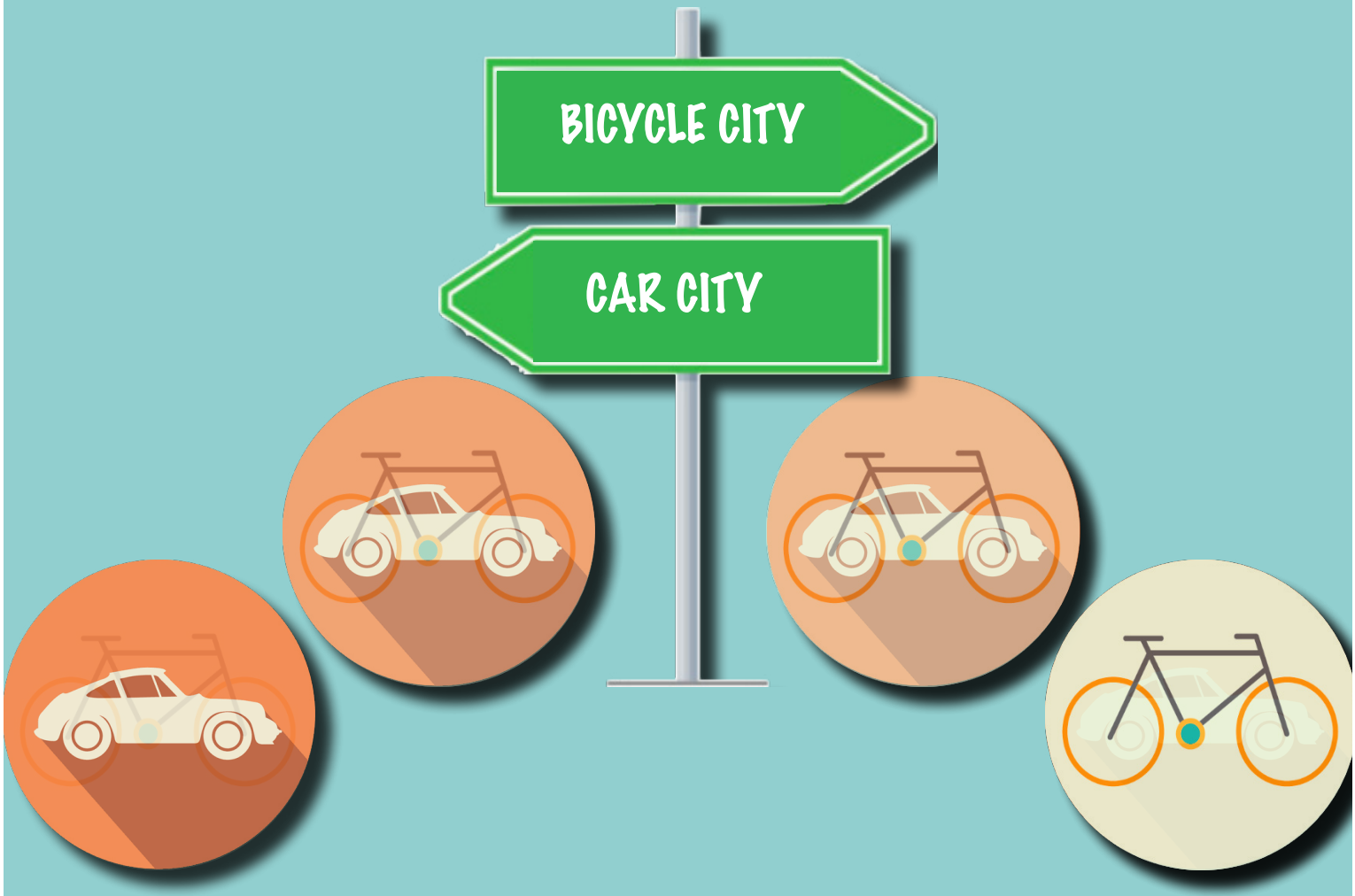
How to design a tool that will contribute to a lower-stress cycling experience?

Designing a solution that will disrupt the current socio-technical regime, people's practices and will re-arrange the way we perform and valuate cycling



AALBORG UNIVERSITY
STUDENT REPORT

TITLE PAGE

Education:	MSc in Sustainable Design
Educational institution:	Aalborg University Copenhagen
Project period:	February 2018 – June 2018
Course:	Master Thesis Project
Supervisor:	Birgitte Hoffmann
Collaboration Partner:	City of Darebin

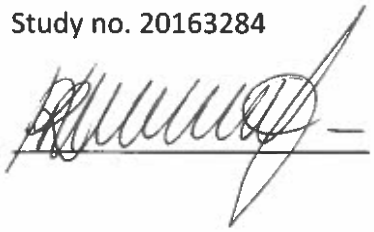
Title:

How to design a tool that will contribute to a lower-stress cycling experience? Designing a solution that will disrupt the current socio-technical regime, people's practices and would re-arrange the way we perform and valuate cycling.

Author:

Rūta Kniukštaitė

Study no. 20163284



Abstract

This project is a study case of Melbourne that addresses the complex process of sustainable transitions in mobility. The study explores Melbourne's heavy, car-focused socio-technical regime and people's challenges and barriers to bicycle commuting. It presents navigational pathways as a method to look for cracks in the existing regime while building new networks to support and encourage the sustainable transition. The project addresses stress as the major deterrent of cycling and explores how to design a safer, lower-stress and more enjoyable bicycle commuting practice. The project proposes Comfort Cycling app to lower-stress cycling experience as a tool to disrupt the existing regime, address car-based practices and involve relevant actors in the network. The main findings of the project suggest that assigning new values to cycling, building new networks and designing a new cycling practice are the basis of enabling the sustainable transitions.

Preface

This project is carried out as a Master's Thesis of the final semester of Sustainable Design program at Aalborg University in Copenhagen. The inspiration for this thesis evolved from my time in Melbourne where I undertook the third semester's research project that looked into the city's liveability and examined the challenges and opportunities of bicycle commuting. I decided to continue to work on cycling however, now focus on designing a new and better bicycle commuting practice.

Undertaking a project in the environment that is very different in many ways was not an easy task. It challenged me as designer and as a person to adapt, learn more about the culture and embrace its local context. I learned the importance of observing, listening when seeking for answers and deter from making general assumptions.

Working on my own was another challenge that I have experienced. At times it was easy not to be dependent on anyone and schedule the process of the project as desired. Nonetheless, I have also learned how valuable the team work is to projects and their outcomes. Working in groups allow us to learn from each other and challenge each other, constantly question and evaluate the process and the ideas. These are the important lessons that I will carry with me.

Acknowledgment

I would like to express my sincere gratitude to my supervisor Birgitte Hoffmann who helped and supported me throughout the entire process of this project. Her remarks, constructive criticism, insightful comments and engagement in the project challenged and guided me from the very beginning to the very end of it.

I would also like to thank Angela Andrews and the rest of the City of Darebin team for devoting their time and knowledge and expressing the enthusiasm in this project. I hope that it will contribute to Your further work.

Finally, I would like to thank everyone who contributed or were involved in this project. I greatly appreciate the time, knowledge and feedback that has been given.

Table of Contents

CHAPTER 2 →

CHAPTER 1: INTRODUCTION

The city of Melbourne is well-known for being one of the most liveable cities in the world. Despite this, the impact of climate change continues to play a pivotal role; extreme weather events, drier and warmer climate compared to historical averages, new heat records and the number of days where the temperature went above 35 degrees exceeding prior projections for 2030 (Climate Change Adaptation Strategy, 2017). As a result of such impacts it remains essential that strategies continue to be put in place in order to minimize the adverse impact of climate change and promote sustainable transitions.

The following thesis aims to tackle the complex challenge of addressing green mobility and conscious choices of using sustainable modes of transport. The inspiration for this paper evolved from my time in Melbourne where I undertook a research project that looked into the city's liveability and examined the challenges and opportunities that could help increase cycling participation. This thesis will continue to focus on cycling however will now aim to concentrate on the next step; a design phase which will examine the deterrents and facilitators with the concluding objective of presenting a tool which will help make cycling a more enjoyable practice.

1.1. Previous Finings

The previous analysis of the research project showed that Melbourne, throughout history was designed and constructed as a car-focused city. Long travelling distances, affordability of cars, fuel and the high status symbol of car ownership stabilized the car-dominant regime which continues to this day. With increasing car ownership and use congestion has become a problem that is affecting the city and its citizens; delayed public transport, 90 minutes on average spent in the car daily (ABC News, 2018) and expensive parking facilities has increased people's level of stress. Despite these issues the car remains as the dominant mode of transport while cycling is perceived as less legitimate, dangerous and a male dominant form of activity.

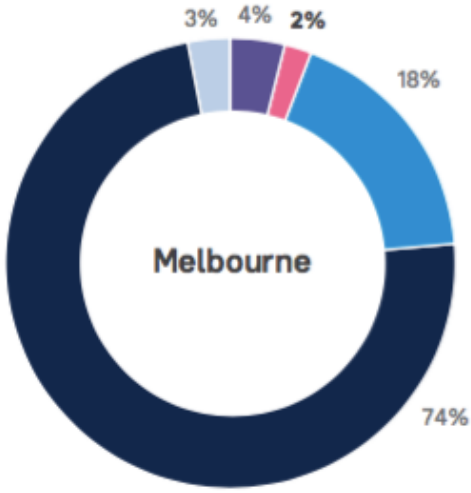


Figure 1. Journey to work by mode of transport. Source: Victorian Cycling Strategy 2018-28.

Cars have formed a strong path-dependency which creates a number of challenges for making the transition towards more sustainable modes of transport. *Figure 1* presents that 74% of all trips made in Melbourne are done using a private vehicle while just 2% are made on a bicycle (Victorian Cycling Strategy 2018-28, 2017). Socio-technical networks such as interrelations between infrastructure, facilities, people's practices or regulations are built and formed around vehicles which makes it difficult to change as councils continue to emphasize limitations in budget. With a continual lack of government funding, investment and collaboration between key stakeholders forming an improved transport and cycling culture will remain a challenge.

There is a constant struggle between actors who own roads in Melbourne. Road owners are more likely to invest in something that brings an economical value in return. Car park revenue is one of the cases; it is an enormous source of income and therefore it stays stable (Appendix 1). For this

reason, the actors have this distortion where they do not want their roads to be used for bike infrastructure as they do not have to pay for it. As a result, there is an ongoing struggle between stakeholders and actors.

The deterrents of bicycle commuting, socio-technical elements and social perceptions about cycling encourage people to use a car. Cycling in Melbourne is not seen or performed as a strong practice and therefore cars continue to dominate in the city.

1.2. Problem Area

In the research project I identified the key challenges and values that prevent or motivate people to ride a bike. These insights could be used creatively when generating ideas to help encourage increased bicycle commuting. Traditional planning methods such as reinforcements that hinder car use is a big change for the state, hence it might not be a realistic approach in such a car dominant city. Furthermore, it could create more tension among different road users and more importantly might not provoke a transition. The city needs to look beyond the traditional methods and tackle the problem from a creative and broader perspective. As a sustainable design engineer I work towards sustainable transitions; addressing existing regimes with the tools and ideas based on the design thinking approach in order to deconstruct them. In the meantime, building new networks and new relations to support these tools and ideas that are designing the change. Therefore, with this master thesis I intend to strategically work on destabilizing the heavy regimes while creating new networks in order to push the sustainable transition.

1.3. External Collaboration

In this project I established an informal collaboration with the City of Darebin in Melbourne. The council is located in the northern part of the city and has a population of over 155,000 people (Profile.id.com.au, 2018). Despite having a good reputation for cycling infrastructure and participation (Appendix 2) the City of Darebin has an ambitious goal which is to create a culture of cyclists where the bicycle is used as the main mode of transport. Furthermore, they aim to make riding enjoyable, safe and relaxing for everyone (Darebin Cycling Strategy 2013-2018, 2013).

In the previous project I conducted an interview with Angela Andrews - a Senior Project and Policy Officer in the City of Darebin - where we discussed key challenges for cyclists in Melbourne. Several ideas were exchanged and key areas were identified that needed to be tackled first in order to establish meaningful change which could enhance the cycling experience. It was agreed that cycling induces a high-stress environment which requires further attention. Angela shared the idea of an app that the City of Darebin had envisaged for the classification system and trail grading. Such a system would enable commuters to have knowledge on routes and guide people within the network. One shortcoming was the lack of people who could develop this idea further. Since deciding to continue my project on cycling I reconnected with Angela with the aim of helping popularize cycling in Melbourne.

1.4. Problem Formulation

A key issue identified in the research project was that cycling causes stress. The research suggested that shortcomings of infrastructure and inappropriate behavior created this high-stress environment. Stress was seen as a major factor which influenced an individual's decision when selecting a form of transport. With this project I aim to design and propose a tool that could reduce associated levels of stress which appear when cycling and help to optimize the overall cycling experience. Therefore, the problem formulation is:

How to design a tool that will contribute to a lower-stress cycling experience? Designing a solution that will disrupt the current socio-technical regime, people's practices and will re-arrange the way we perform and valuate cycling.

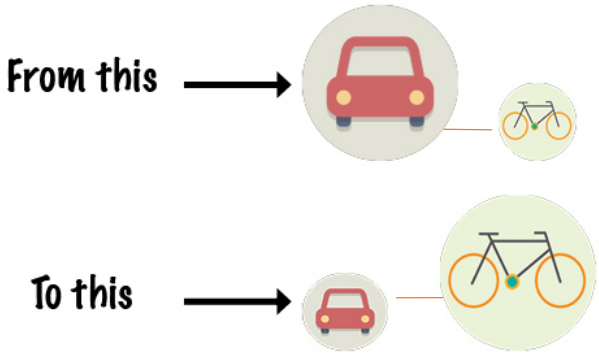


Figure 2. From a car city to a bike city. Own figure.

CHAPTER 2: PROJECT DESIGN

This section explains the design process of the project and how I addressed the research question. Furthermore, it outlines the theoretical and empirical inputs and how they are related.

Previous research project pointed to several important problems that prevent bicycle commuting. I addressed these problems further in this master thesis project. I described and analyzed the identified challenges and used them as opportunities to enhance cycling and its experience in Melbourne. Discovered challenges experienced by citizens concluded that stress played a crucial factor in the transportation choice. Cycling was seen as a stressful activity that is often used for sports purposes rather than commuting. This project is based on the design process with a focus on sustainable transitions. Therefore, the problem formulation was established with the basis of designing a sustainable practice that not only will lower the stress and optimize the overall cycling experience but will also challenge the unsustainable car-focused regime.

The collaboration with the City of Darebin council was established during the project's process. As we discussed the possible directions of the project the idea of an app that would classify routes into different categories in regards of level of stress they hold was presented. I decided to explore this idea further and see if it could be part of the transition process.

In sustainable design field the design approach is mixed with sustainability where the focus is placed on transitions. With this in mind, I used theoretical framework of Geels Multi-Level Perspective theory, Callon's Actor-Network Theory and Design Thinking approach combination. I used Geels Multi-Level Perspective (MLP) approach to describe and analyze the heavy socio-technical regimes. I did not use the MLP theory throughout the entire project as the theory itself is good in explaining the regimes but not on how to change. Therefore, I chose to work with navigational pathways to look for *cracks* in the system and use them as windows of opportunities to destabilize the regime and provoke the transition. The Actor-Network Theory (ANT) was used to explore and form new relations to design the new future together and build new networks in order to pressure the regime. I made an analysis that described the existing lock-ins in Melbourne. Throughout the process I was able to identify crucial cracks in the regime that the design could address in building new networks and I chose to investigate them further.

To have an overview of current cycling and vehicle usage situation in Melbourne I enhanced my background knowledge through the desk and literature research. I explored and analyzed the current cycling strategies and future goals of how cycling is planned to be performed and promoted. Chosen design methods were used to facilitate a communication with the relevant actors and get into dialogue about urban development. Design games helped to identify more challenges, explore the existing relations between the actors and involve them into design process by gathering the data on cycling and commuting practices. Empirical findings enhanced the project with the new insights, challenges and new cracks that were summed up and used as windows of opportunities to disrupt the regime. All possible design ideas for this project to promote and optimize cycling were proposed and analyzed along with the theory. This created a framework for design brief to examine and evaluate the ideas in order to delimit the focus of the project.
The app to lower-stress cycling experience was chosen as a design proposal. The app was presented as a tool that strategically works on deconstructing the regime by creating new relations and addressing citizens' and councils' challenges. The proposed app designs and promotes new,

sustainable practices, helps to overcome the experienced barriers and presents cycling in new light. The role of this app has been explored throughout the project and has been argued to be an essential part of destabilization process, construction of new networks and the overall sustainable transition.

The prototype of the app was constructed throughout exploring other similar apps or strategies that address the topic of stress in the practice of cycling. Several ideas were taken and used to build the prototype that was later tested by the fellow classmates. In the discussion chapter the design proposal was evaluated through its role in the regime, practices and building new relations. The paper concluded that the proposed app is just one part of the whole transition process. However, this part is essential as it works on designing the sustainable future by the new ways of how we see, perform and value cycling.

