CROWDSOURCING
URBAN PLANNING:
Using interaction design to aid interstructure analyses

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ABSTRACT

This thesis investigates how the methods and tools of interaction design can contribute to the development of physical meeting places. A basic assumption of this study is that the role of physical meetings are of importance, since they generate understanding between people and cultures and provide opportunities for collaboration and work as a foundation for a well functioning society. The dynamics of meetings are described through the theories of interstructures, which aim to explain how meeting places exist and interconnect with each other and how people interact with these. In the urban environment, these interstructures are rarely purposefully created to actively generate meetings between people of different social groups. Also, there is a lack of contemporary methods and tools for making interstructure analyses.

Using crowdsourcing as the ruling method and a smartphone application as the tool, prototypes were developed with the aim to answer the research questions: how to design a technical solution capable of crowdsourcing the collection of data regarding interstructure analyses, and how this would influence the process. We aimed at answering these questions through literature studies as well as through discussions with employees at inobi. The prototypes were used as a base for these discussions. Through this process a set of guidelines was generated, for future projects within the field. In these guidelines, we state that type and quantity of the collected data should be a beacon for the UI design, since these factors have a large impact on the usage. The ambition of this research is to contribute to the practice of architecture and urban planning by the development of novel technical solutions for interstructure analyses.

Keywords:
Interstructures, crowdsourcing, interaction design, architecture.
1. INTRODUCTION

Even in our increasingly digitalised world, where a lot of physical spaces are being replaced by digital counterparts, the role of the physical meetings are of utter importance. Libraries, marketplaces, parks and countless other sites form the base for creating meetings between individuals. These meetings are carriers of information between individuals, the soil where knowledge grows to become insight. These meetings generate tolerance and understanding and provide many opportunities for collaborations, breeding innovation. They generate the social capital needed for a dynamic economy and a well functioning society. The kind of meeting being created, and even the fact that it is created at all, is largely dictated by the configuration of the meeting place and the flow of individuals between these — the so called interstructure. While these meeting places often are artificial, rarely are these created purposefully with the interstructure in mind. While research regarding the subject of interstructures has been done in the past, it’s only in the last couple of years that the economic value of purposefully engineered interstructures has been noticed and taken use of. Several notable examples can be found in the newly built headquarters of many IT corporations, like Googles Googleplex and Apples Apple Campus. There are currently several technical solutions for tracking individuals behaviour and movement pattern. These solutions are most often applied in larger brick and mortar businesses. By mapping these patterns, the companies behind these customer tracking applications claim to be able to provide data that will help stores optimise their layout and signage.

The science regarding human interaction in relation to physical spaces does offer more use besides increasing the revenue of malls. Within the field of architecture and city planning, the creating and shaping of
physical interstructures is a very important building block. Finding a way to provide feedback and information regarding how individuals interact with these spaces could therefore be very valuable. By gathering this information, a very valuable base of objective data could be created and used as a foundation for the subjective, creative process that architectural work is.

A core aspect of this thesis will be to explore the way an individual can interpret a man-made physical space in a number of aspects: what associations does it bring to mind; what feelings arise while sojourning there; what kind of activities does it promote; how does the space influence a person’s relation to surrounding people? After treating these topics, the insights will be percolated through the field of interaction design in order to lay down a foundation to possible technical solutions which could help shed light on the mechanics surrounding the erratic nature of value-creating meetings.

In this project we will be treating a case where architectural office inobi Arkitekter AB aims at applying a method developed on their own for describing how people interact within and between meeting places, called interstructure analysis. This method is thoroughly described in Att Bygga Mötesplatser (Berg et al. 2014), but also briefly described in chapter 3.1. In its current incarnation this method is done by observation and subjective gradings of interstructures. It is a very time-consuming process that ultimately generates a subjective result. The method is further described in chapter 2.2. Therefore, finding a technical solution that is able to more efficiently provide objective results is something that is of interest for inobi. This solution could be useful even past the scope of this masters thesis, throughout their cooperation with Chalmersfastigheter and their future work within the field of analytic architecture.
Building on these conditions, we pose two research questions:

1. *How should a technical solution that crowdsources data for an interstructure analysis be designed to ensure that relevant data is collected?*

   To answer this, we need to identify the course of action when conveying an interstructure analysis. Having identified these steps, the dynamics of interstructures needs to be researched. This means finding out how they are created or what differs a well functioning meeting place from a poor one. Even though the actual creation of the interstructures isn’t the goal of this thesis, a gained understanding regarding the subject will be helpful in the process of identifying the suitable data to gather. Having found the appropriate aspects to focus on; how should the user interface be designed to make it possible to actually input the observations as data. Finally, how should the user-interface be designed to assure that the users, knowingly, input the correct type of data?

2. *How can crowdsourcing as a method contribute to interstructure analysis?*

The current method for conducting interstructure analyses (see chapter 2.2) lacks in two fields: the dependability of the gathered subjective data and the large amount of time required to conduct a study. Crowdsourcing the data might provide a solution to both of these problems.

A key aspect to all crowdsourcing projects, and so this one, is to get enough users motivated enough. This means that a certain number of participants are required in order to make the amount of data thorough.
enough to discern patterns. It also means that the users need to take the study seriously enough for them to put the extra effort in and provide quality data. Alternatively, the technical solution should be designed in a way that the quality of the data won’t suffer too much the inputs from unserious participants.

Through answering these research questions, the following aims should be reached throughout the project:

• Creating a set of recommendations for future projects aiming to create a tool for crowdsourcing data for interstructure analyses.
• A well defined design which will make it possible to crowdsource data for interstructure analyses.
• Implement the design to some degree.

We decided to divide the aims into three steps. Each of these steps build upon the previous — to reach the second aim, the first aim needs to be fulfilled and so on.

1.1. Limitations

This thesis is delimited in two aspects: geographical limitations of the study and functional limitations of the implementations.

1.1.1. GEOGRAPHICAL LIMITATIONS

The geographical limitation serves as a basis for the development of the design. We’ve chosen to keep the geographical limitations of the study which this thesis is based on—the area of Chalmers Johanneberg Campus. This limitation includes the demography belonging to this area, consisting mostly of individuals familiar with technology.

