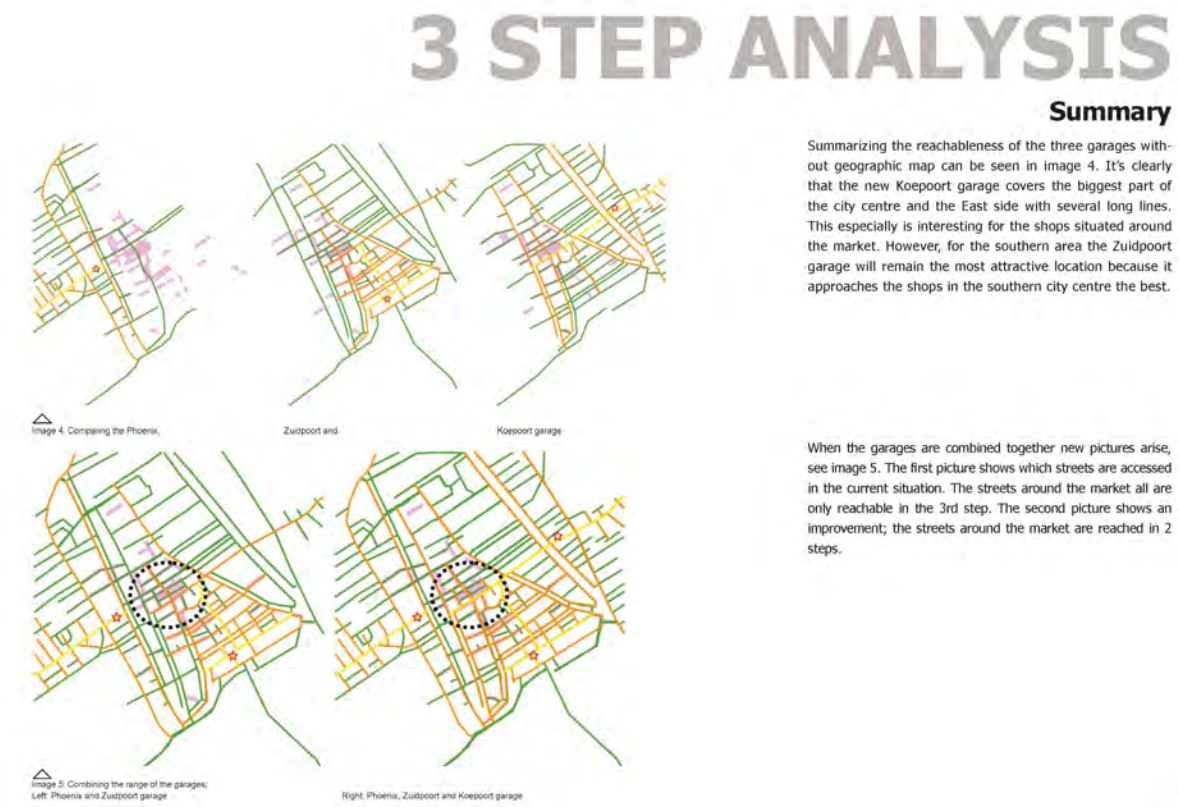


Figure 6: 3-step analysis

Figure 7: from current situation to intervention: new pedestrian link to accommodate slow-traffic more logical and offer better circuits for pedestrians.

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