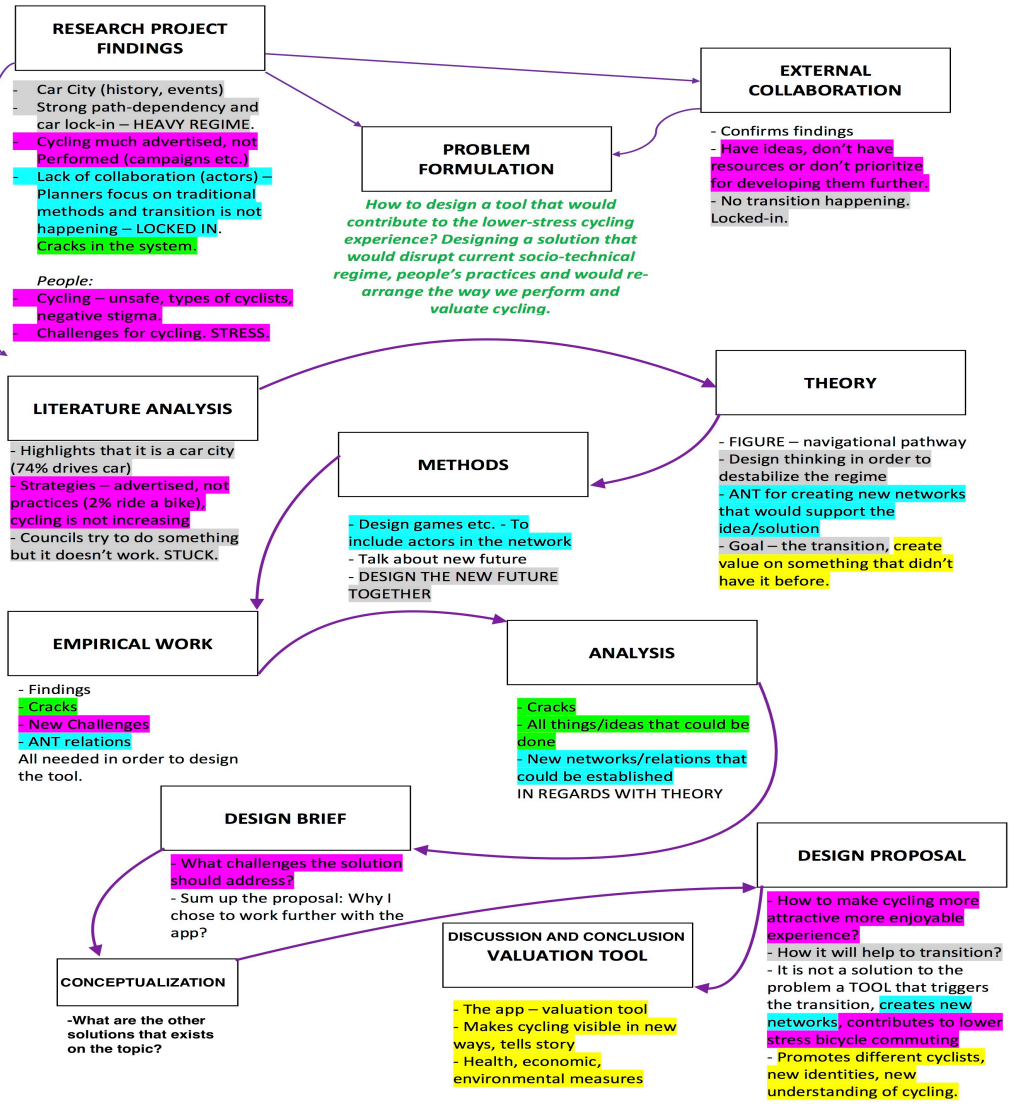


Figure 3. Project Design Diagram.

CHAPTER 3: DESK & LITERATURE RESEARCH

In this section I will present four different strategies and plans from City of Melbourne Council, City of Darebin Council and Transport for Victoria which will discuss their targets, goals and future plans for enhancing bicycle commuting in Melbourne.

3.1. City of Melbourne Bicycle Plan 2016-2020

City of Melbourne council's vision is to make Melbourne a cycling city. The council has very ambitious goals to increase cycling participation in the city; expanding cycling infrastructure, increasing bicycle parking and maintenance stations, one in four vehicles entering the city will be a bicycle, by 2030 10% of all trips will be made by bikes and many more are listed in their bicycle plan (*Figure 4;* Bicycle Plan 2016-2020, 2016).

The plan presents four main areas that council is focusing on:

- **Planning for people to ride bikes;**
- **A connected bicycle network and facilities;**
- **A safe and encouraging environment;**
- **Measuring outcomes.**

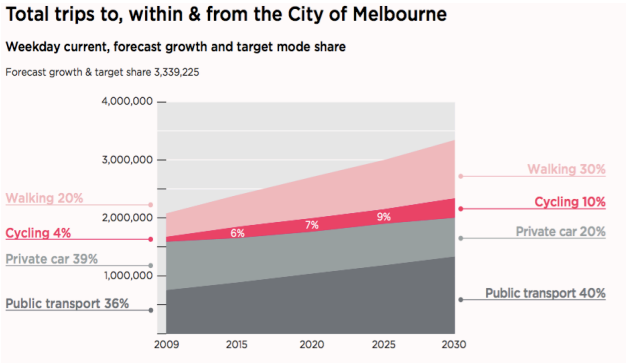


Figure 4. Mode share targets. Source: Bicycle Plan 2016-2020, City of Melbourne.

City of Melbourne council addresses safety in the city, needs of infrastructure for growing population, accessibility for all abilities, encouraging bicycle environment and comfort to ride a bike more frequently (Bicycle Plan 2016-2020, 2016).
*"This plan supports our ongoing collaboration with the Victorian Government as a means of achieving our goals and targets. In particular, the Plan supports the development of strategic cycling corridors, routes in local suburbs, reducing speed limits and improving the separation from traffic and car doors to enhance safety outcomes for people riding bikes." (*Bicycle Plan 2016-2020, 2016, p.2).

Council addresses the issue of lack of participation in cycling from women and elderly *(Figure 5)*. Therefore, they are planning to deliver a connected network that suits all abilities, all ages and various group's needs. High-quality cycling routes, secure parking and facilities, well-lit environment and creating motorist's awareness all to make cycling journeys more convenient.

City of Melbourne collaborates with Vic Roads in order to develop innovative solutions as well as supports the Victorian Government strategic cycling corridors plan that connects central Melbourne to other parts. Collaboration with Victoria Police and Bicycle Network is also mentioned in the plan as a way to create more awareness and programs on cycling.

3.2. Transport for Victoria - Victorian Cycling Strategy 2018-28

Transport for Victoria plans and coordinates all transport systems in Victoria. Recently they released a cycling strategy which major focus is investing in a safer and well connected network with strategic cycling corridors being a main area of development in order to make bicycle commuting a more inclusive experience (Victorian Cycling Strategy 2018-28, 2017).

"About 60 percent of Victorians are curious about cycling and like to ride, but they don't cycle, or cycle less, because they want a safer, lower-stress, better-connected network and a more inclusive cycling culture" (Victorian Cycling Strategy 2018-28, 2017, p.6). *(Figure 5).*

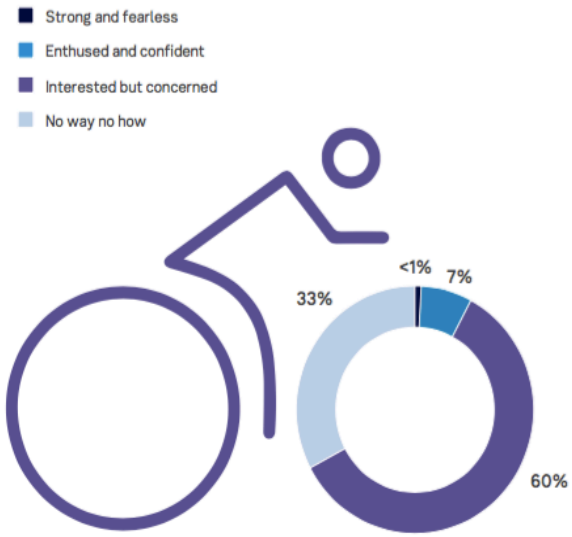


Figure 5. Four types of cyclists. Source: Victorian Cycling Strategy 2018-28.

Transport for Victoria states that they will improve safety by separating pedestrians, motor vehicles and cyclists. Furthermore, separated routes will provide a lower-stress cycling experience and reduce the exposure to traffic pollution and noise (Victorian Cycling Strategy 2018-28, 2017).

Strategic Cycling Corridors are a major tool for developing a better network and cycling infrastructure. They will provide faster and more direct routes that will link the suburbs and the city center.
"Strategic cycling corridors are the arterials of the bicycle network, which join up important destinations: the central city, national employment and innovation clusters, major activity centres and other destinations of metropolitan and state significance." (Victorian Cycling Strategy 2018-28, 2017, p.7).

Another goal of Transport for Victoria is to increase women, senior and children participation in cycling. This will be achieved by safer network with lower levels of stress.
"Women, children and senior Victorians cycle far less than the typical cyclist, who is male and under 45" (Victorian Cycling Strategy 2018-28, 2017, p.5).

Victorian Cycling Strategy addresses the importance of changing people's perception about cycling. They aim to promote cycling as something that diverse range of people do. Furthermore, they are willing and planning to work with other stakeholders to create more awareness, educate people and support programs on bicycle commuting.

3.3. City of Darebin – Darebin Transport Strategy 2007-2027

Darebin Council highlights the importance of accessibility in the city and emphasizes the priority of moving people and goods instead of cars. They focusing on developing a better network for walking, cycling and public transport in the city of Darebin (Darebin Transport Strategy 2007-2027, 2007).

Transport strategy tackles the issues of perceived and actual safety of walking and cycling routes, completing "the missing links" in the network, enhancing the maintenance of cycling paths and providing secure parking. It also promotes cycling by reducing traffic speed and setting traffic signals in cyclist's and pedestrian's favor.

One of the objectives of the strategy is the travel behavior change programs. Such programs encourage people to make responsible choices when commuting that recognize the impacts of motor transport based journeys.

3.4. City of Darebin – Darebin Cycling Strategy 2013-2018

Darebin Cycling Strategy goes further into details and indicates actions and targets for improving cycling in Darebin. The council's main objective is to enhance cycling experience and make it enjoyable, safe and relaxing which could result in bike being the first choice of transport between 2 to 7 km in the city of Darebin (Darebin Cycling Strategy 2013-2018, 2013).

The strategy points out to southern part of Darebin where the participation in cycling is significantly higher. Then on contrary, the northern part is less likely to commute by bike (Appendix 3). Suggestions for that will be proposed further in the Analysis chapter.

Strategy discusses the importance of creating a high quality network that would accommodate growing population and those of all abilities and ages. Furthermore, to guide people within the network by indicating locations of popular activities, points of interests or less busy routes which are often preferred by cyclists.
"When promoting cycling to a particular group, it is important to understand which barriers the group experiences, so that Council can take the most appropriate approach" (Darebin Cycling Strategy 2013-2018, 2013, p.27).

Council sets ambitious targets such as increasing the trips made by bicycle by 8%, reducing the risk of accidents by 50% or overcoming the perceptual barriers that cycling is inconvenient or slow mode of commuting. Additionally, cycling strategy points to a long-term commitment of building and promoting a culture of cyclists. They plan to engage stakeholders and other important actors to prioritize investment in bicycle infrastructure.
"The community's awareness of the benefits of active transport is increasing and the Darebin community is calling for more support for cycling" (Darebin Cycling Strategy 2013-2018, 2013, p.3).

Furthermore, City of Darebin has established a vision of 5 key cycling corridors, 5 local access routes and 2 creek trails to improve the cycling network (Appendix 4).

This section presented and illustrated the role of cycling in Melbourne's future strategies and plans which will be further discussed in the project.

CHAPTER 4: THEORIES

This chapter will present and argue for the choice of selected theories and how these will enhance the project throughout its process.

4.1. Historical Path

How Melbourne is built today, the city's socio-technical regime and people's practices are the result of the history, cultural values and meanings, technology, regulations, knowledge, user practices and networks (Geels, 2005; Unruh, 2000). Historical events such as World War II and oil crisis had enormous impact on how Melbourne developed through the years. After World War II Melbourne's population (including immigration) grown quickly causing the expansion of the city's physical boundaries. People moved out of the inner city towards the inner and outer suburbs creating a need for better infrastructure and transportation to conveniently move around (Appendix 1). Consequently, roads were expanded and new connections were built in order to suit people's needs. Such planning embedded a strong dependency on cars. Furthermore, a car played a significant role in society; it provided a possibility to have a bigger property further away, it also represented people's status in the society and symbolized wealth and prosperity. When oil crisis hit in 1973 it did not stop the car dependency; planning for motor vehicles continued to grow, busses and trains emerged into the city and cycling was seen more as a hobby rather than a way of commuting (Appendix 1).

Things started to alter around 1990's when the city center of Melbourne started to develop further creating new employment opportunities which encouraged people to move back to the inner city. As major activities and jobs were located in the city center the increased people flow caused traffic congestion. Councils started to look for another way to move people in and around the city (Appendix 1).

4.2. Multi-Level Perspective and Lock-Ins

Socio-technical regimes discuss and help to understand why transitions are so hard to accomplish. Geels (2005) multi-level perspective (MLP) explores three conceptual levels of the transitions; socio-technical regime, niches and socio-technical landscape (*Figure 6).*

Socio-technical regimes are very structured and stable. Regimes guide and provide a strong coordination for the actors in regards of their activities. The regime is constituted of existing routines, science, culture, material aspects like investments, dominant rules or current practices that are dominating in socio-technical systems.

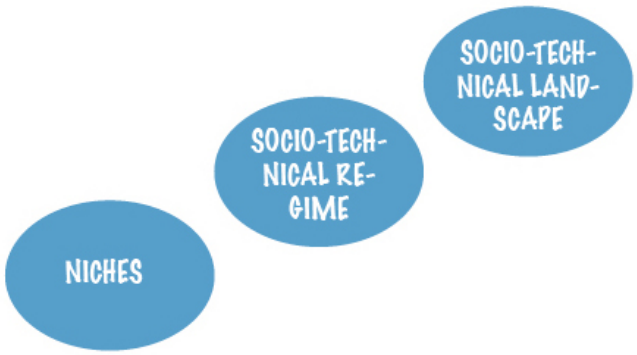


Figure 6. Multi-Level Perspectives. Own figure inspired by Geels.

Niches are portrayed as a space where new innovations are being created and explored. *Niches act as 'incubation rooms' for radical innovations, nurturing their early development* (Geels, 2005, p.450). Niches are not stable, there is much uncertainty and they are loosely structured.
Socio-technical landscape is an overall socio-technical setting that includes various cultural and political patterns as well as economic aspects that forms the environment. Socio-technical landscape is even more stable and structured than the regime and therefore is very difficult to change. *"The metaphor 'landscape' is used because of the literal connotation of 'hardness' and to include the material aspect of society, e.g. the material and spatial arrangements of cities, highways and electricity infrastructures*" (Geels, 2005, p.451).

In this project I chose to use a combination of Geels MLP approach and Unruh reflections on path-dependency and lock-ins in order to portray the heavy regime in Melbourne. Geels MLP approach extensively explains how regimes are built while Unruh reflections help to picture Melbourne's carbon dependency that is visible through fossil fuel-based energy innovations and system lock-ins.

A Constructed Car City

Today in Melbourne, sustainable transportation alternatives such as walking, public transport and cycling are being promoted by councils and government but the heavy regime is still present and very much functions around cars: "*Despite a recent revival of government interest in improving public transport, governments continue to spend at least four times more on roads than rail"* (Lowe, 2014, p.20). Investments in motor vehicle infrastructure, affordability of cars, fuel and taxes and on top of that cycling is seen as dangerous (aggressive cyclists' behavior, serious riders passing by extremely fast etc.) and mainly male dominated activity. These perceptions and challenges leave people not to even consider the practice of cycling and if they do it is seen more as a hobby, sports or bike itself is seen more as a toy for kids: "*Meanwhile, cycling and walking are discouraged by a lack of safe and convenient pedestrian and cycling routes, particularly in sprawling suburbs and rural areas. Driving is further encouraged by fiscal policies such as subsidies and tariff assistance to the automotive industry, providing fringe benefits tax for car use and having a low fuel excise, which makes petrol in Australia cheaper than in most developed countries"* (Lowe, 2014, p.20). Therefore, the combination of car affordability and accessibility, urban sprawl, low fuel prices, population growth, vision of owning a house and practices based on car use created this heavy regime in Melbourne that makes cycling, as a practice, extremely difficult and challenging. Social perception of car, on contrary than bike, being such a convenient mode of transport leads to discussion of why even change?

The regime plays an important role of why cycling is not valued or performed as a strong practice in Melbourne. Certainly, people are the ones who make the choice and that choice is influenced by various factors. Nonetheless, citizens are part of the existing regime and people's practices are affected by socio-technical elements. Therefore, when a particular technology or a product becomes dominant and institutionalized it develops to a lock-in (Unruh, 2000). Regime itself can be seen as a lock-in; once something develops to the regime level it gets locked-in. Unruh (2000) argues that carbon lock-in occurs through a process of development where throughout the time institutions and technology formed a path-dependency to be in favor of carbon emissions. The car-dependency in Melbourne created this strong lock-in of the regime which is very difficult to break.