1.1.2. LIMITATIONS TO THE IMPLEMENTATION

During the implementation of a prototype, the priority was to demonstrate the different aspect of the core functions rather than
putting effort into implementing pure technicalities like network capabilities, a modular back-end, database storage, etc. These properties aren’t specific for this project and can be added when and if needed. Additionally, the prototype is created for one platform which also is restricted due to different versions of the operating system.

Above: The geographical limitations of the project.

1.1.3. PHYSICAL VERSUS VIRTUAL MEETINGS

This thesis will focus solely on the nature of physical meetings, a decision which stems from a number of reasons. First of all, the study being conveyed by inobi, which this project is based on, exclusively handles physical meetings and meeting places. Second, virtual meetings have proven to be less effective than physical counterparts.
Studies have confirmed the common perception of virtual meetings compared to real life meetings and the impact of these, namely that virtual meetings doesn’t have as great impact. One of these studies conducted at MIT’s Human Dynamics Laboratory states that:

"The most valuable form of communication is face-to-face."

(Pentland 2012)

A reason for this is that interactions through a virtual meeting place becomes a meeting of both lesser quality and quantity compared to interactions in the physical domain. The reduced quantity can be explained by the “friction” which transboundary meetings often holds. To partake in another person’s world view, and thus reflecting on one’s own, is often something which can be uncomfortable. On virtual meeting places uncomfortable opinions can be easily dismissed with the press of a button, while that possibility doesn’t come quite as easy in the physical world. Many virtual meeting places offer the possibility to choose which sources opinions the users partake in, for example when “liking” something on Facebook, which further assist in reducing the friction between different groups.

The higher quality of physical meetings compared to the virtual equivalent derives from the virtual meeting places many limitations. The technical boundaries removes some sensory input such as smells, touch and eye contact. In addition to this, diversities in language enhanced by body language, voice tone and gesticulations is also limited. Furthermore, natural limitations of virtual meeting places are constructed by the program code which is what a defines a virtual meeting place, and also sets the limits what is and what isn’t possible.
2. BACKGROUND

The thesis springs out of a project done by inobi Arkitekter AB on behalf of Chalmersfastigheter. Through this project, inobi has developed a method for describing how people use meeting places, a so called interstructure analysis. The point with the interstructure analysis will be to give a better foundation for strategic development for different architectural spaces — in this case, the Johanneberg campus of Chalmers Institute of Technology. The attention of inobis work will be focused on the identification of spaces for meetings. In our work towards the three project aims listed in the previous chapter, we will mainly touch upon three fields of research; physical interstructures, interaction design, and crowdsourcing.

2.1. Spaces and places

At the theoretical foundation of this project has a its roots in the philosophy that the physical environment, in which we all reside, can influence how we behave. The list of physical environments is most likely immeasurable, but its entries could be divided into the two subcategories: spaces and places. This distinction was first shed light on by Chinese writer Yi-Fu Tuan in his aptly named book Space and Place (Tuan 1977). Breaking down our surrounding environments into these two subsets can be very useful since it helps discern why certain locations attract (or repel) certain kinds of people and activity.
In essence, Tuan states that a “space” and a “place” can both refer to the same physical location, but highlighting distinctly different nuances:

“What begins as undifferentiated space becomes place as we get to know it better and endow it with value. [...] The ideas “space” and "place" require each other for definition. From the security and stability of place we are aware of the openness, freedom, and threat of space, and vice versa.”

These feelings, evoked by physical locations through mechanics deeply rooted within our being, influence how we behave and interact with our surroundings. Successfully seeking a shelter during a thunderstorm may provide a cozy feeling of safety. This feeling then reduces stress and therefore improve ones ability to focus. So effectively, in fact, that numerous websites and applications simulating the sound of thunder and rain rumbling against a window have emerged, ready to help you ignore the sunshine outside the window when work has to be done.

Our frame of mind is of course an important part of how we interact with objects and individuals. To highlight this, we need not get more scientifical than to remind ourselves of our contrasting behaviours before and after we’ve had the first cup of coffee for the day. Or how being surprised by an early morning rain shower, without proper clothes or an umbrella to keep you dry, might imprint the rest of the day with a feeling of a constant incline. Luckily, our emotional state isn’t exclusively malleable through coffee and precipitation (otherwise this would’ve been a much shorter paper) — amongst many other things, the large physical structures that make up the architectural landscape around us has an undeniable impact on our behaviour:
“The built environment clarifies social roles and relations. People know better who they are and how they ought to behave when the arena is humanly designed rather than nature's raw stage because of the social rules encoded within the building.”

There are innumerable examples of how an architecture makes us change our behaviour — holy buildings like churches and temples, classy restaurants, fashion boutiques with all their mirrors and cool music. All the places are endowed with a unique identity. These identities could either have grown to appear out of long-time use of the place or through deliberate architectural planning, so called placemaking. As the society of urban planners, architects and landscape architects have grown more and more aware of the ability of their craft to mold the behaviour of people, using placemaking has become more and more frequent. This approach to the planning, design and management of public places aims at promoting peoples health, happiness and well-being (Project for Public Spaces 2009). The growth hasn’t been spared of criticism though. The process of placemaking often uses establishments such as coffee shops, restaurants, and stores carrying certain identities to drive the transformation of the place identity. While this often proves effective for the goal in itself, the use of establishments requiring economical compensation for the citizens to partake in them eclipses the economically weaker part of the population. Looking at the effects at a micro level, the financial strength of the areas residents often increases through making the housing more attractive and therefore driving up the prices (a process commonly referred to as ‘gentrification’). However, when eyeing the effects at a larger scale, this process often sharply segregates the encompassing society, thus halting economical and social development by reducing the social capital.
There are other ways to refine spaces into places though. By using catalysts that doesn’t require economical compensation from people for participation, people of different socioeconomical backgrounds can be attracted to the space. Getting these people to share the use and conditions of a space encourages transboundary meetings, which is one of the most powerful tools for increasing social capital. Using the encouragement of meetings rather than financial establishments as a way to cultivate spaces into places is to the avail of both the residents as well as the hosting society. The theories explaining how our environment affects the way these transboundary meetings occur can be found in the field of interstructures.