The car regime in Melbourne is supported by the infrastructure expansions and people's daily practices while cycling is a niche that is not interesting or even inviting to the majority. Geels (2004) argues that transformation and reconstruction of large-scale sociotechnical systems is the basis for the sustainable future to happen. Geels introduces niche as a way to break the regimes and transition however, the dynamics of niches are not explained or very developed. Very often niches are outside the regime working on innovations and products expecting them to conquer it. For this reason, I leave out niches and choose to work with navigational pathways and look for cracks in the regime. In this paper I define crack as a *gap in the system* or a *tension point* where the regime is really vulnerable and therefore, it creates windows of opportunities to make a change. I use the concept of crack as a way to challenge the existing regime while using Callon's (1986) Actor-Network Theory (ANT) to enable new relations and build a strong network to promote and present cycling in new ways *(Figure 7).* To accomplish this, I choose to use the above presented theories which can be translated into formula: **Deconstruct – Design – Build New Networks.**

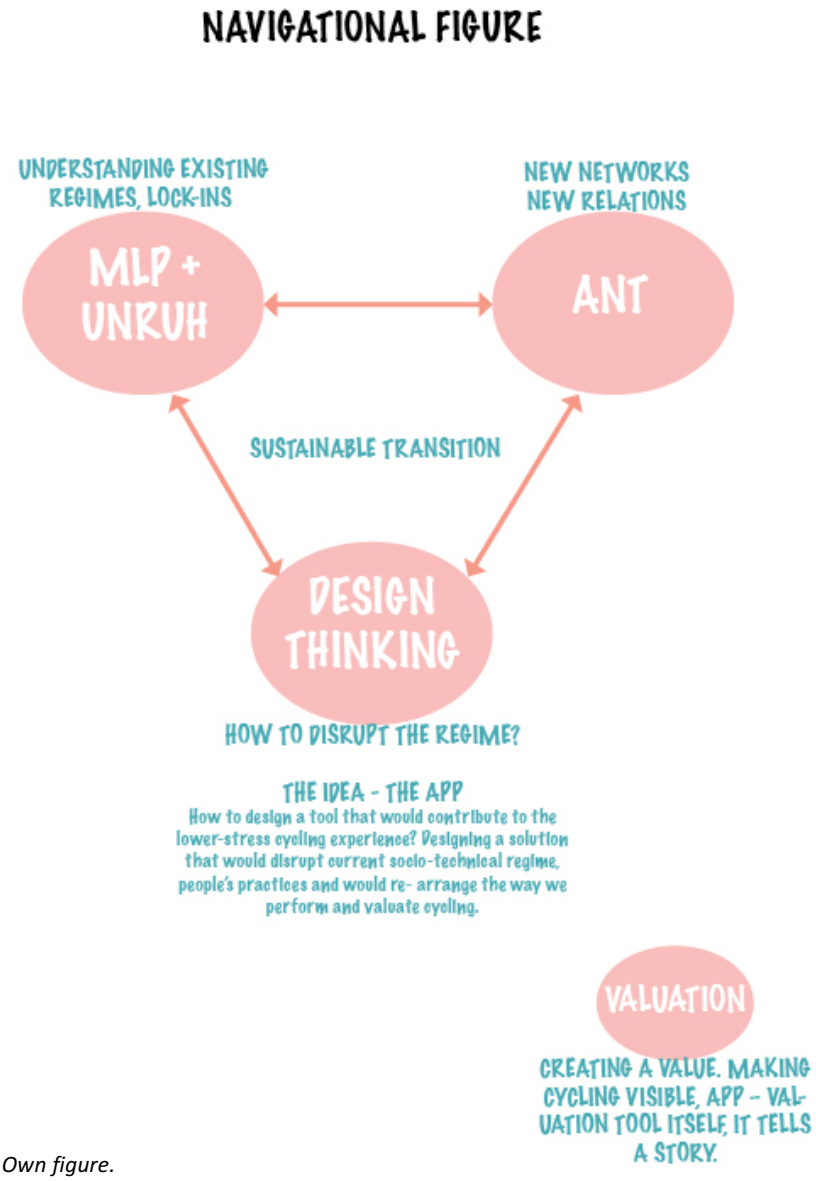


Figure 7. Theoretical framework. Own figure.

4.3. Design Thinking Approach

It is not enough to be innovative. For the sustainable transition to happen it is essential to disrupt what has been constructed and inculcate innovative ideas and creative problem solving approach. A design solution alone cannot solve the problem, it needs the support from actors and networks to be able to *survive* in the heavy regimes that often resist the change.

Regimes can be softened; implementing design methods and enabling new relations can ease the regime and make it more acceptable of the changes. The design methods strategically work on deconstruction while aiming for transition. Local government and councils are trying to transition but often their methods lead to innovation regime rather than transition regime. Design is to work and concentrate on the process and not only on the product itself. It means that we are working with knowledge creation instead of dealing with products to enter the market faster (Munthe-Kaas & Hoffmann, 2017). *"Design in this perspective is working with engagement, not aesthetics - it is design for and with, not design of."* (Munthe-Kaas & Hoffmann, 2017, p.289). When we start to do the experiments, engage with the world, look for the data and analyze it we orient our minds towards the learning experiences. This helps to question the ideas, constantly test and adjust them in order to create the transition.
Figure 8 presents the overall goal of transitioning and *Figure 7* demonstrates on how I plan to do it.

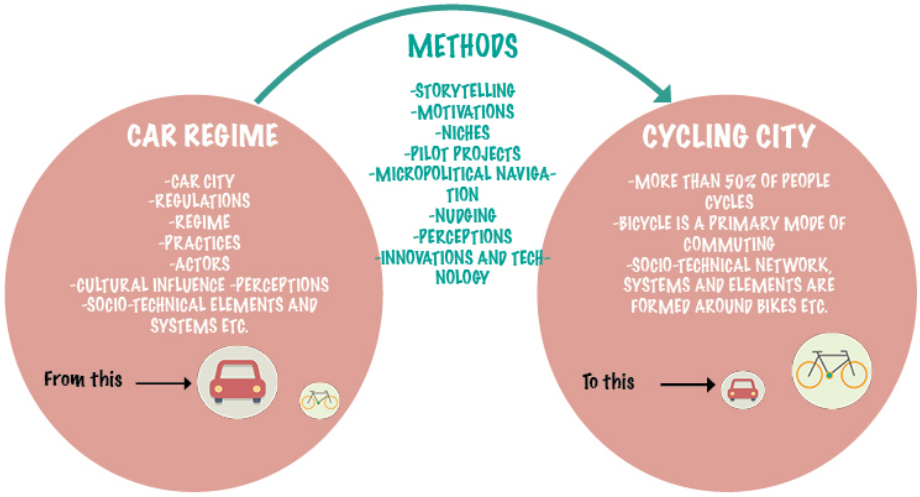


Figure 8. Transition. Own figure.

4.4. Actor Network Theory (ANT) Approach

Actor Network Theory explores and analyzes the relations between both human and non-human actors, the level of power they have and their involvement in the network (Callon, 1986). The ANT is good in addressing the dynamics in process of transition. It helps to analyze how the creative ideas or design proposals change the relations between actors in the network as well as how it builds new ones (Munthe-Kaas & Hoffmann, 2017). In this project I use ANT to study the relevant actors and look for opportunities to enable new relations and form new networks that supports the process of transition.

To establish a strong network can be challenging. Different actors have different goals and agendas which can lead to barriers when establishing the common vision of the project. Some actors might not find the project profitable and therefore they will not be willing to get involved in the network. It is essential to study and learn about the actors; their power relationships, characterize their interests in the project and level of involvement in the network. The aim is to create alliances between actors that would help to strengthen the network.
I choose Callon's ANT approach which he uses as a tool to analyze '*the role played by science and technology in structuring power relationships'* (Callon, 1986, p.1). With the help of ANT, I aim to create a strong network that would support the design proposal and push cycling agenda into strategic urban planning.

4.5. Valuation Theory

As discussed before, cycling in Melbourne is not seen as something that has a strong if any value (except for sports purposes). The value that is visible in the activity can promote bicycle commuting or be seen as a motivation that drives people to take up cycling. Different value registers such as health, saving money, not queuing in the traffic, reducing CO2 or more spacious city are important when telling new stories about cycling. It is necessary to examine different actors' views on identified valuation registers to understand how to interest or cater them (Heuts & Mol, 2013). In this project I aim to assign new values to cycling as part of building new networks and break the misperceptions and common narratives about riding and riders in Melbourne.

In this chapter I argued for the theories and approaches that I chose to use as a combination to understand how regimes are constructed and how to strategically challenge them in order to enable transitions. The presented theoretical framework will follow through the entire project and will be used to identify cracks, propose the ideas and evaluate them.

CHAPTER 5: METHODOLOGIES

This chapter will introduce and argue for the different methods that were used to collect the empirical data.

5.1. Methods

Figure 9 presents all methods that were used in the project to collect the empirical data.

	Method Form	Method Purpose
Desk Research	• Literature Research; • Plans and strategies; • Articles; • Reports; • Emails; • Websites.	In order to explore the topic in depth and gather the information different methods were used. Literature research, articles and reports, websites and emails from council members helped to understand what is the situation with the problem area and what are the planning methods and strategies to approach it.
Ethnographic Field Research	• Interviews and meetings from previous research project; • Letters from previous research project; • Observations from previous research project; • Design Game with citizens; • Design game with Darebin Council; • Coding; • Facebook page; • Photographic field notes.	Ethnographic field work helped to get in touch and talk to various actors. Gathered findings from previous research project was used to build the design games. **Design game with citizens:** the game was conducted in order to facilitate a conversation with the citizens. Furthermore, understand their preferences and dislikes for bicycle commuting and get their personal stories and experiences through the interactive game. **Design game with Darebin:** the game was created based on previously collected information. It was conducted for the purpose of getting a deeper understanding on what topics, issues and problem areas the council is working on. Additionally, what strategies and approach they use to solve the problems and to increase cycling popularity. **Coding:** this method was used to categorize and structure the collected data. **Facebook page:** the cycling page was set up in order to create a place for discussions, share the experiences and storytelling. **Photographic field notes:** field notes were used to capture people's responses of the design game.
Idea Generation	• Affinity Diagram; • Brainstorm.	Affinity Diagram: this method helped to classify the data into groups or categories (types of commuters, crack etc.) in order to develop them further. Brainstorm as a method was used to generate the ideas throughout the entire process of the project.

Figure 9. Methods Table. Own figure.

Design Game with Citizens

Brand argues that design games are great tools for user involvement (Brandt, 2006). However, not only design games enable the involvement of different actors with various backgrounds and competencies they also help to establish collaborations and create new relations between them.
The design game with citizens of Darebin was facilitated in order to have an informal conversation about what they think is a desirable and undesirable cycling experience. The design game was used as a method to engage citizens to share their experiences and personal stories. Citizens are an essential part of the network additionally, they will be the users of the proposed solution therefore, it is important to talk to them about the new future and design it together. The design game was

also a visual tool that helped easily relate to situations and reflect on them. This game focused on qualitative rather than quantitative data in order to build up a detailed picture on people's practices, choices and feelings about them. The game aimed to stimulate people's individual experiences and encouraged to elaborate on their responses rather than analyze ranks and counts.

The design game with citizens was conducted in three rounds. After each round I reflected on the results and improved the game. The game focused on constructing individual's cycling experience, comment and reflect on it. The board and cards were used as boundary objects with the intention of creating a common language between me - the facilitator and the citizens. Carlile argues that an effective boundary object *"facilitates a process where individuals can jointly transform their knowledge"* (Carlile 2002, 452).
After the discussion the second part of the design game followed; people indicated and marked on the map good and bad cycling routes in Darebin.

Mapping the Best and the Worst Cycling Routes in Darebin
This mapping game/method was used as a means to examine if citizens of Darebin cycle in their local area, can identify any good and/or bad cycling routes and elaborate on why they categorized them as they did.

Players were provided with the city of Darebin map which indicated all cycling routes. The map was used as a boundary object to facilitate the discussion and obtain players comments and opinions. It also helped to imagine themselves to be *in the cyclist's shoes* (if they don't cycle) and think where they would prefer or avoid to ride a bike.

Design Game with Darebin
The design game with Darebin Council was initiated with the aim to present the findings from the collected data, learn the knowledge they have on cyclists' challenges, barriers and needs and stage the new future together. Darebin Council is the key actor in the network; they are familiar with other relevant actors such as other councils, government and citizens. Furthermore, they have highest percentage on women who cycle than any other council and cycling in Darebin is increasing while people who choose to travel by car is slowly decreasing (Darebin Cycling Strategy 2013-2018, 2013). It was important to engage Darebin Council in the data collection process as they have their own insights and researches made on cycling. Talking to the members of the council helped me to expand my knowledge on the topic, understand what are the struggles they face when trying to push cycling into strategic planning and ask them to share their ideas on how to overcome the identified barriers.

The design game with the members of Darebin Council was conducted in two parts. Firstly, to gather the knowledge that they have on different types of commuters and compare it to my collected data. Secondly, to share the deterrents along with facilitators of cycling in order to provoke and generate the ideas on how to overcome the barriers and improve the overall cycling experience. The board, with the identified issues that were placed on sticky notes, was used as a boundary object to engage and facilitate the discussion.

Design Game with Bicycle Network

Another important actor of the network is the Bicycle Network. Being Australia's biggest bike riding organization Bicycle Network works on improving various areas that support cycling and promotes to ride a bike every day (Bicycle Network, 2018). The organization has a strong relation with citizens of Melbourne. The member of Bicycle Network explained that citizens can inform them about their good and bad experiences on the roads. They represent bike riders and work towards an ambitious goal – to be a nation of cyclists. The design game was conducted with a member of Bicycle Network in order to explore their – as representatives of citizens – view on issues and how and who, they think, should address them.

The game was conducted in exact same way as it was conducted with Darebin Council. The aim was to examine and explore their knowledge on different types of commuters and facilitate an idea generation process on the main deterrents and facilitators of cycling.

Facebook Page

Netnography as a method is often used to look at the built communities and their online communications or interactions, look for commonalities and capture that data in order to analyze it (Langer and Beckman, 2005). Langer and Beckman state that *"the internet offers increased opportunities for social group participation, where consumers form virtual communities of consumption in order to assert social power, to unite, and to claim symbols and ways of life that are meaningful to them and the communities they build"* (p.192). I conducted a quick research on various groups at different online platforms however, most of the cycling groups that exist are mainly about sports and touring or promote sports related activities. For this reason, I decided to create a Facebook page called Cycling Experience in Melbourne in order to reach out to more people (not only sports enthusiast), create community, trigger the discussions and hear their voices. Such a page allows people with various backgrounds, professions, knowledge and experiences to join and get involve in the discussions or follow them. Not only it is a good tool to hear more stories from various sources it also allows people to express their feelings and share their personal thoughts.

The Cycling Experience in Melbourne page was set up using a social networking website called Facebook. As it is one of the widely used social networking websites it increases the chances to reach a greater audience. The name of the page was set up with an aim to capture the attention and entice various people and cyclists.

This chapter discussed different methods and the process of data collection. The data will be taken to the next chapter where the main findings will be presented.

CHAPTER 6: EMPIRICAL WORK

As the project developed further different empirical methods were used with the purpose of getting practical and observational knowledge from the field. Following section presents what was obtained using different data collection methods.

6.1. Previous Project Conclusions

Several findings from the prior research contribute to this project. These findings are presented below.

Types of Bicycle Commuters

"There are just two types of cyclists in Melbourne: sports enthusiasts and work/university commuters" - is a common narrative about cyclists in this city. Throughout the research I was able to discover more types of commuters who remain invisible because of the social stigma. Commuters that I managed to identify are: children, environmentalists, sports, every day, health driven, trendy, female and social commuters. Every mentioned group has different purpose or level of experience to ride a bike and often face different challenges or required different needs when cycling *(Figure 10).*

Figure 10. Individual's cycling experience. Own figure.

Facilitators to Bicycle Commuting

Main motivations for bicycle commuting among cyclists are health and physical activity benefits. These two facilitators are the major force that drives people to choose cycling over other modes of commuting. A lot of attention is given for cycling as a health producing activity because it seems to be such an *effortless* physical activity that people can do just by going to work, university or shops.

Other important values identified from the empirical data was sports followed by independence, financial benefits and time. However, sports as a value was identified mainly by athletes and fitness cyclists, people who cycled as for a hobby or professionally.

Deterrents to Bicycle Commuting

The research showed that the biggest challenge that prevents people from cycling is safety. That includes unsafe infrastructure (narrow lanes, evaporated lanes, constant vehicle obstruction, no physical separation from cars which creates an unsafe and uncomfortable environment for cyclists) and unsafe and dangerous behavior from other road users (aggressive behavior, rude comments, some ride very close at a high speed, dangerously jumping in and out of lanes, perform risky maneuvers, lack of tolerance for slow riders and female cyclists).

Cracks

Conducted research have examined factors that affect the choice of bicycle commuting. Despite that, I investigated where are the cracks in the regime; the tension points where the car regime is weak and could be destabilized. Throughout the entire project I managed to identify several important cracks that if approached strategically could lead to a positive change. These are presented below and further analyzed in the paper:

- Health;
- Stress;
- Congestion;
- Climate change;
- Population growth;
- Budget/investments;
- Perception of cycling and cyclists.

6.2. Design Game with Citizens

The design game with the citizens was conducted in the city of Darebin. The primary reason why city of Darebin was chosen as a study case was of the established informal collaboration with the council and their knowledge sharing throughout the project's process.

Purpose

The findings from previous project were used in order to create a design game. The game was based on challenges, obstacles and future improvements of bicycle commuting. The initial purpose of the design game was to understand what conditions form a good and a bad cycling experience. It also revealed the insights of why citizens choose or avoid cycling, what do they think is needed to boost the *riding culture* and what are the common narratives about cyclists and cycling in Melbourne. The knowledge gained through the game was used further in the data collection process.

Process

The game had 28 cards with different problems that they presented such as *uneven surface, vehicle obstruction* or *parking facilities* (Appendix 5). It also had a board with a line in the middle as indication that separated *a good cycling experience* and *a bad cycling experience.* The task was to go to Darebin and play the design game with the citizens in order to collect some valuable insights on their knowledge and experiences on cycling. The first round of the game was played at the Preston market. I managed to approach 15 people who agreed to participate in the game. I asked people to select the cards and place them accordingly to what they think makes a good and a bad cycling experience. I specified that it is not necessary to use all of the cards, just the ones that are relevant for them. Furthermore, while they were playing I asked them different questions to understand their commuting practices and what are the reasons behind their transportation choices.

Reflections
After the first round several gaps in the game were discovered; not all the issues (the cards) were clear, they needed to be elaborated on or some cards were missing clear recognition whether it addresses a car or a bike. The environment acted as barrier too; the market was busy and loud and people did not have much time as they were on lunch breaks or already on the way to work. I decided to fix the game and play it again but now I changed the location.

The second round of the game was played at the Preston Library in Darebin as it seemed to be more quiet and less chaotic place. However, the place did not help much again as majority of people were studying or working. The library was very quiet and people seemed to be concentrated on their study or work activities. Despite that I got to talk to 10 people and managed to get helpful insights. I approached people in exact same way as I did in Preston Market however, this time I asked more open-ended questions and if they had any experiences worth sharing. The outcome was better nonetheless, as the room was very quiet, if asked any questions, people tried to stick with short comments and avoided to elaborate on them.

The third round was played at the Preston Library as well, however, I chose to interact with people at the *lounge* area. People there seemed to be more relaxed and more engaged with the environment. I managed to talk to seven people in total and was able to get the desired insights and personal stories.

Findings
Findings showed that majority of the people that I approached cycled very little. Most cycled for commuting or recreational purposes. Dominant reasons for choosing other mode of commuting were:

- the infrastructure was not good and safe enough,
- a car is more convenient mode of transport,
- people did not identify themselves as cyclists,
- negative attachment towards cyclists by calling them poor behaved and rebellious,
- negative previous experiences.

Despite people commuting practices they had a strong opinion on what is a good and a bad cycling experience. Findings indicated that majority of people, especially less experienced cyclists, prefer off-road lanes however, they do not mind white line as a separation as long as the bike lane is wide enough. It is important to mention that some people even preferred white line as a separation nonetheless, they were experienced cyclists who cycled mostly every day.

Steep grade was very disliked in the game and often was seen as a barrier getting to places; people get sweaty, that affects their clothing and they need a changing room and shower facilities which are not available at all of the end destinations. However, steep grade was liked by serious cyclists for the reason that it challenges their physical activity.

Another important observation was the relation between detours and signage. Participants complained that there are not enough signs, particularly where the detours are. In addition, some suggestions for signage were made; for example, that there should be a sign with a kid on a bike

next to the routes that are favored by kids or parents commuting with kids. This could create awareness about children on the road.

Seemingly, narrow lanes and vehicle speed were seen as two predominant issues that create a very inconvenient cycling experience. Findings point out that if there is a narrow lane people prefer off-road lane or lower volume traffic with speed limit not higher then 40k/h. Furthermore, it was indicated that there should be either lower volume motor traffic or lower speed limit in order to feel safe while cycling.

Surprisingly, interconnected public transport was seen more as a negative rather than a positive aspect; too crowded, too much of chaos, you need to pay more attention when cycling, more accidents can happen that involves vehicles and it might increase inappropriate behavior from road users.

Shared lanes with pedestrians were favored among less experienced cyclists while serious cyclists avoid them because of the higher riding speed that can cause serious accidents.

The major issue that contributes to a bad cycling experience was vehicle obstruction. On the contrary, highly valued and needed components for the good cycling experience were secure parking, good road conditions and bike facilities. *Figure 11* presents the most dominant card combinations:

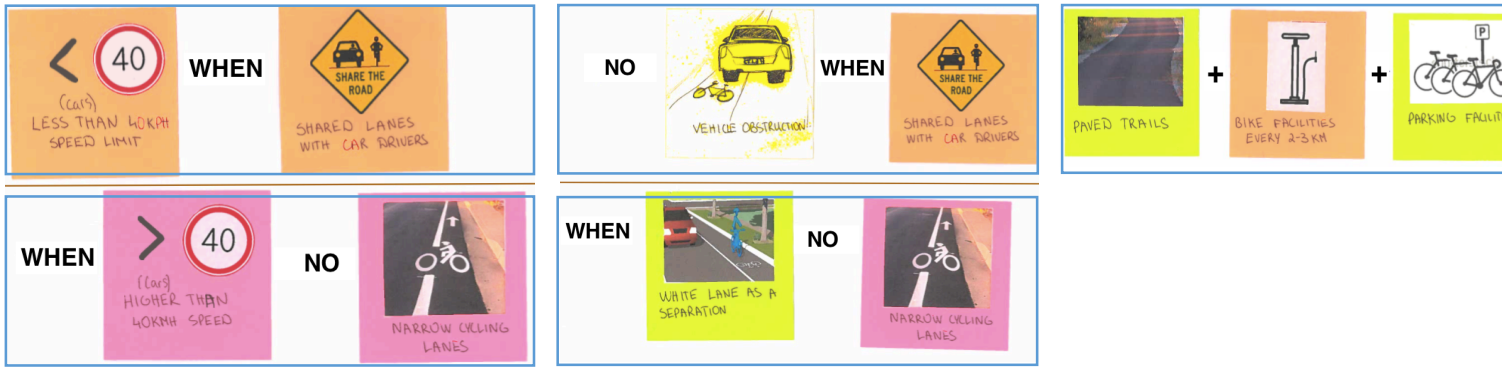


Figure 11. Dominant cards. Own figure.

Main limitations

- There were too many cards that often created a bit of a chaos;
- Some cards were not very clear, I needed to interrupt and explain what is the issue that this card represents;
- Locations: market was too busy, it was difficult to find someone who would have time to play the game, even though it took not more than 3-4 minutes. Library was a bit too quiet, people refrain themselves from talking too much which was a barrier to facilitate a broader discussion.

- Audience. I noticed two common groups that come to the library: usually people with more time for purpose such as reading (mostly elderly people) or studying (school/university students). On contrary, in the market I noticed busy, everyday people with full time jobs.
- More time is needed (per person) to play this game in order to get people's stories and experiences.

6.3. Mapping Out the Best and the Worst Cycling Routes in Darebin

This was the second part of the design game that was conducted with the citizens of Darebin. Citizens were asked to mark on the map the roads/routes where they would and wouldn't feel comfortable to cycle.

Purpose

Identifying good and bad cycling routes could help to design the solution by analyzing what are the conditions, environment and traffic volume of these routes. Additionally, how to plan and connect them in order to create a better network within Darebin and the other parts of Melbourne.

Process

After citizens would finish to place the cards on the board I would ask them to identify routes they think are good or bad for cycling (Appendix 6). There was a printed map (one for the entire game) that had all the roads and indicated major activity centers. Routes that were seen as good, convenient and safe for cycling were marked with the blue color while bad, inconvenient and unsafe were marked with the pink color.

Findings

Mapped out cycling lanes were compared with the map of cycling routes. Findings showed that people mainly marked the good routes that were off the road. Almost all the on-road routes were seen as dangerous and stress causing. (Appendix 7).

6.4. Design Game with Darebin Council Members and a Representative from Bicycle Network

This game was created with the objective to facilitate communication with the relevant actors. The design game was a way to bring creative thinking to the regime (talk to councils, government), present the results and stage the new future together. Members from the Darebin council and a representative from Bicycle Network agreed to talk and have an input (play the game) in order to help develop the project further.

Purpose

Findings from previous project and the design game with the citizens helped me to better understand the commuters and use the insights to construct a new game for the actors. The aim was to find out how much of this information the council and Bicycle Network have and whether they thought on how to approach these issues.

Process

The design game has two parts: identifying types of commuters and selecting a note with an issue and suggesting how it could be improved. Firstly, the participants were asked to specify which types of commuters they can identify in Melbourne. Then there were presented 21 sticky notes with different deterrents and facilitators of bicycle commuting (Appendix 8). The second part was to choose three issues and propose how they can be solved or improved. The players needed to use the provided format:

1. Write down the issue
2. What is needed to solve the issue?
3. Who is responsible in solving it?
4. How it can be made/managed/improved?

Findings

The main types of commuters were identified as sports/serious, recreational and everyday followed by local, confident/less confident, kids, casual experienced and casual less experienced commuters. These findings present that cycling in Melbourne is performed mainly for training, commuting or recreational purposes.

An important finding was that every participant highlighted the value of collaboration with other actors and stakeholders. Citizens and communities were recognized as critical actors in the network and their support and engagement was seen as a key factor in pursuing the cycling agenda.

Another important finding was that there is lack of information on electric bikes, on how to deal with curly clothes (after cycling), how to avoid 'helmet' hair, ride with a dress, clothing choice in bad weather or avoid getting sweaty. Furthermore, there is not much or enough information about cycling routes; where they lead, what you can see/do while riding, are they quiet or busy, well maintained or not, is there a secure parking lot or if they have any bike facilities *en route*.

When participants discussed about who is responsible on making changes almost all concluded that responsibilities must be shared. There are some actors who have more authority than others to make a change but it is rarely that one actor is responsible for solving the problem.

Limitations

- First I asked people to choose the notes with the issues which lead participants to choose the 'easiest' options. Then I changed the strategy and selected the cards myself.
- When I asked to specify *who is responsible* some participants would clearly define the power range as an excuse for approaching the issue. However, majority described it as a cooperation for the common goal.
- The initial design game idea was to create a workshop where participants could work on solutions in groups, present them and argue for the concepts. Perhaps, this would had facilitated more discussions and arguments for the ideas. However, both – the council and Bicycle Network could not gather the employees for the workshop in the short timeframe that I had for the empirical data collection before going back to Denmark.

6.5. Facebook Page

Online platform is another way of reaching out to people. It is a fast and convenient way to access a great variety of citizens and get information on various topics and issues. It is a platform where discussions are constantly going and everyone is expressing their opinion freely.

Purpose

Cycling Experience in Melbourne is a Facebook page accessible to everyone who has a Facebook profile. It is a space for talking, creating discussions and sharing the experience of bicycle commuting. The page was created with a purpose of inviting different people with various knowledge and backgrounds to share their thoughts, ideas or stories about cycling in Melbourne. Social media pages such as Facebook can create communities, gain power and also be used as a tool for approaching the authorities.

Process

I set up the Facebook page and invited few friends to like it. Furthermore, I asked people to share it and invite others. I made few posts on weather, infrastructure and preferred routes to make the page more visible. Every post contains a question to start the discussion and a photo to capture the attention.

Findings

The Cycling Experience in Melbourne has eight people who are following the page. There were no responses, comments or likes from published posts. It was challenging to invite more people as majority of my own network resides in Denmark. However, the page is considerably new and requires time to build a community. Further actions will be considered to boost the popularity; ask Darebin council to share the page in their digital platforms, invite people who are working on improving cycling (employees from Bicycle Network, other councils etc.) and share more posts relating to bicycle commuting experience.

This section presented the findings from empirical data which will be taken further into the analysis chapter.

CHAPTER 7: ANALYSIS

This chapter will present and organize challenges identified in the empirical data which will be used as windows of opportunities (cracks) to disrupt the regime. The cracks will be analyzed within the introduced theory formula (Deconstruct-Design-Build New Networks) in order to build design concepts that will be further discussed in the design brief to scope the project. The purpose of this chapter is to structure the challenges, recognize the opportunities to transition and strategically approach them.

7.1. Organizing the Challenges

The analysis of regional plans and empirical data pointed out to a number of challenges that citizens and councils face. However, I want to underline that the challenges are experienced very differently depending on whether you are a citizen or a planner. Councils talk very different about challenges, often is more in the planning terms such as budget or regulations. Whether citizens experience them more personally like too narrow cycling lanes or constant vehicle obstruction. Some challenges points to same issues but even then they are understood, experienced and addressed very differently by the actors. Identified challenges from councils and citizens contribute to large-scale or societal challenges such as health problems. Large-scale challenges are experienced by various societal actors in the different levels: regional, country or national. Despite that, they can be experienced on the individual level too. One of the examples is obesity that has profound economic consequences which are experienced by councils and government. Whereas individuals experienced it more personally for example as a result of poor health. Thus, it is essential to include both actors (councils and citizens) and address both worlds when designing a solution. For this reason, I aim to organize these challenges in three groups in order analyze them and delimit the focus.

Groups:

1. ***Challenges** that are experienced by **councils and planners (overall challenges)***
2. ***Challenges** that are experienced by **citizens (personal challenges)***
3. ***Large-scale (societal) challenges** that are experienced by the **city/country/nation**.*

7.2. Overall and Personal Challenges

All of the challenges that were identified in the empirical data and in the previous project are presented below and categorized into two groups. From these two groups I recognized and selected the challenges that point to the same issue. These are summed up into a separate table and will be further used for identifying windows of opportunities.

Challenges experienced by councils and planners:

- Stressful commuting
- Better network and infrastructure is needed
- Safety for all modes
- Inappropriate behavior translates to accidents, tension on roads between road users
- Perception of cyclists and cycling
- Congestion
- Lack of participation in cycling
- Budget and Investments
- Lack of collaboration between actors and stakeholders

Challenges experienced by citizens:

- Stress while (or even before) commuting
- Infrastructure; evaporated lanes, narrow lanes, unpaved trails/uneven surface/tram tracks, shared lanes with pedestrians/cars, speed of cars, detours, lack of signage, road maintenance, facilities and parking, carry bike on public transport, much involvement of other modes, well-lit environment, challenging to ride at personal pace, secure parking, no facilities for training, vehicle obstruction, lack of legitimacy;
- Safety
- Inappropriate Behavior
- Types of cyclists
- **Cycling with a child**
- **Lack of knowledge on cycling from councils on:** being sweaty, clothing, business attire, skirts and dresses, proper way to lock a bike etc.
- Weather

Common/primary challenges from councils and citizens:

- **Stressful experience**
- **Need of better infrastructure**
- **Safety**
- **Inappropriate behavior**
- **Social perception (cyclists and cycling)**

These five presented issues are common and primary challenges among citizens and councils. As mentioned previously they are experienced through very different perspectives. This also contributes to understanding why councils and planners have difficulties in addressing these challenges and why their methods often do not work as they expected them to work.

Despite these five main challenges, other three issues addressed by citizens were highlighted in the empirical data; weather, cycling with a child and lack of information about cycling on how to deal with curly clothes, what is the safe way to lock the bike or what to do with the 'helmet hair'. In this project I will not address the weather as it a very abstract issue. Other two issues seemed to be very important on the behalf of the citizens however, not much addressed by councils or authorities.

Both of them require further attention however, they are out of this project's timeframe therefore, they could be followed up in a later project.

7.3. Large-Scale (Societal) Challenges

Large-scale challenges are influenced by the socio-technical regime, people's practices, facilities and regulations. Throughout the desk and literature research and previous interviews the three dominant issues were recognized and indicated:

- *Health and Obesity*
- *Climate Change*
- *Population Growth (in terms of Urban Space)*

These are the main issues that Australia faces today and that are jeopardizing its people's future (Lowe, 2014). More than 60% Australians are obese and in period of 2011-2012 the obesity cost $8.6 billions for the Australia's economy (National Eating Disorders and Obesity, 2018; Australian Institute of Health and Welfare, 2017). In 2017 Australia experienced the third-warmest year on record (ABC News, 2018a) and in the past six years the population growth in Melbourne accounts to almost a million and is expected to keep growing (Population.net.au, 2018). Surely, these issues cannot be solved by cycling only, even though, if performed, it could positively affect people's health, slow down the climate change and re-arrange the space to accommodate the growing nation.

The organized and summed up challenges will help to identify cracks in the regime which will be further analyzed along with the ideas of how to approach them.