2.2. Interstructures

Interstructures can be described as the interconnected social places of a society — places where individuals interact and exchange information. The theories upon which these definitions and claims rely on are described in the Theory section. Compared to the more commonly referred concept of infrastructure, the value being generated through interstructures are difficult to directly quantify and measure. However difficult to measure though, the importance of the social values created by well functioning interstructures cannot be overstated. It is momentous for human, societal and economical development. Creating these spaces that stimulate spontaneous interactions between individuals will breed acceptance and innovation, simply because more exchanges of thoughts and ideas will occur. For us, the value of understanding the dynamics of interstructures will be in better understanding what factors that an eventual technical solution should analyse. On top of that, we will also be able to better understand the needs of the eventual technical solution’s end users: architects and city planners, among others.
The current method for analysing interstructures is both time-consuming and generates a subjective result. It uses the QGIS geographic information system (QGIS 2015) as a base — a software which allows users to create maps with many layers of information, using different map projections. For the interstructure analysis, a layer dedicated to treat the relevant data was created by inobi. The software was then installed on a Windows-based tablet, and then carried around on the campus, conducting the analysis. As you can probably notice, the solution had a sorely utilitarian design, not really focusing all that much at creating a pleasurable use-experience. Not that it really had to, since it has as of yet only been used by a handful of professionals at inobi.

Before starting the analysis, an investigation of the campus was done in order to delimit the area which would be analysed as well as identifying locations suitable for interstructure analysis. This is done in cooperation with individuals with a thorough knowledge of the area — in the case of this analysis, a work-group from Chalmersfastigheter was contacted. Factors taken into account when identifying these key locations can be, for example, physical barriers and borders (walls, hedges, privileges, etc.), ownership structures (areas requiring certain privileges to access), and informal area boundaries (a study hall mostly occupied by students of a certain field f.e.). Next, an identification of the main internal and external agent groups is conducted. These agent groups consist of the groups that regularly or irregularly make use of the area.

With the locations and agents identified, researchers are then sent out to each and every one of these locations to rate them on all the identified key properties. For reference, in the study of Johanneberg Campus done by inobi, 116 locations were each judged on circa 60 variables. The data is then manually entered into the QGIS layer–tool
for statistical visualization to render a map of the area, based in the research questions and aims of the project, for further analysis. This often amounts to a very time-consuming process, which, on top of its time–inefficiency, also leads to ultimately subjective results.

Above: An example of the results of an interstructure analysis, representing the number occurrences of places for different kinds interactions.
2.3. Interaction Design

Interaction design can be considered the hub of this project. It is a relatively young term, coined in the mid 80’s (Cooper et al. 2007, p. xxviii), and a branch of design which could be defined as “the practice of designing interactive digital products, environments, systems, and services”. Similarly to many other design practices, interaction design also takes interest in form, but differs in that its main focus lies on behaviour. Unlike the practices of industrial or graphic design, whose main focus traditionally has been on the design of static form, interaction design can ostentate a language capable discussing changing user interfaces and dynamic behaviour (Cooper et al. 2007). The practice of interaction design is also distinguished by its heavy focus on goal-oriented design, concerned most significantly satisfying the needs and desires of the people who will interact with a product or service (Cooper et al. 2007, p. xxviii).

In this project, the practices of interaction design is used to shape the way users interact with the design, so that the gathered data is as useful as possible for the architects and urban planners who would apply it in their work. Certain designs might need a combination of different technologies to filter the interesting data. Certain designs might need to effectively motivate the users to participate, so focus might be laid on the aesthetical values of the solution. Of course, choosing one of these paths often leads to straying further away from the other. But that’s why we’re here.

2.4. Crowdsourcing

The term crowdsourcing was coined in 2005 (Safire 2009), and combines the meanings of crowd and outsourcing. The word crowdsourcing has multiple definitions, many of them compiled in the paper Towards an Integrated Crowdsourcing Definition (Estellés-
In our paper, however, we found the definition of Gabriella Kazai (2011) to best correlate to our aims and usage of the term:

“... an open call for contributions from members of the crowd to solve a problem or carry out human intelligence tasks, often in exchange for micro-payments, social recognition, or entertainment value.”

Crowdsourcing is interesting for this project for several reasons. The project goal revolves around the collection of data, which isn’t limited to only objective data which is naturally easy to measure, but also involves subjective experiences. Since the Johanneberg Campus has several thousands of individuals using and experiencing it, certain number of measurements and opinions needs to be recorded in order for some kind of guidelines to appear. These can all be achieved through crowdsourcing data.

An as interesting as important aspect with crowdsourcing is finding a way to motivate the participants to contribute with their time and attention. This could be achieved in many ways, monetary compensation being the most common (Buettner 2015), but far from the only one. As mentioned in the definition, there are different motivators for users contributing to crowdsourced projects. There are certain risk with relying on crowdsourcing because of the reason the users are participating. The five most mentioned compensations are: money, altruism, fun, reputation/attention and learning. These all have their strengths and weaknesses, of course. For example, research has found, rather surprisingly, no significant quality differences between paid and unpaid crowdsourced work (Buettner 2015). Money is, however, the main reason for engaging in crowdsourced work. A strong correlation exists between the level of attention the workers
get, regarding their result, and whether they continue to contribute further or not (Buettner 2015). This would all prove useful throughout our work.
3. THEORY

This project will rely on several fields of research, which are listed below.

3.1 Theories regarding interstructures and their dynamics

Interstructures is a term first developed by a number of employees at inobi Arkitekter AB. The concept was introduced as a tool to be used in a study done in 2012 for Gothenburg University (Sernhede, Berg & Eklöf 2012). In that study, the term was first introduced as:

“...the concrete configuration of specific environments for interaction... that is able to promote and support creative processes.”

Later on in the same study, the term is explained in the context of a knowledge-centered city, as opposed to an industry-centred city:

“The structures that a knowledge-based city is dependant on is of an entirely different nature than the infrastructures of the industrial city; libraries, cultural institutions and public spaces. That is; interconnected interstructures that enable meetings, cooperations and interactions.”

In a personal e-mail conversation, Erik Berg stated that they introduced the term because they couldn’t find an established concept that managed to incorporate the function that they desired. This function, he phrased like this:
“Places that link together groups and individuals; that enables, stimulates, generates, and sometimes forces meetings, cooperation, and interaction between individuals.”

In some way, this could be incorporated by the term meeting place. This was, however, considered to be too narrow of a definition to incorporate everything stated in the quote above. They take the example of public transport as a proof of this. This, they mean, is an “interstructure of great importance”, while adding that it “isn’t generally defined as a meeting place since the meetings being generated are an unplanned by-product of its main function”. In the survey done for Chalmersfastigheter, which our thesis stems from, they make use of the following, somewhat unwieldy, definition:

“Interstructure... describes the interlinked places and the network of places within an area that enables, stimulates or forces social interaction between individuals and groups.”