7.4. Cracks in the Regime

As a sustainable design engineer I work with socio-technical approach that looks into physical infrastructures, technology, social practices and their relations. I navigate along the network analyzing these relations in order to enable a change towards a more sustainable society. In this project instead of working solely on designing a product (such a concept has limited chances to actually enable the change) I chose to work with cracks, as part of navigational pathways, as a way to intervene the existing regime.
Previously presented findings are summarized into eight challenges. These challenges will be translated into windows of opportunity (cracks in the regime) by creating new networks and redefining cycling as stressless and enjoyable experience. In this section I will analyze each crack using a formula proposed in the theory chapter: **Deconstruct – Design – Build New Networks.**

A *– App to Lower-Stress Cycling Experience*
Deconstruct: Creating a low-stress cycling experience. This proposal would tackle the issue of stress while cycling by providing an app with a network that categorizes roads into low, medium or high-stress routes.

Design: This app would offer an option to personalize your route according to your level of experience, confidence and the riding frequency. If a cyclist does not like to ride on shared roads with vehicles he/she can put it as a preference and the app would guide the cyclists to the off-road routes. If the rider is

confident and just need the fastest route from point A to point B he/she can put it as a preference and the app will calculate which route the cyclists should take. Many more preferences the app will be able to offer to make the rider's journey enjoyable.

Build Networks: Involve councils to make the network (map with all routes) in the whole city, students who would be interested in collecting the data that is needed for the app, cycling organizations (such as bicycle network) and local communities. Find actors who would be interested to work together for the design, creating prototypes and testing them (design, media companies, product design students etc.).

***B** – Safety*

Safety is a large issue that is addressed from different perspectives; individuals might experience lack of safety caused by inappropriate behavior or infrastructure and councils might convert and evaluate safety through the number of accidents. Other cracks include and address safety in one or another way. For example, a lower-stress cycling experience will improve safety too or reducing inappropriate behavior will certainly increase safety on the roads. Consequently, I choose not to focus specifically on the issue of safety as it is too broad subject for the dedicated time for this project. Instead work with other cracks that will integrate safety.

***C** – Campaigns to reduce inappropriate Behavior*

Deconstruct: Inappropriate behavior is one of the biggest deterrents for bicycle commuting. It is necessary to build more tolerance on the roads, among cyclists and other road users.

Design: Campaigns/programs on how to pass other cyclist (e.g. ring a bell twice, make sure no one is passing you and make a move), how to act on shared roads (with pedestrians and with cars) or propose creative design solutions for the signage on the streets *(Figure 12).*

Build Networks: Collaborate with students for the design ideas, involve councils and government, get support from bicycle organizations and local communities (collect signatures, petitions etc.).

Figure 12. Behavior Campaigns. Source: Pinterest.dk

***D** – Infrastructure: increase cycling participation in north part of Darebin (refer to Appendix 3).*

Deconstruct: In the southern part of Darebin participation in cycling goes up to 14% where in the northern part cycling goes up to 4%. The reason why more people cycling in southern part of Darebin could be because of its location which is close to Central Business District where the major workplaces are established. However, more detailed analysis should be done in order to understand what prevents people from cycling in the northern part.

Design: The analysis would provide insights of commuting practices in the northern part of Darebin. These insights could help to create a solution to increase cycling participation. As an example: to interest more people to take up cycling a cycling 'playground' could be set up as an urban structure to promote liveability and green mobility. It could be a playground to learn how to cycle or to enjoy a bike ride

without vehicle intervention. The playground could be set up with smaller scale traffic signs and bike lanes and would provide a safe space to learn or improve cycling skills.

Build Networks: Establish where is the best to install such a playground in the northern part of Darebin. Strategically address the actors or owners of the space; prepare a model of how it could look like, how many cyclists the playground could accommodate, how this playground can improve cycling in Darbein etc. Involve students, bike organizations in helping with the model, visual renderings or surveys. Identify other possible relations in the network (Facebook pages, communities, NGO's etc.) that could support the idea.

***E** – Advert to Break Perceptions of Cycling and Cyclists*

Deconstruct: Breaking the social stigma about two types of cyclists, cycling being unsafe or slow and not a legitimate mode of commuting. Changing the way, we value and perform cycling.

Design: *Storytelling* - creating a video advert on how various people with different background, age or occupations use a bike (as a main mode of transport) within their daily routine; a doctor, student, lawyer, mother, grandmother, child, teacher, nurse and more approaching their day with a bike.

Build Networks: Study the actors who would be interested in working or supporting this video (media companies, bike shops, councils, government, students, cycling organizations etc.), look for how to interest them and build the relations.

***F** – Campaigns for Health and Obesity*

Deconstruct: Health is the biggest facilitator for choosing to ride a bike which makes it easier to target the bigger audience. Obesity is a serious issue in Australia and it is important to show that cycling is an easy and effortless way to commute while also improving your health *(Figure 13)*.

Design: Campaigns such as *'We spend money on repair and not on the cause'* could be promoted, events were cycling would be introduced as health producing activity could be organized and more awareness created on benefits of cycling daily.

Build Networks: Include health sector, hospitals (to promote campaigns), schools or kindergartens. Make preliminary calculations on how much money would be saved if everyone would cycle 20-30 minutes a day and propose them to relevant actors.

Figure 13. Health Campaigns. Source: Pinterest.dk.

***G** – Fighting the Climate Change*

Deconstruct: Climate change is a broad subject that involves many sectors. Instead of trying to fight it all why not to focus on smaller steps or one specific goal?

Design: *Reducing CO2 in the city*. For example, by 2030-2035 Melbourne will follow other green cities and will become carbon-neutral.
Build Networks: It is an ambitious goal to become carbon-neutral city. Even though, it is important to find actors who would be *on board.* Starting from small local communities to government and The State of Victoria. To create a network and establish the relations it is necessary to interest the actors and stakeholders. Clear vision and goal, economic calculations, health, social and environment benefits would need to be made and presented to defend this idea. Examples of others cities such as Copenhagen could be used to support the goal. Involve important international actors such as United Nations and other organizations in order to build a strong network.

H *– Awareness on Population growth and Urban Space*
Deconstruct: Population growth is another crack were cycling could be introduced. As Melbourne soon expected to accommodate more than 5 million people it is essential to create space, facilities and provide good quality of living at the same time.
Design: Project: creating awareness of how much space cars take up (streets, parking lots etc.) and if not the cars, how could this space be used to serve public (cycling lanes and facilities, creating parks, activity centers, city playgrounds etc.). *(Figure 14).*
Build Networks: Involve the state, road authorities (for cycling infrastructure), different councils and their planners and show how the city would benefit in different sectors (health, social, economic etc.). Find the key areas in the city where the parking lots/roads could be exchanged to public areas, parks etc.

Figure 14. Campaigns on urban space. Source: Pinterest.dk.

What else could be done?

- *More attractive and safer cycling infrastructure in the middle part of Darebin (Appendix 9);*
- *Strategic plan for increasing budget and investments to support cycling.*

These are two other issues that I was able identify in this project. Despite that, I chose not to work with them as I do not have an authority or access to council's budget plans as well as not enough empirical data to support the first issue.

This chapter presented the cracks identified throughout the project and proposed ideas how to approach them. This creates a framework for a design brief to evaluate the cracks throughout the challenges they address and select one for the design proposal development.

CHAPTER 8: DESIGN BRIEF

This chapter will argue for the selected design proposal by evaluating it through the previously identified challenges and their relations.

8.1. Which Challenges the Design Proposal Should Address?

As a sustainable design engineer I seek to guide people to make conscious choices of adopting more sustainable practices. Therefore, the solution/design proposal must aim for sustainable transition; enable the change in people's practices, regulations and socio-technical elements by making cycling visible and inviting for everyone.
Based on the previously presented information the ideal solution should aim to deconstruct the regime and address the challenges and their relations from both - citizens' and council's perspectives. Furthermore, it should help citizens to develop stress-free bicycle practices, support bicycle planning and address the overall transition.

I present the list of all the challenges that the ideal solution should aim to address:

Stressful Experience: *provide an enjoyable and low-stress cycling experience.*

Infrastructure: *help to support the development of a well-connected, high-quality road network that would help citizens to avoid unpleasantries such as evaporated lanes, narrow lanes or unpaved trails and guide them effortlessly to their destinations.*

Safety: *improve the overall safety of the infrastructure and the personal safety; people should feel comfortable and safe to ride a bike.*

Inappropriate Behavior: *reduce the possibility of situations where inappropriate behavior could occur, promote tolerance and equal rights on the roads.*

Perception of Cycling and Cyclists: *create new identities, normalize cycling and promote bicycle culture.*

Lack of Participation in Cycling: *motivate people to take up cycling.*

Budget and Investments: *establish new strategic ways of how to allocate more investments to cycling.*

Lack of Collaboration Between Actors: *build new networks and new relations between the relevant actors and stakeholders.*

Health and Obesity: *help to fight the obesity, promote health and physical activity.*

Climate Change: *guide people to adopt sustainable practices, inform and create awareness on environmental issues.*

Congestion: *help to lesser the congestion and promote a convenient way of moving flows of people without them being stuck in the traffic.*

Population Growth in terms of Urban Space: *address the issue of limited urban space and how it could help to accommodate the growing nation.*

Below is presented a figure that analyzes and illustrates all the challenges and their relations *(Figure 15)*. There are four important challenges (*shortcomings in infrastructure, lack of safety, inappropriate behavior and perceptions on cycling and cyclists*) that forms the major barrier of cycling - *stressful experience*. All four of these challenges are interrelated and all contribute to making cycling experience more stressful:

- Shortcomings of infrastructure create lack of safety, provoke inappropriate behavior and reaffirm the perceptions that cycling is dangerous activity;
- Lack of safety is caused by shortcomings of infrastructure, inappropriate behavior and perceptions about cycling and cyclists;
- Inappropriate behavior contributes to lack of safety and perceptions about cycling and cyclists. Inappropriate behavior is supported by the shortcomings of infrastructure;
- Perception of cyclists and cycling is caused by inappropriate behavior, lack of safety and shortcomings of infrastructure.

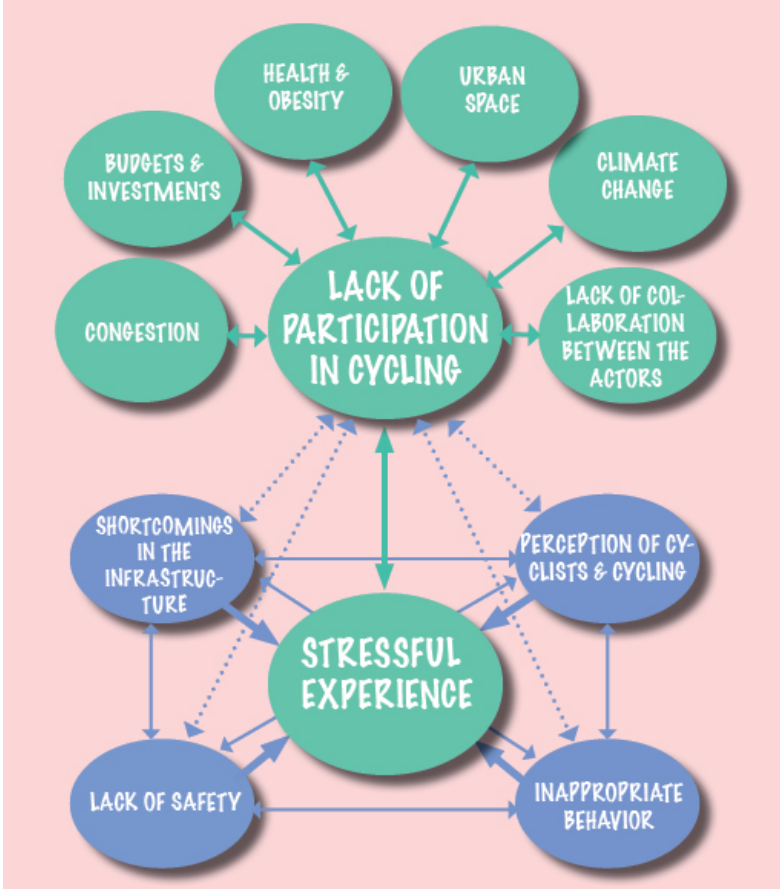


Figure 15. Experienced challenges. Own figure.

Individually these four challenges not only contribute to the *stressful experience* but also to the *lack of participation in cycling* which then leads to many different overall challenges. The design solution should address not only these challenges but also the important relations between them in order to enable transition.

8.2. Concepts

As mentioned in the theory chapter I use cracks as windows of opportunities to disrupt the regime. Cracks are where the existing car regime is vulnerable and therefore it is an opportunity to make changes. Below are presented several concepts - cracks along with the strategic ideas, in order to delimit the focus and develop the project further.

Crack A - *App to Lower-Stress Cycling Experience* concept grasps several main challenges; it addresses the issue of stress, infrastructure and network (Crack D), while also focusing on improving safety (Cracks B and C). Furthermore, it tells new stories about cycling (Cracks E and F), and highlights the importance of the individual's riding experience. The concept of the app could strategically address both – councils' and citizens' challenges and be used as a tool to disrupt the existing regime. The presented concept focuses on the transition through optimizing people's cycling experiences and addressing council's lock-ins.
Cracks B – *Safety,* as mentioned in Chapter 7 will not be developed further.
Crack C - *Campaigns to reduce inappropriate behavior* tackle the issue of poor behavior while also addressing safety and perceptions about cycling. It is an important crack that should be looked further to make cycling more safe and less stressful, therefore the concept also relates to Cracks B and A. Despite that, in this project I choose not to work with it further as this concept focus mainly on behavior to improve cycling experience and it does not incorporate physical elements such as infrastructure which as identified previously is causing a lot of stress too.
Crack D – *Infrastructure: increase cycling participation in northern part of Darebin* could work as an effective tool to prepare cyclists for the *real* traffic, help to increase their confidence and provide with basic cycling experience. Furthermore, the solution is related to Crack B - safety and Crack F – promoting health. However, taking into consideration this project's timeframe this idea would require more time and empirical data to be developed further.
Crack E - *Advert to Break Perceptions of Cycling and Cyclists* tackles the issue of social perceptions. It introduces new identities, shows cycling in different and more inviting way and makes it more visible. It challenges the social stigma that cycling is just for sports enthusiasts or students and is slow or inconvenient. It also relates to safety (Crack B), inappropriate behavior (Crack C), health (Crack F), urban space (Crack H) and climate change (Crack G) as these issues could be addressed and promoted in the advert. This crack and the concept of video advert is essential in order to break the social misperceptions. I intend to use this crack later in the process as a supplementary concept.
Crack F - *Campaigns for Health and Obesity* are very important because they are targeting a large group – people who want or need to improve their health. This concept relates to cracks G and H and could be used as a supplementary concept in other projects on cycling. I choose not to work with it as it is focusing on motivation to take up cycling and not on how to make it less stressful.
Crack G - *Fighting the Climate Change* is a very abstract and broad concept that could be interesting to take up in another project. Crack G relates to other issues such as promoting health (Crack F) and

climate change (Crack H). However, the main motivation of this concept is to reduce the level of CO2 rather than to make cycling experience better. For this reason, I leave this concept out.
Crack H - *Awareness on Population growth and Urban Space* also as cracks F and G focuses more on motivating people to take up cycling rather than improving cycling experience. I argue that all three concepts (F, G and H) are related and could be used as supplementary concepts to promote and motivate people to cycle along with ideas that address other issues.

Within the limited time allocated to this project and the data that I managed to collect on my stay in Melbourne I choose to work with the ***Crack A*** – App to Lower-Stress Cycling Experience along with ***Crack E*** to strengthen the concept and promote the app and other important issues. Cracks A and E relate to more challenges than any other crack. Therefore, I argue that the chosen concept combination will work as a strategic tool that will address other challenges too *(Figure 16).*
However, because of the limited timeframe Crack A will be the main focus of the project. More detailed conceptualization process of Crack E will be proposed after the project's deadline.

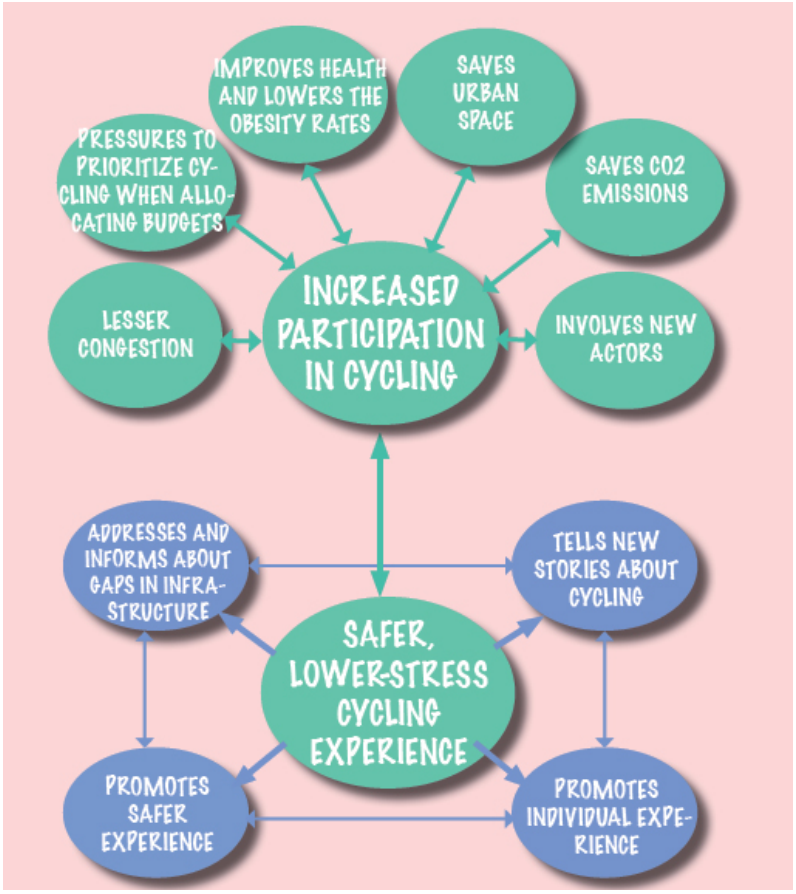


Figure 16. Illustration on how app relates to and addresses the challenges. Own figure.