In the report of this survey, Berg states, they go on with explaining that the term is very inclusive. Everything from the simple, small-scale and everyday place where we can come in contact with other people in a relaxed and spontaneous manner, to the strongly niched meeting place that has a specific goal and a well defined target group. In Att Bygga Mötesplatser, which aims at providing an introduction and a guide to creating and working with interstructures, the term is defined with a more efficient phrasing:

“The society's interconnecting social places for interaction and exchanging of information.”

(Berg et al. 2014, p 89)
This definition depicts interstructures as the spaces where the peoples’ paths are crossed in any way — a bus stop, a hallway, or a meeting room to name a few examples. Even though its short length, the phrasing is airy enough to encompass even the asynchronous meetings. These forms of meetings takes place when reading a book, watching a movie or partake of the thoughts formulated by another person. Even though these meetings are indirect, and most likely not as efficient a meeting occurring in person, their importance should not be neglected. This phrasing, unlike the two mentioned earlier, also leaves out the qualitative aspects of interstructures. This we interpret as stating that an interstructure can provide different levels of performance and quality. This is the definition that we’ve chosen to adhere to throughout this project.

### 3.2. Theories regarding meetings

When searching for a suitable definition, we’ve aimed at having the term ‘meeting’ as inclusive as possible:

> “Any activity where people come together, whether at the same place at the same time, or in different places at different times.”

*(Jay Nunamaker, 1989.)*

Rephrased:

> “Interactions and exchange between two or more people or groups.” *(Berg et al. 2014, p 89)*

Using this definition, we highlight the multi-faceted nature of meetings. They can involve just a few people, or whole populations. They can take the form of a structured and planned meeting or when exchanging a few words about the weather with a stranger in an elevator. Somewhat contradictory to these romantic statements above,
it will be useful for the project to approach the concept a bit more abstractly. Thus, we’ve used the Four Main Forms of Interaction in the Room (Berg et al. 2014, p 96). These are:

• **Presence and seeing.** “*To be in the same space, aware of each other.*”
  This is the most rudimentary and frequently occurring form of interaction between individuals or groups. This kind of meeting occurs when seeing one another and being aware of each others presence. While it may seem like a pointless interaction, there is about as much communication occurring as for any of the other forms of meeting. Through sight and physical presence cultural codes are being exchanged, norms confirmed or skewed, and social behaviours manifested. It is an important part of establishing tolerance, respect for others, norms and customs.’

• **Parallel activity.** “*To exercise parallel activity in the same space.*”
  In this form of interaction, we aren’t only aware of each others presence — we can also observe each others actions. Compared to the form described above, parallel activity has yet another layer of socialisation, safety-creation, and building of trust. Ideas, lifestyles, and inspiration is powerfully transmitted. Individuals see and copy each other, strengthening the feeling of community and belonging. This helps creating individual values, insight into the conditions of others, mutual inspiration and parallel activities.

• **Active interaction and conversation.** "*To interact through conversations or exchanging of objects.*”
  The step from mutual awareness to active interaction can often be a difficult one. It is a social gamble; misunderstandings, embarrassing events, and conflicts are all possible outcomes of the active interactions. But while the risk is higher, so is the reward. The active interaction opens the doors to deepened relations and understandings, acknowledgement, exchanging of information and ideas, conflict management, and knowledge development.
• **Cooperation and community.** "Work together and develop common goals."

The highest form of social interaction. Usually at this point, the previous levels of social interaction have been passed and a mutual trust has been established. Advanced cooperation through mutual projects and development of communities are the most value-creating — and most demeaning — forms of interaction. Creative conflict, shared visions and goals, and mutual inspiration is generated, driving social development.

### 3.3. Theories regarding gamification

Today there is a large amount of programs and application which forces developers to fight for their users interest. One method to add extra value to the application is to gamify it. Gamification is a concept which has existed for a long time but has in recent years gained the attention of researchers within interaction design. Gamification is defined by Detering et. al (2011) as:

> "The use of game design elements in a non-game context".

The gamification concept is to abstract game mechanics and gameplay feeling and applying them to activities which aren’t naturally a game. The purpose with the mix up is to motivate users to solve problems and get them to invest more time with the system. Early examples of gamification is the American Boy Scouts who implemented and used the badge system to encourage their members to seek out knowledge as well as group identification and social approval (Deterding 2012). With all the programs and applications today there are other good examples of how gamification adds extra dimensions. The internet forum for programming Stack Overflow rewards its users with badges and points for being active within the forum. Points are gained from answering questions, given by other users, in a correct and easily
understandable way. To promote good answers, points can also be lost which can help motivating users. New users are limited to the basic functions of the forum but gains more access when points are gained. Another good example is Duolingo, a multi-platform program, which goal is to teach users new languages. A user starts out with a new language and learns easy words and sentences. When the user completes a set of words he will be given experience points and can access new material on the page to learn more. The users can also compare themselves to friends which adds a competitive aspect to the program.
4. METHOD AND PROCESS

This section describes the phases through which this project was executed. The general structure of the project followed the tried and true method of user-centered design process. It is an iterative, user-centered design process, described in the book *Interaction Design: Beyond HCI* (Rogers, Sharp & Preece 2002).

4.1. IDENTIFYING NEEDS AND REQUIREMENTS.

In order to design something that has the role to facilitate people, the designer needs to know the target users and understand their needs. During this first phase in the process the designer should also find out in what way an interactive product could be useful, in order for the design to be successful. The requirements should be written down so
that the target design doesn't sway too far from the users needs. While it's important to stay close to the requirements, these can still be changed based on the feedback from user testing and/or evaluation. The first phase is also an iterative process and the requirements should be based on the interpretation of gathered data from the users. The goal for this first phase is to create a set of requirements. This set then forms the rest of the design process. In user-centered design the need of the users are fundamental.

The technical solution which this thesis project aimed at improving was peculiar in that it had only been used by one person for one (1) project. Also, the user who would input the data via the software was also the user who would be considered the end-user, handling the collected data. This was in contrast to our intended results, where the many users crowdsourcing the data and the users processing it would be completely separated. So, since there were no possibilities for user studies, observation based methods were out of the picture. The most viable alternative to this was therefore to simply conduct interviews and unstructured discussions with the person who had used the software. This proved to be a quite effective method (in spite of its informal nature) and we formed the research questions of this thesis from the insights gain throughout. The questions were posed in a way that answering them would lead to reaching the research goals.

4.2. (Re)design.

Crystallising the requirements and user needs for the design leads us to the design phase. This is the core activity of the design process and consists of applying the insights gained during the first phase of the process into structured designs (Rogers et al 2002, p 170). Our work in this stage started with some research regarding smartphone applications with similar functionality. This was done in order to gain some inspiration and insight on how to solve common problems.
Sketches were made iteratively with increasingly high definition, taking more and more aspects of the use into focus. Examples of these aspects could be ergonomical placing of UI-elements on screen and using animations and structure which would help with the use of the application in stressful environments.

4.3. Prototyping.

In this phase the designs are realised into physical or digital prototypes of different levels of fidelity. The prototypes are then used to test the design and provide the designers with new insights. As the phase progresses and the general characteristics of the design take shape, higher fidelity prototypes should be developed in order to test the specifics of the design.

Throughout this project, the prototypes were created as iteratively as possible, so that designs could be reviewed as thoroughly as possible by as many people as possible. The prototypes created varied wildly in fidelity and functionality. In the lo-fi end of the scale were simple, chicken-scratch paper prototypes, mainly used as an aid to describe ideas between the group member. The next step was creating mockups using software dedicated for the cause, like mainly Balsamiq (Balsamiq 2008) and the web based Moqups.com (Encoder Software SRL 2013), detailing the layout of the UI elements. Finally, there were the high-fidelity, interactive prototypes pushed onto the smartphone, using the web-based prototyping tool Proto.io (Proto.io, 2015).

4.4. Evaluating designs.

The evaluating of the design puts focus in how well the design meets the requirements for the first phase. Testing the prototype as well as the requirements serves as a base for the evaluation. By evaluating the design, problems can be located and redesigned iteratively.
Having laid the bases of user requirements and the functionality of the design, we started threading the path towards creating a smartphone implementation of the design. For this, the Android platform was used (Android 2008). As so often is the case, the alternative to the Android platform was iOS, but since the project group lacked any experience in programming for iOS, the apple was thrown into the waste bin.

4.5. Implementation

The prototype was built in three different stages. From the design and project proposal, all information about what data was supposed to be gathered and how this was supposed to be used later was extracted. This information was then used to design a backend which could support these features. Included in this stage is also how the data was supposed to be saved, loaded and forwarded to other parts of the application as well as exported to other systems.

With a crude base for the back-end, the development with the visual core was started. The centrepiece of the application was the map and the interaction with it, for example adding markers to the map and handling the information with these. In addition to the basic touch gestures such as scrolling, zooming and panning some custom responses were added, the major one here was the long press response for adding a marker manually. Additionally, the GPS functionality was also developed with the map. This includes calls to the systems location manager and how to handle updates.

When the core mechanics as well as the back end functionality was formed, the appearance was developed. The graphic elements of the implementation were updated to match the look and feel of the mock-up design. In this stage a lot of changes were made to the graphical interface, such as the layout and typography. This is also where sounds
and other type of feedback were added, such as animations and visual feedback. This process started out with creating a base animation and then adding details on top, such as the length of the animation and interpolation of movements.

During the research of the platform, Google Maps API was used for map support. Google Maps worked well because of Google’s involvement in the Android system. But from the design point of view there was a need to stylise the map tiles in a custom way. For this purpose Mapbox, provider of custom online maps, was a good alternative—both because of the flexible styling but also since their Android API was developed to support the prototype’s functionality. Furthermore, Mapbox is built upon OpenStreetMap (2012) which is a free map system with user generated content. Since one of the goals with the project was to create a crowd sourced solution where the data input were to be shared this platform aligned better with that purpose.

A large part of the visual impression of the interface stems from the appearance of the map. One of the main advantages of using the Mapbox platform is the widely customisable visual appearance. Mapbox uses CartoCSS, a derivative of the CSS language, for styling its elements. The main difference between CartoCSS and CSS was that CartoCSS addresses different layers of pre-defined classes with map data (#landuse, #water, #building, and so on.), instead of user-defined visual elements. The flexibility of the maps styling allowed the general visual appearance of the application lead the development of the look of the map, rather than the other way around. Below are two pictures showing the same area of Gothenburg using the default map appearance and using the final iteration of the custom appearance.
Above: The default (left) and the final (right) styling of the map.
5. RESULTS

This chapter presents the final iterations of the concept and the prototype as well as a set of guidelines for future studies within the field of interstructure analysis.

5.1. Concept

The work began by searching for a suitable technical platform. Many solutions existed for monitoring movement of individuals, such as low-energy Bluetooth transmitters or physical sensors permanently placed in stores or other buildings. However efficient these may have been in tracking user movement, they don’t provide the possibility for the user to interact with them. This means that the user won’t be able to convey their observations and subjective analysis of the situation, which is of a high importance than track their movement. These solutions were therefore not suitable for this project, which therefore rendered the smartphone application—albeit unoriginal—as the best option to base the concept on. This, since it was the one that most efficiently was able to provide a platform for a design that would help sourcing data for an interstructure analysis, mostly because of its established user base and availability.

Different parts of the concepts has different target groups. The design will mainly be used by participants of the study (most likely students or teachers at Chalmers University) in exchange for some form of compensation. In the other end of the use-flow there will be architects and city planners using the data to identify patterns in the use and experience of the Chalmers campus.

The core feature of the concept is allowing the users to tag geographical locations and answer a short questionnaire, which is linked to the geographical location. The questionnaire is constructed
from two types of questions. The first type consists of questions focuses on the users themselves — what they are doing at the location and their subjective qualitative experience of it. The second type of question asks the user about their surroundings: how many people are residing the location and how many are just passing through? What are the people residing there doing? Because of the importance of the temporal aspects of the answers, the same location can be analysed multiple times. The gathered data is then exported into suitably formatted files for further analysis.

5.2. Guidelines.

Because of the tender age of the field of interstructure analysis, one of the goals with this project was to compile a set of guidelines to facilitate further research and future projects.