Tool for Citizens and Councils

The presented crack A tackles primary issues of bicycle commuting identified by citizens; infrastructure, behavior, safety, stress and social perceptions. The app will address infrastructure by offering a service where a cyclist can specify what is wanted, needed or prefer to be avoided on the way to the destination. It will introduce the stress map that could be used when planning the journey in order to avoid lower-comfort roads or stressful experiences.
Safety will be improved by minimizing conflicts and inappropriate behavior; making cycling more visible and recognizing new identities would call for more tolerance on the roads.
The app will address council's challenges too. It will work as a strategic tool that provides information on infrastructure and characterizes cyclists and their transportation practices. These insights could be used to improve cycling network, create effective campaigns, increase safety and optimize cycling experience.

The proposed crack A addresses all major challenges and include both – citizens and council – perspectives. This app is a strategic tool to disrupt the regime however, it needs the support from the actors and stakeholders. The proposal of the app will be used as an interessement device to build stronger networks and relations among the actors. *'Interessement is the group of actions by which an entity attempts to impose and stabilize the identity of the other actors it defines through its problematization'* (Callon, 1986, p. 8). Interessement devices are an important part of building networks as they can keep the actors interested in the project: *"Innovation is the art of interesting an increasing number of allies who will make you stronger and stronger"* (Akrich et al., 2002, 205). Strong networks that support the idea of the app could put more pressure on the regime resulting its deconstruction which is the first step towards sustainable transitions.

The design proposal will be addressed in the next chapter where I will explore and analyze other existing global ideas and strategies on stress in bicycle commuting. These ideas will be used as an inspiration when building and prototyping the presented app.

CHAPTER 9: CONCEPTUALIZATION

This section will introduce other similar, existing global solutions such as applications, strategies and campaigns that work on lower-stress bicycle commuting.

9.1. Existing Global Cycling Applications

Many global apps address cycling as an important aspect to focus on. They offer to improve the users' cycling experiences, track their workouts or plan their routes. I chose to present and shortly discuss six apps which were selected in regards of their offered features that improve cycling experience. These apps highlight different issues that are relevant to this project and therefore could be used as an inspiration when designing the proposal.

Bike Hub Cycle Journey Planner

This app focuses on finding the **quickest possible biking routes** and nearest bike shops. It automatically **avoids hills where possible**, and if specified will find **quietest route**. This app is available only in United Kingdom (Play.google.com, 2018).

Criticism from the users: Asks to **confirm various actions while cycling** which distracts cyclist's attention. (Play.google.com, 2018).

OsmAndMaps

This application provides lots of different features including offline maps, **points of interests** or hiking routes. It has detailed maps where it is possible to **display cycling routes**, see the city map and **public transport hubs.** Available in most of countries around the world (Play.google.com, 2018).

Criticism from the users: Some people find it **too complicated** or difficult to use (Play.google.com, 2018).

Maps.Me

Maps.Me application provides offline map function to **walking, driving or cycling navigation** anywhere in the world. **Points of interest** are available as well as possibility to **save and share the locations with your friends** (Play.google.com, 2018).

Criticism from the users: Does not specify street names and **does not offer alternative routes**. Furthermore, is **slow to recalculate the route** if you chose to ride in different direction (Play.google.com, 2018).

Ride Report – bicycle route comfort map

This app focuses a lot on **decreasing stress while cycling**. It shows **worst and best routes that are identified by people who cycle**, **has a stress map**, tracks your routes and rewards you for riding in rain or other inconvenient circumstances. Available in several American cities (Play.google.com, 2018).

Criticism from the users: **Can stop tracking the data** when a cyclist stops at the traffic light or so, and starts to track it as a new journey (Play.google.com, 2018).

Endomondo
This is slightly different app. It is a fitness tracker and personal training application that **focuses on stats, health and fitness goals**. This app could be used as a **motivation** to cycle. Available worldwide (Play.google.com, 2018).

Criticism from the users: GPS is not very accurate and the **design is cumbersome** (when you on the move) (Play.google.com, 2018).

Rejseplanen
This app is for journeys made by public transport in Denmark. It searches for trips, navigates and offers several options and informs if public transport is delayed (Play.google.com, 2018).

Criticism from the users: Sometimes the app **shows inaccurate times of the public transport delays** (Play.google.com, 2018).

Besides Rejseplanen, these were the apps that has different focus on cycling however still contributes (except the Endomondo) to lower stress cycling experience. Rejseplanen app was chosen for its easy and understandable navigation when planning a trip. It provides detailed journey, connections and a map where you can track the locations. These features will be used as inspiration to prototype the design proposal. Most of the existing applications focus on navigation or tracking your workout. Not many offers low-stress bicycle commuting by providing information on routes, their conditions or traffic volumes.
Presented apps highlighted the importance of the simple yet informative design. The app functions and features should be easily understood and do not take up too much of the user's time. It should aim to navigate the user through the network while adapting to his/her preferences. The app should offer a stress map and suggest best and worst routes that are classified or identified preferably by real people's cycling experiences. To increase the app's usage, the navigation should work online and offline too. Moreover, it must be able to store the user's cycling data, information and allow the user to rate, comment or share his/her experience with friends.
To be used widely the app could aim to incorporate other cities or countries however, this would require lots of resources and strong actor collaboration. If the app is designed to be used locally it could be a good branding tool for the council. Despite that, if the app will be *too small* it might not be successful (used) and therefore, it could be seen as amateur.

9.2. Strategies on Low-Stress Cycling

It is not easy to measure stress in cycling practice. Variety of issues can affect stress levels including stressors caused by other things than traffic. Below are presented strategies and campaigns that

acknowledge and tackle the stress factor in bicycle commuting. These guidelines will be used as inspiration for the design proposal.

Low-Stress Bicycling and Network Connectivity and *Bicycle Strategy – San Francisco*

These reports analyze and develop measures of the level of traffic stress in order to guide bicycle network planning (Mekuria et al., 2012; SFMTA Bicycle Strategy, 2013). Both of them recognize and classify cyclists into four categories:

- Strong and Fearless – can ride in almost any traffic conditions.
- Enthused and Confident – can ride in bike lanes along arterial roads or share smaller roads with traffic.
- Interested but Concerned – can feel uncomfortable about sharing the roads with other modes. Despite that, can comfortably ride on off-roads, paths or streets with low volume or slow traffic.
- No Way No How – this group has no interest or motivation in riding a bike at all.

The reports identified different factors of what causes stress; facilities, detours, width of the lane, speed or stressors other than traffic. They categorize stress in four levels using the guidelines from Dutch standards:

LTS1 (level of traffic stress 1) – little traffic stress and relaxing bike ride. This level is suitable for almost all cyclists. *"On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a slow traffic stream with no more than one lane per direction, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where cyclists ride alongside a parking lane, they have ample operating space outside the zone into which car doors are opened. Intersections are easy to approach and cross"* (Mekuria et al., 2012, p.14)

LTS2 (level of traffic stress 2) – little traffic stress, nonetheless requires more attention. Suitable to most adult cyclists. *"On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a well-confined traffic stream with adequate clearance from a parking lane, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where a bike lane lies between a through lane and a right-turn lane, it is configured to give cyclists unambiguous priority where cars cross the bike lane and to keep car speed in the right-turn lane comparable to bicycling speeds"* (Mekuria et al., 2012, p.14).

LTS3 (level of traffic stress 3) – more stress is expected, integrated with multilane traffic. *"Offering cyclists either an exclusive riding zone (lane) next to moderate-speed traffic or shared lanes on streets that are not multilane and have moderately low speed. Crossings may be longer or across higher-speed roads than allowed by LTS 2, but are still considered acceptably safe to most adult pedestrians"* (Mekuria et al., 2012, p.14).

LTS4 (level of traffic stress 4) – highest level of stress. High interaction with other transport modes and/or high volume traffic. (Mekuria et al., 2012), *(Figure 17).*

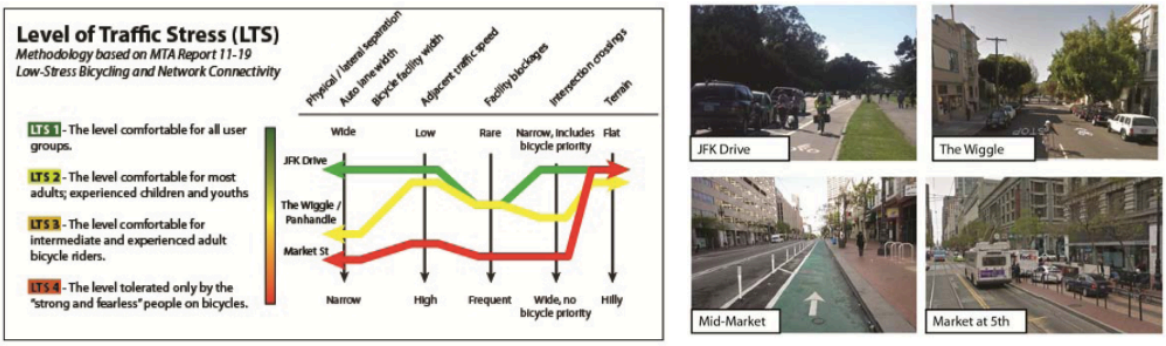


Figure 17. Level of Traffic Stress (LTS). Source: Low Stress Bicycling and Network Connectivity.

9.3. Campaigns

There are a number of campaigns that promotes and nudges cycling, encourages tolerance on the roads or points out to benefits of bicycle commuting. Campaigns are essential for the strategic planning. They can target various audiences, inform and create awareness about the existing problems and issues.

Figure 18 presents several examples from Pittsburgh, USA: "*Pittsburgh bike campaign is a lycra-free zone, showing cyclists as people"* (TreeHugger, 2018). These campaigns can be used as an inspiration to develop the video advert (Crack E) later in the process to challenge perceptions and support the concept of the app.

Figure 18. Campaigns on types of cyclists. Source: Pinterest.dk

This chapter presented few apps that recognize the importance of cycling experience. The two strategies introduced how stress is measured and categorized into different levels and groups. Additionally, examples of campaigns that address perceptions of bicycle commuting were given. These insights and guidelines will be taken further into the next chapter as an inspiration to design the proposal – lower-stress cycling experience app.

CHAPTER 10: DESIGN PROPOSAL

This chapter will scope the project and frame the concept of the design proposal. It will present and analyze the app's features and propose ways to test it.

10.1. Concept of the App

The design proposal that promotes a lower-stress cycling experience must be easily accessible to everyone at any time. In today's modern world mobile gadgets and mobile applications play an important role. Using only counters to get insights and understand cycling behavior is far from the results that can be achieved by using advanced tools such as applications.
The applications offer to user awareness on the products or services and communication with the provider (by rating your experience etc.). User engagement and involvement is a big part of the app services; it helps to better connect with people, provide them with information fast and raise their overall satisfaction with the product or service. Applications can act as tools to provide knowledge on large variety of citizens. Insights from qualitative data could be used to analyze and understand people's practices which then can be translated into more efficient and strategic urban planning.

The choice of the app to lower the overall stress experience in Melbourne is not a coincidence. Many people use apps that navigate them to their destinations; it is convenient, fast and suitable for all modes of transport. Easy access to information can reach a bigger audience and therefore create awareness and communicate a message. Below are listed the main reasons behind the choice of the app:

- Accessibility – the app for iPhone or Android will be accessible to anyone who owns a smartphone;
- Visibility - makes the issue (cycling, its challenges and the problem of stress) visible;
- Flexibility – adapts to the users (personalized features);
- Communication tool/device – communicates a message;
- User involvement – involves important actors (citizens, councils etc.) and creates relations;
- Creates value – provides a value for the users (e.g. lower-stress experience).

The app will target several identified barriers; will challenge the social perception on cycling and cyclists, will make the practice of cycling safer and more enjoyable, will promote health and physical activity and will address the importance on individual's journey experience. Despite these objectives, the greater goal of this app is to make cycling visible, create new relations and act as tool to enable sustainable transition. I intend to highlight these goals with the features that the app will be able to offer.

10.2. Design of the Prototype

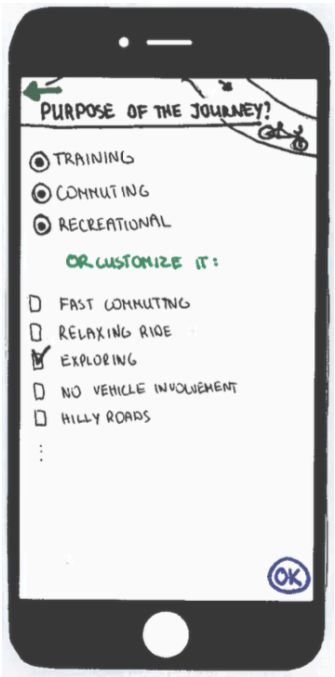
1. *Profile/Identity – forms and highlights new identities.*
   Which cyclist are you? This feature allows people to choose between *Strong and Fearless, Enthused and Confident, Interested but Concerned, No Way No How* commuter or customize their own identity. This grouping of cyclists was inspired by *Low-Stress Bicycling and Network Connectivity* and *Bicycle Strategy San Francisco* reports. It does not categorize cyclists into sports or every day commuters (avoids the negative perception), on contrary

it promotes what kind of interest and experience you have in cycling.

With this feature the users can get the information they need on routes, roads or traffic conditions and make the decisions faster. *Example: if the user is Strong and Fearless the app will automatically find routes that suit this type of cyclist needs (wide lanes, might be shared with cars, not shared with pedestrians etc.)*

2. *Purpose of the journey – acknowledges different reasons and motivations of riding a bike.*

This feature was inspired from the empirical findings about different purposes and needs for the journey that different cyclists have. It allows users to select the purpose of riding; *training, commuting, recreational* or customize it themselves. Each of the purpose holds different needs for the journey and therefore the app will automatically suggest the general options and needs on behalf of the user's choice or will let to customize it with the next feature – preferences. *Example: if the Enthused and Confident user chooses commuting purpose the app will direct the user to the fastest way to get to the destination. It might involve shared routes with cars, wide lanes or will avoid any detours.*

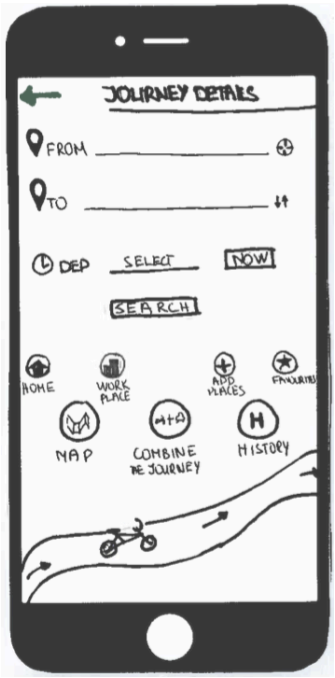


3. *Preferences (optional) – offers personalized journey experience.*

The preferences feature allows user to select what is wanted or needed for the trip. The preferences will include categories such as *Facilities (Points of Interest), Road Conditions, Visibility, Intersections* or *Riding Conditions. Example: if the user specifies that bike repair shops are needed on the way the app will find and guide the user to the nearest shops along the route that provide such a service.*

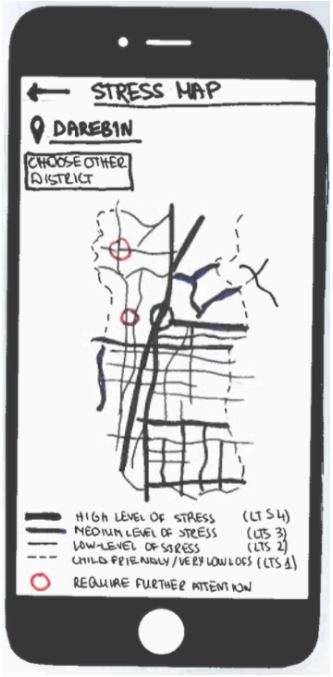
4. *Journey details (including stress routes of the trip) – informs the rider about the important aspects of the journey.*

This feature will allow the user to enter the starting point and the destination of the trip. It will show a (detailed) plan of the trip that includes the time of the departure and arrival, possibility to combine different modes of transport and marked routes according to the

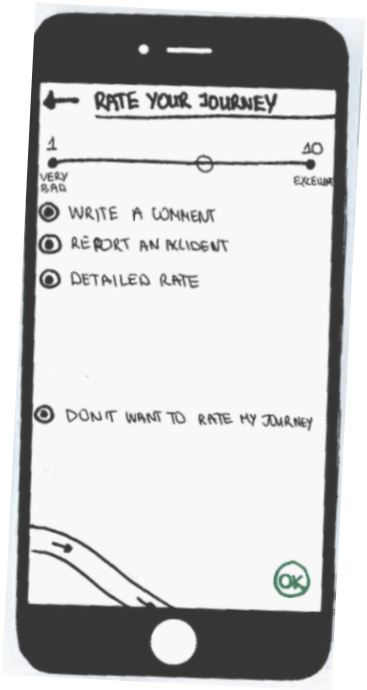


level of stress they hold (LTS1, LTS2, LTS3 and LTS4 inspired by *Low-Stress Bicycling and Network Connectivity* and *Bicycle Strategy San Francisco*). It will also inform about any road works or peak hour traffic and will suggest alternatives to avoid them.