1. **Consider the quantity and type of data being collected.**

An interstructure analysis which addresses all the theoretical aspects of the field contains a lot of different types of data: subjective, objective, quantitative and qualitative. Some data might contain some temporal aspects, like the flow of people at a certain location.

A. Not all forms of data needs to—nor should be—collected through the user manually inputting them. Upon deciding if the data gathering should be automated or not, two aspects should be considered. First of all, is the relative size of the data sets way too large and unwieldy for humans to be able to efficiently compute it? For example, identifying the natural paths which people use requires movement data from the users, which typically generate huge datasets. This problem could be mitigated through reducing the size or quantity of the dataset, if there is room to do so without reducing the quality of the gathered data too much.
B. The second aspect which needs to be considered: can the users interpret their behaviour in a more efficient and/or effective way than an automatic solution would? This if course closely depends of the goal of the study being conveyed. For example; ones location can both be expressed subjectively ("at the crossing of Leonard and Richardson Street") or objectively (40°43'06.6"N, 73°56'54.2"W). The first form of expression is of course less geographically accurate than the set of coordinates and definitely bulkier to handle in data sets, but if the study, for example, is trying to identify which land marks users orientate themselves after, the subjective form of expression can encompass more relevant aspects, making it potentially more useful.

2. **Combine intrinsic and extrinsic motivation for a distributed result.**

In a study on the crowdsourcing market *Amazon Mechanical Turk* (or *MTurk*) Kaufmann et. al (2011) found that crowdsourcing attracts a user base with a demographic distribution representative of society. Through setting up a task at *MTurk*, which consisted of a survey open for all users, on the usage of the service. They then analysed the demography of the users who had completed the task, and the results consistently showed a diverse distribution between genders, education level, income, age, as well as time spent with the tool. This distribution was very similar to those of other studies that has been conducted on the subject (Ipeirotis, 2010) (Ross et al., 2010)—a thorough enough base for us to conclude that crowdsourcing can attract users from all socio-economic sectors.

The same study states that the motivation for the crowdsourcers is a combination of intrinsic and extrinsic motivations. Depending on how much time is put into the task there are different motives.
Users who put in little effort participate in crowdsourcing projects for intrinsic reasons while users who invest more time usually aim for extrinsic rewards.

Since interstructure analysis mostly revolves around personal opinions, which is regarded as sensitive data, trust between the users and the project is an important factor. By providing information about the analysis and adding an overall transparency to the project, users might have an easier time understanding what they are sharing their information for, which might make it easier to trust the study.

5.3. Prototypes.

The work throughout the project resulted in two main designs. The first one, dubbed Prototype 1 (creatively enough), took on the role to show how a rather complete technical solution could look like and function. Implementing would take too much time, so it was only gestalted in the form of a design mockup. Contrastingly the second prototype, dubbed the Prototype 2, aimed at providing a base for exploring the implementation of the core functionality of the design.

PROTOTYPE 1 (PAGE 38 & 41)

The P1 concept aimed at providing the conductors of the interstructure analysis, as well as the users themselves, a powerful tool for both creating an interstructure analysis and digesting the gathered data.

For this concept, we started out by classifying the gathered data into two main categories. These categories were based on whether a certain type of data would require the users’ physical presence at the location in order to ensure the gathered data’s accuracy (dynamic data) or not (static data). The first screen, the Logging screen, housed the functions which required the users to be at the location they were analysing.
These functions are the following:

- **Starting and stopping the positional tracking (A) in order to identify paths throughout the area (E).**
  The logging button (A) uses established symbols for starting and stopping and is larger than the other UI elements in order to make it easier to interact with in less-than-perfect conditions. When the positioning is enabled, the location marker (E) starts to glowing and producing a trail to visualise the users movement.

- **From a dropdown menu choosing between a number of common activities in order to described their current one (B).**
  This is done in order to identify what activities locations are mainly used for. When inactive, the dropdown menu takes the shape of a speech bubble pointing at the users current location—this is to symbolise how the information being entered will relate to it.

- **Input information related to locations identified by the leaders of the survey as especially interesting (D).**
  These locations—dubbed mission spots and represented by green markers—are locations that were identified as locations especially important for the nature of the studied interstructure. To add information to one of the mission spots, the users has to be within a certain minimum distance from the spot. With the positioning active, the user could receive a notification when within reach of a mission spot. If the user choose to complete Add screen with one or more fields already filled out (the name of the spot for example). These mission spots could act as a suitable base for an eventual implementation of gamification or pontification system, because they are of a limited quantity as well as demand extra effort from the users.

- **Navigation bar with an approximated location and the ‘New Spot’ button. (C)**
  The New Spot leads (as the name might suggest) to the screen which allows user to add new spots to the map – the Add screen.
Here the user can input a multitude of data—both the kind that requires physical and the kind that doesn’t. The approximated location will appear as a name suggestion which is used as name suggestion when adding new spot (see Add screen).

The second screen— the Spots screen— handle the static data. This includes adding new static data to already added spots, but also partaking of the dynamic data that has been collectively gathered by all users. This screen aims to both be useful for urban planners while giving user the opportunity to partake of the information. Doing the latter could have several positive effects:

- It gives the users a chance to better understand the project. Through understanding the goal of the study, the users could be able to provide data of higher quality. Of course, this could also skew the data, and this needs to be addressed. Through understanding the project, users could also be inspired to start acting for these kinds of interests themselves.

- Shooting straight and being transparent about the way the data is treated through letting the users partake of it should help create a trustworthy image of the study. This could be an important factor in order to overcome a common hurdle in larger scale behavioural studies: users hesitating to participate on the grounds of being worried about their integrity risking exploitation.

- It could act as a motivational factor. Seeing confirmation of ones efforts and, through the UI, accentuate that they actually make a difference motivates participation. Particularly, the UI should adress the factors described in the psychological theories of expectancy, which claim an important part of motivation as the difference between expected effort and desired performance. These two factors are collectively based on three components:
A. Self efficacy, which is the users belief about their ability to successfully perform a particular behaviour.

B. Goal difficulty, which refers to the perceived attainability of the desired results of a particular behaviour.

C. Perceived control, which is the perceived degree of control of the final outcome of a particular behaviour that a user possesses.

It is primarily the last component (Perceived control) which is affected when emancipating the users with the gathered data. We base this on the anticipation that the users would relate their efforts to the patterns which they are helping emerge through the data, thus realising that they have a say in how things emerge.

It is a lot of information though and to be able to somehow handle it all, the concept uses layers for presenting the different sources of information. By tapping the Layers button (I), a drawer would appear from the left with a host of information layers to choose from. In addition to the layers there would be a number of filters to choose from, which would filter the many data entries of which each informational layer consists. Neither the layers nor the filters are entirely defined in this design, since these would need additional time of testing and discussion to be properly decided upon. Examples of eventual layers could include, but not be limited to: a layer for paths, a layer for spots added by users, and a layer with mission spots, amongst others. Examples of eventual filters: time of day, the age or profession of the contributors, and external data at the time that the spot was added, for example weather data.

With these powerful tools—which otherwise would be limited to the urban planners conducting the study—being introduced to all the users opens up a new dimension of the project. Allowing all users to partake of the gathered data will help spread an understanding of the project and of the problem which it is trying to solve. Also, by letting a
large number of users combine the filters and data layers any which way they please, the work with identifying eventual behavioural pattern would be effectively crowdsourced. This could help speed up the process or even discover patterns which otherwise could’ve been missed.
Continuing on: the third main screen—the Add screen—appears when
the user chooses to either add a new spot, to add information to an
already established spot, or to complete a spot mission. The screen
could have slight variations in the content between these three cases,
but the layout and use flow would be identical. The screen consists of
a number of elements:

- At the top resides the menu bar (L), contains two elements: a text
  field for naming the spot and a Close button for returning to the
  previous screen. Upon tapping the text field, a number of nearby
  spots are suggested for the user to choose from. Part of the reason
  for this of course to perhaps save the user the hassle of typing. Most
  importantly though, it is an effort to make the gathered data more
  organised—since the data sets are connected to spots through their
  names, typos and semantical differences between users would cause
  multiple spot entries, instead of connecting several sets of data to
  the same spot.

- The focal point of the screen is the spot dialogue (J). This is where
  the main part of the information regarding a new spot is entered. It
  contains a number UI elements for input of a multitude of data.
  Amongst these are a drop-down menu where the user can choose
  the main activity at the spot from a number of common activities
  and a button for attaching photos to the spot. Since the dialogue
  most likely would contain a lot of elements with inquiries, these are
  distributed throughout several pages of dialogues. To switch
  between these pages, the user can either swipe the dialogue left/
  right or use the navigation bar (K).

- The navigation bar (K) resides at the bottom of the screen,
  according to prevailing norms. It contains a breadcrumb to show
  progress, a button for switching between the dialogue pages and a
  Save button.
Finally, there is the Profile screen. This is the platform for conveying neatly formatted statistics and information regarding the use and the gathered data back to the user (M). The role of the screen is to provide further feedback to the user, communicating that their efforts have generated results.

The Profile screen also contains a menu bar (N), housing buttons for Information and Settings. Both of these use icons well established for this purpose. Tapping the Information button (left) shows information regarding the study, the application, and its designers. This also aims at inducing more trust towards the app from the user. The Settings button (right) takes the users to the Settings screen (not pictured) for changing personal information. Exactly what kind of information that the user should be encouraged to enter is not entirely defined, but important aspects could include age, gender, and occupation.
The prototype originating from the last iteration of the design——named Prototype 2 (P2) for the sake of consequence—is heavily simplified compared to the P1. The change in scope came from a change of the request from the clients. At the half-time meeting of the project, they expressed their wishes for an implemented and functioning design. We chose to try and fulfil these yearnings, a significant change of path in the project (further discussed in chapter 6.3.). A major change came in the user group which the design was aiming for. While P1 aimed at recruiting as many users as possible, motivating them by accentuating their personal progress and the societal benefits of their efforts, the clients wishes regarding P2 was wholly different. Their aim was for P2 to simply function as a tool to be used by a-handful-or-two of specially chosen users which would receive economical compensation for their efforts. This shifted the main source of motivation from intrinsic towards extrinsic, as well as shifting the role of the design towards acting as a tool with a use as streamlined as possible. This resulted in the P2 design and concept.

The P2 was given a very sparse and monochrome visual appearance. This was done for two reasons. First of all, it aimed at reducing the number of interactable elements. This freed up screen real estate, which could be used to make the elements larger and with more surrounding space, making it easier for the users to tap the correct element. Secondly: since this design most likely would land close to a final product to be used by the clients (Inobi Arkitekter AB), it would be useful to implement the brand identity. In Inobis case, the brand identity is exiguous in both layout and color, which we aimed to adhere to.
The prototype consists of three main screens:

1. The Map screen. Ingeniously named so because of the discreetly coloured map (O) taking up the vast majority of the screen space. Sticking to to the minimalist string of thought, the only location that is labeled is the area which houses the study: Chalmers Institute of Technology (Chalmers Tekniska Högskola). The screen contains a location marker (P), showing the users current location. At the bottom of the screen is a menu bar (Q), containing three elements: the Locate button, which centers the map around the users location; the inobi logo; and the Add Spot button. Tapping the latter shows the Spots screen.

2. The Spots screen continues the streak of gaunt visual design. Here, the user can choose to add a new spot (R), or choose to add data to an already established spot close by (S). Three nearby spots are listed at most, and they are sorted by distance from the users current location. Tapping either +New Spot or one of the spot suggestions will show the Data screen with the one difference that the latter will have their name (T) already defined on the Data screen.

3. The Data screen accommodates all the different controls through which the user can input different forms of data. Note; since the data screen consists of a scrollable container housing all the data entries, the mockup below doesn’t show all controls. Most of the data types were one-dimensional quantitative or quality ratings which only required simple controls in order to be input; spinners and horizontal sliders (Tidwell 2010). One data entry though—the average flow of people— differed in that it was two-dimensional. The flow of people is a quantity in relation to time, so for this data entry we created a different control: a flow counter. This allows the user to count the number of people passing in a certain amount of time.
When inactive, the flow counter is a large, dark button. Pressing the button activates the counter: the dark circle is resized it, revealing a light gray round progress bar. The title of the button changes to a counter, as the progress bar starts to move. Tapping the, now smaller, dark button, adds one count to the counter, until the progress bar has gone full circle indicating that the time is up. This deactivates the dark button and resizes it to its former glory, while displaying the counted number of people and locking it from interaction. At the bottom of the Data screen is a Save button. Upon tap, a confirmation is displayed and the user is taken back to the Map screen.