5. *Stress Map (optional) – provides with the knowledge that contributes to a safer and lower-stress experience.*
This feature is optional; it does not require to create a profile in order to access the Stress Map. This feature will show all the routes in the district/city that are categorized into different levels of stress. Furthermore, it will show the volume of cyclists that are using this route (the thicker the line/route the more cyclists using it). Marking and color identifications will be specified on the map.



6. *Rate, share and comment (optional) – addresses the shortcomings of infrastructure (includes citizens to give feedback on issues of the network), makes cycling more visible (sharing cycling experience with friends or family) and creates new relations (involves citizens to share their issues and councils to act on them).*
This feature allows cyclists to rate their overall experience, report/comment on any incidents, road conditions or make suggestions and share the best and worst routes among their friends.



The presented features should be designed to be used effortlessly. General options such as *'routes suitable for strong and fearless'* or *'road conditions suitable for Interested but Concerned'* commuters should be available and highlighted to speed up the selection process. The *Stress Map* will not require to create a profile therefore it must be instantly accessible. The map needs to be in a good quality with visible street names and building numbers. Information on stress classifications should be displayed on the map. Lastly, the app should include features such as likes or photo-sharing; if the app is interactive, the user will more likely engage with it.
The presented features addresses citizens' and councils' challenges such as stress, network and infrastructure, safety, behavior and social perceptions. Apart from that, the app itself makes cycling visible; it acknowledges cycling as a legitimate way of commuting, creates new identities and new forms of cycling by characterizing the practices of commuting and highlights the need of safer and lower-stress cycling experience. *Figure 19* (also available as Appendix 10) presents the navigation of the app.

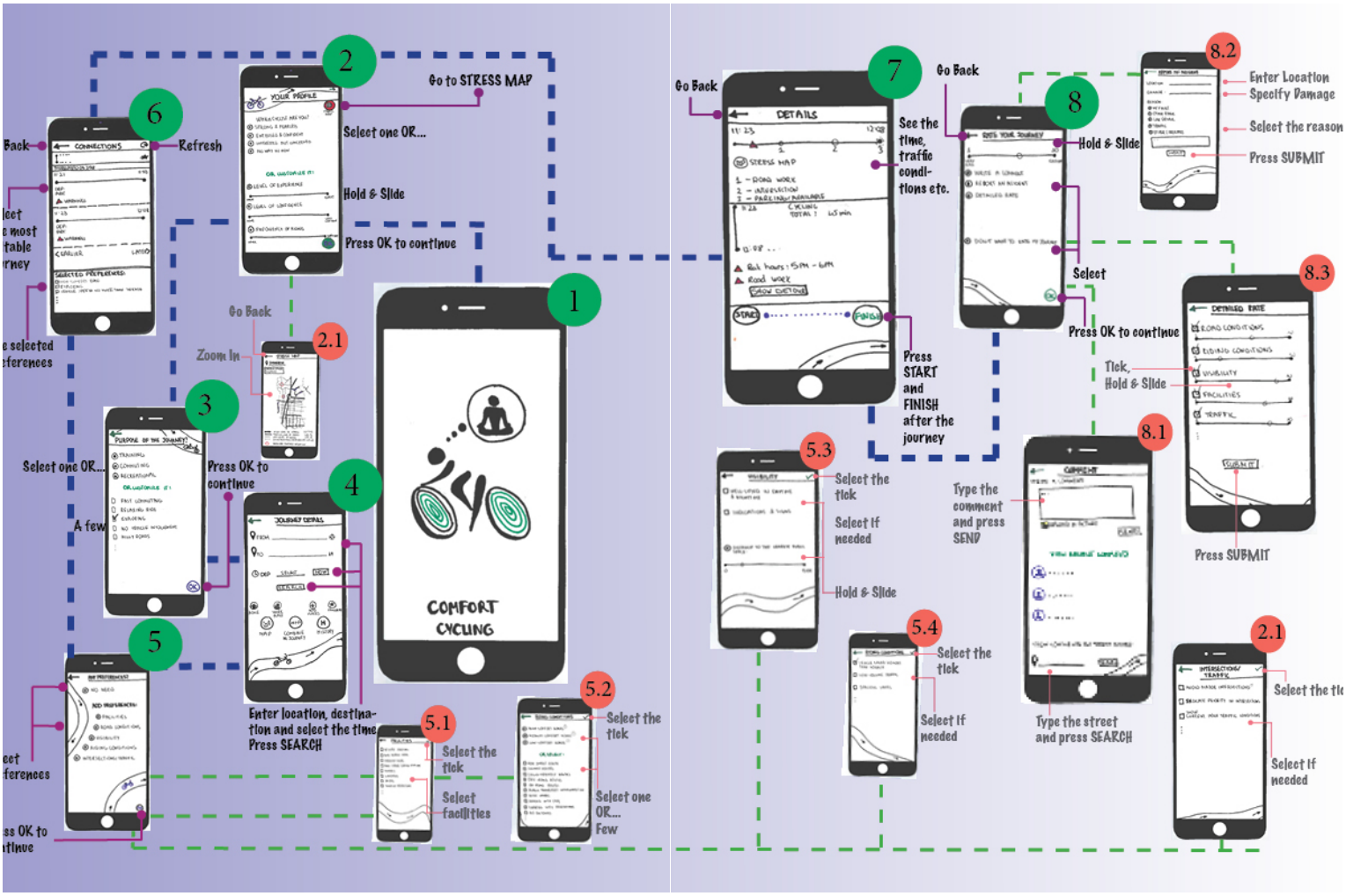


Figure 19. Navigation of the app. (Blue dashes and green ovals indicate the primary functions, green dashes and red ovals indicate the optional or secondary functions) Own figure.

10.3. How This App is Different from Others?

The proposed app will be called Comfort Cycling app in order to create a positive statement by emphasizing that cycling is a convenient way to commute. This app will not be just another app on bicycle commuting. It will strategically address the transition by overcoming berries and challenges experienced by citizens and councils while creating new networks and addressing the unsustainable car practices.

The Comfort Cycling app will:

1. Make cycling visible and not hidden;
2. Tell new stories about cycling (storytelling), create new identities and show cycling in the new way;
3. Improve safety and lower the stress levels experienced while cycling;
4. Perform as a tool for citizens;
5. Perform as a valuation tool. It will assign different values in cycling (health, comfort etc.);

6. Perform as a tool for councils, planners or government (provides the data on transportation practices etc.);
7. Create new relations and builds new networks (include citizens into planning etc.).

Comfort Cycling app is a tool that makes cycling more visible for people, councils or government by bringing cycling into the daylight instead of keeping it in a shadow. It tells new stories about cycling being safe, fast and enjoyable way of commuting. It recognizes new identities and guides cyclists through the network in order to experience cycling practice in the best possible way. The app is a tool built for all types of cyclist – from occasional local riders to hardcore fitness enthusiasts. It explores the riders' needs and guides them within the network. It addresses the issue of stress and seeks to provide commuters with more comfort.

Comfort Cycling app will work towards optimizing the overall cycling experience; making it relaxing and enjoyable. It will help the rider to make decisions faster, smarter as well as more responsive to rider's lived experiences. The level of stress will be reduced (or avoided at all) by providing information on routes before the journey starts. Riders can choose the preferred road conditions, facilities or the level of stress that they are willing to tolerate. The app will also notify the users about areas that require more attention; intersections, possible detours, road works or peak hour traffic conditions.
Decreasing the level of stress while commuting will enhance the riders' cycling experiences. Not only that will motivate the current cyclists to keep commuting by bike but it will also invite others to take up cycling. By breaking social perception of cycling being dangerous and just for certain people it will expand the new ways of how we see, perform and value riding. Creating safer cycling practices will also invite most vulnerable citizens such as kids and elderly to participate in bicycle commuting. Consequently, the bigger diversity and mixture of cyclists, safer and lower-stress experience can lead to re-defining the practice of cycling in Melbourne.

The Comfort Cycling app is as an important tool for citizens as it is for councils. The app can significantly ease the process of data collection on transportation practices and commuter's behavior. Users will be able to provide information on network, stressful routes and where they are located by reporting their experiences directly to the app. The app could give insights into errands and small, local trips made by cyclists that often can be invisible to planners. In addition, it could *paint a picture* of user's cycling lifestyle; how often the user rides (trips per week), what is the user's regular pace (average duration of the commuting), mode share (combined journey or not) and user's relative stress-tolerance. This could provide insights and assumptions on transportation decisions that are based on the overall network.
Such important knowledge and observations could be used by councils in the network planning process. Planners will be able to identify problematic areas in the network, most common destinations or most used roads and routes. This could create more space for experimentations not only with infrastructure but also with urban planning and liveability development.

It is essential to create value in cycling in order to increase its participation. Findings from the previous project indicated that better health, financial benefits, independence and time efficiency are most dominant facilitators among citizens to bicycle commuting. The app itself is a valuation tool; besides the presented values it also seeks to assign the value of comfort and enjoyable cycling

experience. Councils may see this valuation tool as something that provides knowledge and data on cycling practices while also promoting different long-term valuation measures such as health, participation in cycling or cultural change.

Actor involvement plays a big role in deconstruction and transition process. The Comfort Cycling app could strategically bridge different sectors such as health and planning. City planners (usually) do not work with health as it is not their sector. They address health as an outcome of cycling still, they do not plan cycling infrastructure for the sake of health and often do not know how to incorporate it in the network planning process. This app could link different sectors and involve new actors and stakeholders to collaborate for the common vision.
Including features such as comments, rating, likes or photo-sharing is important. These features enable the conversation between the user and the app provider. It helps to understand the user's challenges, preferences and practices which are essential when designing the app and planning the network for the users. The app users will be involved in the planning process by being able to rate their trip and give their feedback. Comfort Cycling app will ask to rate the level of comfort of the user's journey making it an easy way to collect the feedback. Furthermore, the feedback, from people's lived experiences, later could contribute to identifying *tension points* in the network in order to strategically approach them. People's comments or suggestions can be used as valuable information when planning and building the network. For example, users could comment on whether or not the new bike lane made them feel safer after it was set up.

To enable the app, it is necessary to collect the information on existing network; examine, evaluate and categorize the roads into described levels of stress or by people's real experiences. Furthermore, to analyze road conditions, signage, examine visibility in the daytime and nighttime, indicate facilities and services, calculate the traffic volume and flow (both cars and bikes) and much more information on network needs to be gathered before the app will be able to start to work. Other actors such as students, local communities or even volunteers could help to collect the data and contribute to the process of establishing guidelines and evaluation recommendations for the network of the local district. These guidelines and recommendations can be later used by other involved councils helping them to evaluate their local network.

10.4. How to Test the App?

When designing and developing the proposal, the agile manner of working is essential; test the solution, reflect on the feedback and respond to change. It helps to look back on the process and reevaluate previous decisions instead of following the generic product model. Feedback and constructive criticism is an important part of prototyping process. The solution will be used by people therefore it must be designed for and with them.
The constructive feedback can improve the design and the app's features moreover, make sure that it is easy and fun to use. Ideally, the proposed app should be tested in Melbourne, Darebin district as the empirical data used for the proposal was collected there. However, the current circumstances do not allow me to perform such a testing as I am currently located in Copenhagen. Nonetheless, I propose two ways of how the proposal could still be tested:

- *Test the app prototype and get the feedback on the product and the design from the fellow classmates;*
- *Send the app prototype to City of Darebin council in order for them to perform the testing with the citizens of Darebin;*

Feedback from Fellow Classmates on the App

The app was tested three times by three different people. Before the testing, basic information on cycling situation in Melbourne was provided. This was done in order to underline the differences between cycling in Copenhagen and cycling in Melbourne. I explained the purpose of the app and its three main features; stress map, the reason of creating an identity and selecting a purpose of the journey. The collected feedback pointed to several system and design issues that are presented below:

- When selecting *"Your profile", "Purpose of the journey" or "Road Conditions"* make "*or customize it"* as a button too. When a person will select "*or customize it"* then possible options will appear. Otherwise they should stay less vivid.
- When a person selects or customizes his/her profile there should be a button – *"keep the settings".* This would prevent selecting the identity every time when planning a journey.
- When selecting a purpose of the journey there should be a button that says *"go back to profile settings".* This would be helpful in order to change the profile settings when needed.
- In *"Journey Details"* there should be also arrival button and not just departure.
- In *"Facilities", "Road Conditions", "Visibility", "Riding Conditions" and "Intersections/Traffic"* the tick (green button in the right corner) should be changed to *Confirm* in order to be clear that you have to confirm the selected choices. Also the button could be placed right after all the selections (in the bottom).
- In the "*Details"* after pressing a start there should be another window with navigation. A button to silent the navigation should be available as well.
- After the trip is finished, or the person rated the trip the app should redirect you back to *"Purpose of the journey".*

The app will be tested more in order to see if these presented issues are dominating. The feedback of the app will be analyzed after the project's hand-in to alter the prototype and test it again. The alteration and testing process will be made until the process of selecting and completing the journey is effortless and the user is contented with the app service.
The design proposal and its prototype will be sent to City of Darebin council in order to perform the tests and get the feedback from the local citizens.

The concept of the app will be taken further in the next chapter to discuss how the app will enable the sustainable transition.

CHAPTER 11: DISCUSSION

How the App Disrupts the Regime?

It is not easy to destabilize or disrupt the existing regimes, especially if they are as strong as a car regime in Melbourne. The city and its people experience this strong lock-in of the car regime which is difficult to break. It is hard for the individuals to break the regime because of the challenges they face such as stress, safety or infrastructure. It is also difficult for councils to make a real change as there is not enough cyclists on the roads, not enough investments are allocated for cycling or lack of participation from other actors in the planning process. Councils and citizens experience this strong lock-in that they cannot individually break.

Transition requires the thorough analysis of the existing regime with all its aspects such as culture, socio-technical systems and networks, regulations and practices. The analysis of the regimes helps to identify crucial cracks in the systems, windows of opportunities where they can be approached by the strategic design and planning. It is not enough to be innovative, create a product and expect it to conquer the regime. The process of transition requires navigation along the network to enable new possibilities, opportunities and build new relations to support these design ideas.

The Comfort Cycling app is not a solution to the high motor vehicle usage problem in Melbourne. The app itself does not solve the problem of car dependence either. Nevertheless, it strategically works on deconstructing the regime by addressing identified cracks as windows of opportunities and building new relations to trigger the transition process. The previous findings presented that stress is a big factor in the transportation choice. Cycling was seen as a practice that is too stressful and far from being enjoyable. This challenge was identified as a crack in the regime that could be strategically addressed with idea of the app to lower the stress in the practice of cycling. The app's presented features work on improving individual's cycling experience by suggesting routes, facilities or road conditions that avoid stress or stressful situations. Comfort Cycling app collects and reflects upon the information provided by the user in order to suggest the most suitable routes. The app enables new relations with citizens and councils; it creates a space for citizens to share their experiences and thoughts while providing a possibility for councils to access the qualitative data and characteristics of cyclists and bicycle commuting practices.

How It Changes Practices?

As mentioned previously the solution – the app – should aim to trigger a change in people's current practices. It is a challenging and a long process to change the societal car based transportation practices to more sustainable ones. Even though, cycling is much advertised and promoted in Melbourne, the strategic plans with clear goals on how to decrease the car usage are absent. It is difficult to change practices while car-driving practice and the consequences of the car usage are hidden. Important issues such as enormous resource usage in car manufacturing process, the urban space that cars take up or pollution that people suffer in the cities are not very visible. These issues must be discussed instead of being ignored. The change of the practices will be triggered by introducing side effects of current car-based practices and presenting the positive effects of bicycle commuting. Those effects need to be addressed not only on national or city level such as savings in healthcare but also on the individual or personal level. As the analysis chapter indicated citizens and councils experience challenges differently therefore, the effects of bicycle commuting should be presented through different perspectives too. It could address daily effects of cycling in health or obesity rates or focus on incremental change and propose one day a week where a car trip is exchanged to a bike ride; for example, a car-free Friday as a similar concept to meatless or meat-

free Mondays. Meat free Monday is a well-known concept *"which aims to raise awareness of the detrimental environmental impact of eating meat, and to encourage people to help slow climate change, preserve precious natural resources and improve their health by having at least one meat free day each week."* (Monday, 2018). Millions of people now go meat-free on Mondays to support the environment or improve their health (Monday, 2018a). A similar concept could be advertised to create awareness on car driving effects on environment and individual's health. Small incremental changes are easier to adopt while they still contribute to bigger goals.