Above: The inactive and active state of the flow counter.
6. DISCUSSION

This chapter focuses on the ethical and societal implications surrounding the thesis.

6.1. Gamification

Unfortunately due to a shift in focus, from concept design to a working prototype, the gamification part wasn’t developed to the extent set out in the beginning. We think, however, that gamification as a method could be of good use with interstructure analysis and crowdsourcing, and should therefore be examined further in future projects.

6.2. Integrity issues

Integrity will most likely be the biggest threshold to overcome at an eventual launch of the concept. While the core functionality of both prototypes directly deals with the users personal information, the P1 prototype deals with a great a number of sensitive sets of data compared to the P2. These include movement data, information about the users activities, demographic affiliations, and personal preferences regarding a number of things. Gaining the trust of the users to make them willing to give out this information will be an important challenge to manage, even if the data is treated with optimal attention to anonymity. This is of course a subjective factor, in most cases nothing but a gut feeling being dictated by the users image of the product, of the brands relating to it, and the general attitude of peers and society in general. Of course, these opinions are far from set in stone, can be shaped through marketing campaigns for the product as well as the factors surrounding it, which of course are subjects for further ethical implications. While it is an interesting topic, our lack of competence makes it a discussion for another paper.
In our prototypes, we aimed at addressing this problem through making the designs aim at providing the impression of reliability and thoroughness.

6.3. Implications regarding project limitations

So, to address the design methodical elephant in the room: why weren't any user testing done? To start off, some user tests, of a very informal nature, were conveyed. While they definitely helped us gain some insight, they didn't produce results concrete enough to be presented in written form. In addition, our research questions didn't contain aspects which required user tests to be answered. With that said, thorough tests and discussions with the different user groups could've definitely been of use.

Even though the user interfaces most likely could've been tweaked and optimised a bit, the general layout and function of the design follows so well-established approaches within user interfaces that most users most likely would be able to use the design well-enough right from the get-go. No, where user testing most likely would've contributed the most is to explore how users unfamiliar with interstructure analysis would've understood the study, as well as exploring how the end-use of the gathered data would've looked like. The gathered data would've most likely been used as base for presentations — how could this be facilitated? Should new users be welcomed to the application through an intro in interstructure analysis? These questions could be suitable for future work within the field of this project.

6.3.1. A SHIFT IN FOCUS

During the mid project presentation, focus was shifted from designing and testing P1, to creating a working prototype. This led to the development of the P2. This change resulted in an important shift in focus in terms of the main user group. With P2, in contrast to P1, the
users were supposed to be recruited in a more direct manner. Additionally, the users were also supposed to get some form of compensation for the time put into the project. With these major changes, constructing motivators within the interface lost a large part of its critical role in its functionality. This is why P2 doesn’t make use of the motivational tools as much as P1 does.

6.4. Implications of the designs

The first prototype, P1, targets more users and doesn’t limit the user base with its design. The open solution can under good conditions get a good spread of users spanning over most demographics. However, what haven’t been discussed is how to reach the optimal user base regarding different demographics or the amount of users. Additionally, how to market the application haven’t been discussed either. The user base of P2 is controlled in a better way since the users are recruited specifically for the task, thus, the users’ qualities can be handpicked.

Some users, partly those passing by an area being subject to an interstructure analysis, are hard to reach. These people, who use the areas daily, but only in a short period of time, probably have thoughts about an eventual change as well. Taking Chalmers campus at Johanneberg as an example, there’s also companies spread out the area, whose employees also visit the area at certain times. To reach out to these groups of people some kind of marketing or direct contact would be necessary.

6.4.1. DESIGN FOR ALL

There are two main problems regarding accessibility with the design. Some parts of the design demands that the user is present at the spot which is being analysed. The other problem is that it’s designed for smartphones. These problems limit the usage of the application from certain groups of people. The older generation isn’t as used to working
with the smartphone, making the usage unnatural. Other demographics with physical and/or mental variations may limit their usage in other way as well, such as difficulties holding a phone or their ability to absorb information. Reaching out to the demographics who aren’t naturally using the areas being analysed is also a problem. The reason for their absence in the area would also be interesting for the analysis. Creating a tool aiming for a more democratic solution to urban planning while effectively excluding certain groups contradicts itself. Solving these problems is something which would get attention during further development of the designs.

6.5. Impact on interstructure analyses

The concepts which came as the results of this thesis all aim to change the way interstructure analyses are conducted. They intend on speeding up the process as well as increasing the quality of some of the data gathered during the analyses. However, the implementation of the concepts might have other consequences on the process as well. The most prominently change would most likely be on the process of analysing the data. While the original solution produced a quite large set of data, it would most likely be a flatulence in the voids of deep space in comparison with the amount which would be gathered in a crowdsourced study. In other words; data handling would become an issue which would need to be addressed.
7. CONCLUSION

We consider the research goals—a set of guidelines, a defined design, and an implementation—to have been reached. We also consider to have answered the research questions:

1. Through considering the data type—and automatising the data gathering thereafter—we consider it possible to create a technical solution capable of gathering relevant data of good quality.

2. Implementing this solution using crowdsourcing as the data gathering method would help reaching a statistically sound quantity of data—thus creating a bedrock of information upon which the aesthetical processes of architecture and urban planning can be supported.

However, to achieve this and keep the users motivated to participate demands a design which motivates the user in different ways. This depends on the user, and could be done by using either intrinsic or extrinsic rewards.

We hope that this project shows the potential of using interaction design for improving both efficiency and effectiveness of interstructure analyses. By creating a simple and versatile tool, that is easily adopted and enjoyable to use, the threshold is reduced for introducing this still novel field to a wider audience. This, we hope, will help shed light on a group of variables which describe the way we use places—a group of variables which usually are treated as arbitrary factors. Concretising and including these factors into the work process of architecture and urban planning will hopefully pave the way for cityscapes aiming to create meetings—and learning opportunities—between people and cultures all over the world.
8. FUTURE WORK

Concerning future work directly connected to this project there are numerous ways to pursue further work. Conducting user tests would most likely uncover a number of ways to develop this form of project. In terms of interaction design, more time can be invested into exploring the methods for creating motivation through the UI, and the way the end-users (the architects and urban planners) treat the gathered data and how this could be improved.
REFERENCES