Another way to inspire a change in practices is to show how easy, fun and stresslees cycling can be for everyone regardless their background, age or gender. Crack E - the concept of storytelling in a form of a video advert could be an effective tool to challenge the existing social perceptions about cyclists and bicycle commuting. Furthermore, the advert would incorporate the Comfort Cycling app as a way to show how it is used and how it will improve the rider's overall experience. The video advert would present and illustrate various people (different backgrounds, occupations, age etc.) lifestyles that involve daily cycling routines. Furthermore, for which purposes they use the Comfort Cycling app and how it enhances their cycling journey. The video advert can also address the issues of curly clothes or getting sweaty on a bike when commuting to work. The advert could show how people can deal with these issues or avoid them at all.

The concept of video advert will focus on exploring the relations between people and their practices. It will send a key message that it is normal, fun and easy to ride a bike despite where you work, what you do or even your social status. It would challenge the negative perceptions by highlighting the benefits and pleasantries of bicycle commuting, will present cycling in the new light and re-arrange the way we see, perform and value it.

Relations and Navigation

Navigation is the key element for the presented app to succeed in destabilizing heavy regimes and enabling transitions. The app is a part of network building. It is essential to study the network and look for opportunities to create new relations in order to build strong network that supports the app and encourages sustainable transitions. In Desk and Literature chapter I pointed out the relations (collaboration on projects) between City of Melbourne, the government, Vic Roads, Bicycle Network and Victoria Police. From the reports I also indicated the relations between City of Darebin and Vic Roads. These relations are highly important and need to be addressed in order to build a strong network. City of Darebin needs to navigate actively in the existing network; they need to study and examine the relations in order to understand, involve and align new actors to cooperate when pushing the cycling agenda. Darebin Council could use Comfort Cycling app as an interessement device to involve new actors. The app could be used as a proposition to work further on reducing stress of cycling in Melbourne. The lower-stress cycling experience app could be seen as a pilot project that if succeeds in Darebin can evolve and incorporate other parts of the city. Consequently, it will require resources to substantiate the app idea. With this in mind, the stress routes could be categorized by cyclists or the information on stress routes could be validated by bicycle accounts.

City of Darebin should use the app as a tool to sustain and strengthen the relation with citizens' by involving them in the planning process. This mutual connection will provide people with a feeling that the future is co-created by everyone and is rather owned than already decided by someone.

The proposed app is not the solution to the problem, it is a tool that council needs to use strategically. The support from the actors and stakeholders and the app is a strong combination that can disrupt the existing regime and enable transition.

Feasibility and Valuation

Feasibility studies focus a lot on measures such as economic, legal, technological or scheduling. Often the ideas are evaluated through these factors leaving other important measures such as health or sustainability remaining invisible. The tools we have and use now are measuring the current world and not the sustainable future. Tools such as socio-economic analysis highlights the aspects of accessibility, travel time or economic productivity and development of vehicle usage. Nevertheless, these tools often do not include the long-term environmental costs or health problems caused by pollution. Decisions of which measures to include are often made on specific criteria when others are excluded or left invisible. Therefore, if feasibility studies should be made it should include other measures than just economics. There is a need for new feasibility models that includes important long-term values. New feasibility studies should include health-economics (measure obesity cost to the economy and whether it is decreasing), urban space (the space available in the city and whether it is decreasing) and pollution measures (the level of pollution in the city and whether it is decreasing). The current traditional tools measure the existing world and therefore we need new tools that would support the vision of how we want our sustainable future to look like.

The presented design proposal has different evaluation perspectives and success criteria. Investors perspective on evaluation is very different from society's perspective. Investors tend to focus on short-term goals rather than a long-term change and for this reason the app cannot be evaluated only through one, investor's perspective. I propose three perspectives for the evaluation process:

- *Citizens perspective;*
- *Councils and planners' perspective and;*
- *Overall (transition) perspective.*

From *citizens' perspective* the design proposal of the app and the video advert addresses their challenges and makes cycling less stressful and more enjoyable. It does not fix the shortcomings of the infrastructure however; it helps cyclists to avoid them and councils to strategically act on them. The app itself is a valuation tool that highlights new values in cycling, normalizes it, makes it visible and promotes safety and experience. The combination of app and proposed video advert presents cycling in new ways and tells new stories about cycling that are not been told today.

From *councils' and planners' perspective* the app addresses their challenges and lock-ins such as lack of participation in cycling through improving citizens' cycling experiences. Furthermore, it acts as a tool that collects the data on cyclists and cycling practices and provides an access to planners to these larger scale qualitative data insights that often are unavailable to them. These insights could act as key points to support and plan for bicycle infrastructure.

From the *overall (transition) perspective* the design proposal promotes individual's health and physical activity that could be translated into larger goal - healthier society. It addresses sustainable

transportation that could be translated into preventing climate change and saving the urban space. The design proposal addresses the transition from a car regime towards a cycling culture. It calls for a change by indicating the contrast between the car and bicycle infrastructure development. The design proposal does not make a radical change yet it promotes incremental improvement towards sustainable future. The cumulative effect of the incremental improvements could instigate a societal change – transition.

This chapter discussed how the design proposal could disrupt the regime, change people's practices and enable the sustainable transition. With the Comfort Cycling app and the video advert as a design proposal I scoped my project and delimited my focus, however other presented ideas could have been used and explored further as well. As mentioned previously, the proposal does not create an instant or radical change therefore, more ideas, actions and planning that support cycling will only contribute to the transition. It is important to keep planning for cycling, adapt to practices and people's needs. The Comfort Cycling App needs to be updated constantly and think one step ahead of people's practices to offer a cycling experience that could not even make to consider to use a car. Certainly, one can never know if the app can actually change people's practices unless it is being enabled and used by citizens. However, change in practices is a long-term goal that will not happen overnight therefore besides the tool – the app - it needs new relations, new networks and strategic planning that will support that change.

CHAPTER 12: CONCLUSION

This master thesis project has explored a complex topic of sustainable transition of a car-focused socio-technical network in Melbourne. The study analyzed the heavy regime and the role of building new networks with the aim to design a lower-stress bicycle commuting practice that would enable a sustainable transition. In this paper I examined the different challenges and opportunities bicycle commuting presents and analyzed lock-ins of the heavy regime that keep constructing Melbourne as a car-focused city. Geels Multi-Level Perspective theory and Unruh lock-in reflections helped to explore and illustrate the heavy regime that has a strong car-dependency which throughout history continues to dominate till this day. I argued that historical events such as World War II and oil crisis, accessibility and affordability of cars and fuel, urban sprawl and socio-technical systems and practices had an enormous influence of how citizens in Melbourne commute today. Important findings from prior research highlighted the role stress plays as a barrier to bicycle commuting. From these findings a problem formulation was formed with a basis of disrupting the regime, building new networks while designing a less stressful cycling practice to enable transition and re-arrange the way people in Melbourne perform and value cycling.

Desk and literature research explored the role of cycling in Melbourne's future plans. Through the analysis of future strategies and proposed ambitious targets, the research concluded that councils and transport authorities strongly advertise cycling yet the practice of bicycle commuting is lacking. This lead the research to hypothesize that the traditional methods used by the authorities such as regulations to hinder cars is not an adequate solution capable of leading to a transition. Based on this belief I undertook work with navigational pathways and addressed the existing regimes with a design thinking approach. I achieved this by looking for cracks as vulnerable points of the regime that are not working or require further development in order to help create meaningful change. Furthermore, I sought to assign new values to cycling as part of building new networks and creating new relations using Actor-Network Theory that will support and encourage sustainable transitions.

In this project I used several design methods for empirical data collection in order to involve relevant actors in the network, explore their challenges and design the new future together. Findings from collected data confirmed that stress was seen as the biggest deterrent of bicycle commuting followed by shortcomings of infrastructure, lack of safety, inappropriate behavior and perceptions about cycling and cyclists. Empirical findings indicated that these challenges are faced not only by citizens but also by the Darebin council. However, both – citizens and council experience these challenges very differently. Therefore, when designing a solution to increase cycling participation in Melbourne both worlds, citizens' and council's, need to be addressed. Furthermore, large-scale or societal challenges such as health and obesity, climate change and urban space were identified as very important challenges as well that could be fought with cycling. In the paper I argued that these presented challenges created strong lock-ins of the regime which citizens and councils, individually cannot break.

In this project I looked for ways to intervene and disrupt the heavy regime. Cracks were presented as a concept of gaps, weak and vulnerable points of the system that if approached strategically, can trigger a change. Eight different cracks along with proposed design ideas were presented as concepts that could be developed further to disrupt the regime. Among them all I argued for the app to lower-stress cycling experience to be the concept that works on deconstruction by addressing council's and citizen's experienced challenges and lock-ins. The app creates new

relations by including citizens into urban planning process and providing the council with the important knowledge about their commuting practices and behavior patterns. The design proposal addresses current, unsustainable car practices by making cycling visible and highlighting the pleasantries of bicycle commuting. It also presents new identities and stories about cycling, assigns new values and builds new networks that would support the transition. As a supplementary concept I argued for a storytelling idea of video advert that could introduce the app and strengthen its concept by breaking the existing social perceptions about riding a bike in Melbourne.

The app was designed based on the addressed challenges, lock-ins and facilitators of bicycle commuting. The app prototype and its features were inspired by several global apps and strategies that looked into cycling, navigation or the stress involved with bicycle commuting. The aim was to design an easy, accessible and entertaining application and provide people with navigation according to their selected facilities and level of stress they can tolerate. The stress map was proposed to be the essential feature of the app providing cyclists with the knowledge on the classified stress routes in infrastructure. The study proposed that the stress map could be done by classifying routes using proposed standards or by cyclist's real experiences.

This project led to the conclusion that the app itself is not a solution to all existing problems. The objective of the design proposal was not to design the technical app but to design the network that will support the sustainable transition. The app is a strategic move that integrates the social and technical elements and explores the dynamics between them in order to disrupt the existing regime. Returning to the problem question posed at the beginning of this study, it is now possible to state that the app is designed to be used as a tool to lower-stress cycling experience but more importantly it is an essential part of building new networks and the process of designing a change.

The main limitation of the study was that it did not look in detail towards formal planning of cycling infrastructure or the technical aspects of it. The study addressed it from a pragmatic perspective. Another limitation was the timeframe available to collect empirical data that could have had an impact on this project's direction and scope. If more empirical data had been collected other challenges or areas of concern could have been identified. A final limitation of this study was not being able to test the proposal in the local environment. Different ways of testing and intervention could have further enhanced the design proposal.

To further this project, the structural aspects of how the Darebin council could use the design proposal need to be addressed. It is important to discuss within the council how far the proposal should be developed, to consider funding requirements and to understand what the short and long-term social, economic and sustainability outcomes are on the regional and individual level. In order to encourage sustainable practices, it is critical that we start to act, plan and design for the future we want by challenging the status quo and inspire the society to move towards a more sustainable future.

REFERENCES

A

ABC News. (2018)a. *If you thought 2017 was hot, now it's official*. [online] Available at: http://www.abc.net.au/news/2018-01-10/annual-climate-statement-2017-third-hottest-year-on-record/9314364 [Accessed 18 May 2018].

ABC News. (2018). *Fact check: Do nine in 10 Australians spend more than 90 minutes a day commuting?* [online] Available at: http://www.abc.net.au/news/2015-07-09/commuting-times-travel-shorten/6592510 [Accessed 18 May 2018].

Akrich, Madeleine, Michel Callon, Bruno Latour, and Adrian Monaghan. 2002. "The Key To Success in Innovation Part I: The Art of Interessement." *International Journal of Innovation Management* 06 (02): 207–25.

Australian Institute of Health and Welfare. (2017). *A picture of overweight and obesity in Australia 2017.* Cat. no.PHE 216. Canberra: AIHW.

B

Bicycle Plan 2016-2020. (2016). [online] City of Melbourne. Available at: https://www.melbourne.vic.gov.au/SiteCollectionDocuments/city-of-melbourne-bicycle-plan-2016-2020.pdf [Accessed 17 May 2018].

Bicycle Network. (2018). About Us | Bicycle Network. [online] Available at: https://www.bicyclenetwork.com.au/about-us/ [Accessed 25 May 2018].

Brandt E. (2006). *Designing exploratory design games: a framework for participation in Participatory Design*, Danmarks Designskole

C

Callon M. (1986). *Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay.* In John Law (ed.), Power, Action and Belief: A New Sociology of Knowledge (London: Routledge & Kegan Paul).

Carlile, Paul R. 2002. "*A Pragmatic View of Knowledge and Boundaries: Boundary Objects in New Product Development*." Organization Science 13 (July 2014): 442–55.

Climate Change Adaptation Plan. (2017). [online] City of Melbourne. Available at: http://www.melbourne.vic.gov.au/sitecollectiondocuments/climate-change-adaptation-strategy-refresh-2017.pdf [Accessed 17 May 2018].

D

Darebin Cycling Strategy 2013-2018. (2013). [online] City of Darebin. Available at: http://www.darebin.vic.gov.au/-/media/cityofdarebin/Files/YourCouncil/HowCouncilWorks/CouncilPlan/CouncilStrategies/Sustainable-and-Resilient-Neighbourhoods/Cycling-Strategy-20132018.ashx?la=en [Accessed 17 May 2018].

Darebin Transport Strategy 2007-2027. (2007). [online] City of Darebin. Available at: http://www.darebin.vic.gov.au/-/media/cityofdarebin/Files/YourCouncil/HowCouncilWorks/CouncilPlan/CouncilStrategies/Vibrant-City-and-Innovative-Economy/Transport-Strategy-October-20072027.ashx?la=en [Accessed 17 May 2018].

G

Geels, F. (2005). *The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930).* Technology Analysis & Strategic Management, 17(4), pp.445-476.

Geels, F. (2004). *From sectoral systems of innovation to socio-technical systems: insights about dynamics and change from sociology and institutional theory.* Research Policy, 33 (6–7), 897–920.

H

Heuts F., and Mol A. 2013. *What is a good tomato? A case of valuing in practice*, University of Amsterdam.

L

Langer, R. and Beckman, S. (2005). *Sensitive research topics: netnography revisited. Qualitative Market Research: An International Journal*, 8(2), pp.189-203.

Lowe, M. (2014). Obesity and climate change mitigation in Australia: overview and analysis of policies with co-benefits. *Australian and New Zealand Journal of Public Health*, 38(1), pp.19-24.

M

Mekuria, M., Furth, P. and Nixon, H. (2012). *Low-Stress Bicycling and Network Connectivity*. Report 11-19. Mineta Transportation Institute.

Monday, M. (2018). *About - Meat Free Monday*. [online] Meat Free Monday. Available at: https://www.meatfreemondays.com/about/ [Accessed 20 May 2018].

Monday, M. (2018) a. *Quarter of Brits eating less meat - Meat Free Monday*. [online] Meat Free Monday. Available at: https://www.meatfreemondays.com/quarter-brits-eating-less-meat/ [Accessed 20 May 2018].

Munthe-Kaas P., and Hoffmann B. (2017) *Democratic design experiments in urban planning – navigational practices and compositionist design*, CoDesign, 13:4, 287-301, DOI: 10.1080/15710882.2016.1233284

N

National Eating Disorders and Obesity. (2018). *Australia's Obesity Statistics in 2017 - National Eating Disorders and Obesity*. [online] Available at: https://eatingdisordersaustralia.org.au/australias-obesity-statistics-2017/ [Accessed 18 May 2018].

P

Play.google.com. (2018). [online] Available at: https://play.google.com/store [Accessed 18 May 2018].

Population.net.au. (2018). *Melbourne Population 2018*. [online] Available at: http://www.population.net.au/melbourne-population/ [Accessed 18 May 2018].

Profile.id.com.au. (2018). *Community profile | City of Darebin | profile.id*. [online] Available at: https://profile.id.com.au/darebin [Accessed 17 May 2018].

S

SFMTA Bicycle Strategy. (2013). SFMTA.

T

TreeHugger. (2018). *Pittsburgh bike campaign is a lycra-free zone, showing cyclists as people*. [online] Available at: https://www.treehugger.com/bikes/pittsburgh-bike-campaign-lycra-free-zone-showing-cyclists-people.html [Accessed 25 May 2018].

U

Unruh, G. C. (2000) *Understanding carbon lock-in*. Energy Policy, 28, pp. 817-830

V

Victorian Cycling Strategy 2018-28. (2017). [online] Transport for Victoria. Available at: http://https://transport.vic.gov.au/content/docs/Victorian%20Cycling%20Strategy%202018-28.PDF/sitecollectiondocuments/climate-change-adaptation-strategy-refresh-2017.pdf [Accessed 17 May 2018].

APPENDICES

Appendix 1 - Interview with Bicycle Network
Appendix 2 - Interview with Angela Andrews
Appendix 3 - Darebin Cycling Participation Map
Appendix 4 - Darebin Plans for the Network
Appendix 5 - Cards for Better or Worse Cycling Experience
Appendix 6 - Routes in Darebin Marked by People
Appendix 7 - Compared Maps
Appendix 8 - Second Design Game
Appendix 9 - Cycling Participation in the Middle Part of Darebin
Appendix 10 - App Navigation